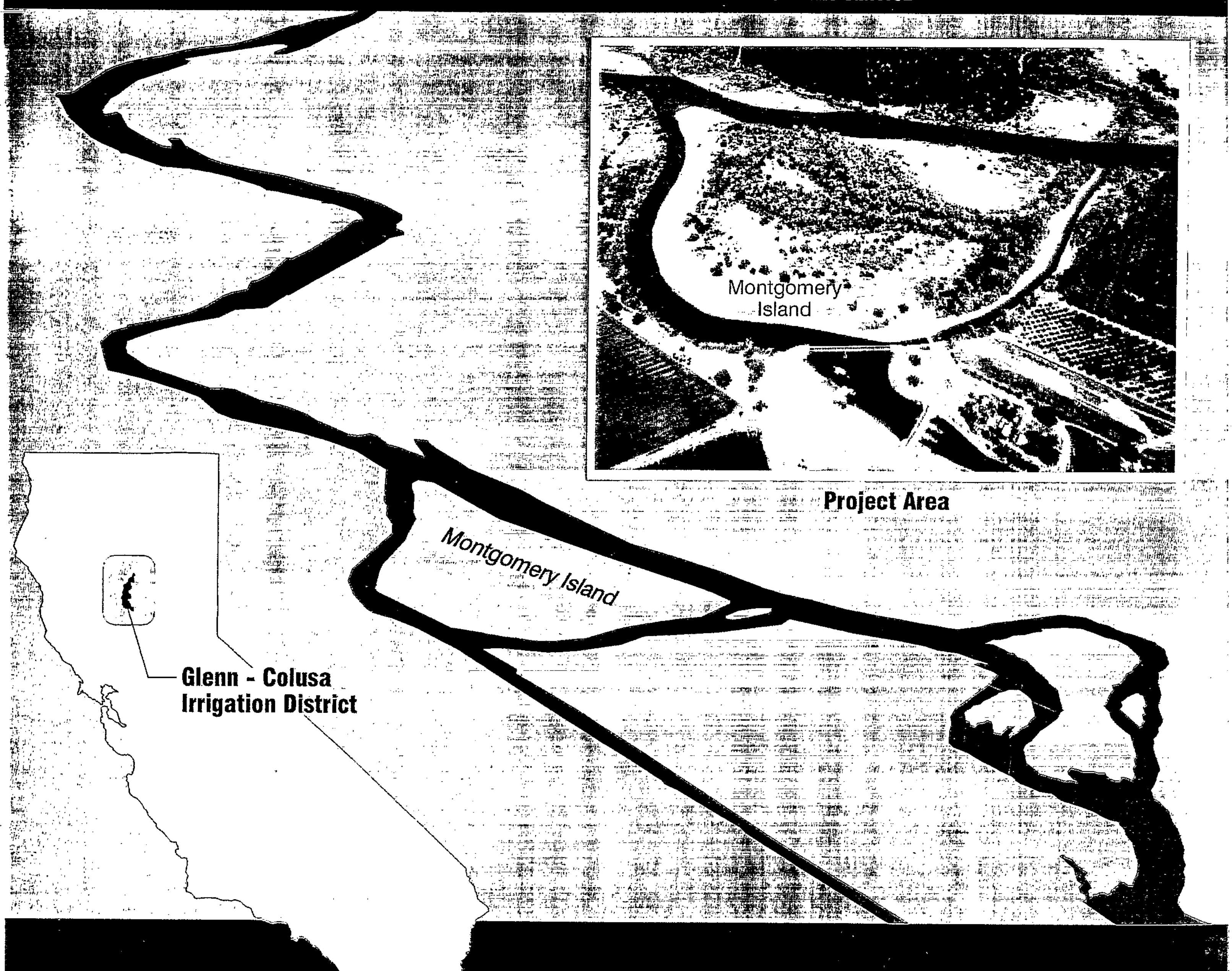
Hamilton City Pumping Plant Fish Screen Improvement Project Final EIR/EIS

Glenn-Colusa Irrigation District • California Department of Fish and Game • U.S. Bureau of Reclamation • U.S. Army Corps of Engineers

in cooperation with
U.S. FISH AND WILDLIFE SERVICE and NATIONAL MARINE FISHERIES SERVICE



STATE CLEARINGHOUSE NO. 93062042

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C-085309

COVER PAGE/ABSTRACT

C-085310

C-085310

HAMILTON CITY PUMPING PLANT
FISH SCREEN IMPROVEMENT PROJECT
ENVIRONMENTAL IMPACT REPORT/ENVIRONMENTAL IMPACT STATEMENT (EIR/EIS)
SCH # 93062042

Draft EIR/EIS		Final EIR/EIS
( )		(X)
Responsible State Agencies	**Lead Agencies**	**Cooperating Federal Agencies**
California Department of Water Resources The Reclamation Board California Regional Water Quality Control Board, Central Valley Region California State Lands Commission	Glenn-Colusa Irrigation District California Department of Fish and Game U.S. Army Corps of Engineers U.S. Department of Interior, Bureau of Reclamation	U.S. Department of Commerce, National Marine Fisheries Service U.S. Fish and Wildlife Service

Affected Counties

Butte County, Colusa County, Glenn County, and Tehama County, California

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This Final EIR/EIS contains changes to and responses to public and agency comments on the Draft EIR/EIS issued October 3, 1997.

Glenn-Colusa Irrigation District's (GCID) past diversions from the Sacramento River at its Hamilton City Pumping Plant have been identified by the California Department of Fish and Game, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, National Marine Fisheries Service as a significant impediment to the downstream migration of juvenile salmon. To minimize future losses of fish, and as a component of the U.S. Department of Interior's program to restore fisheries under the Central Valley Project Improvement Act, a fish screen improvement project is proposed. The preferred alternative was unanimously selected by involved State and Federal agencies.

In compliance with State and Federal laws protecting fishery resources, the purposes of the project are to minimize losses of all fish in the vicinity of the pumping plant diversion, including the endangered winter-run chinook salmon, and to maximize GCID's capability to divert the full quantity of water it is entitled to divert to meet its water supply delivery obligations.

One main feature of the fish screen improvement project would be an approximately 600-foot extension of the existing 475-foot long flat-plate fish screen on a side channel (oxbow) of the river. The fish screen extension would be designed and constructed by GCID and the U.S. Department of the Interior, Bureau of Reclamation (Reclamation).

Another main feature of the project would be an approximately 1,000-foot long gradient facility on the mainstem Sacramento River. The gradient facility would be designed and constructed by the U.S. Army Corps of Engineers (Corps) to reduce the effect of gradient changes on screen performance, provide hydraulic gradient to operate a fish bypass system, and stabilize water levels for pumping plant operations.

Reclamation, the Corps, and GCID would also design and construct additional features as part of the proposed project including:

- A gravity bypass system to the oxbow that would reduce juvenile fish exposure time to the screen;
- A replacement combined oxbow flow control structure and bridge to Montgomery Island, just downstream of the screen structure; and
- Bank and channel modifications in the oxbow and on the mainstem of the river to improve and stabilize channel alignment and hydraulics.

Alternative methods and schedules could be used for construction of the gradient facility. These include variations on two basic methods: dry construction involving the use of cofferdams to exclude water from construction areas (e.g., the proposed one-year, four-phase construction method), and wet construction involving the in-water placement of materials from barges. A schedule option would include a two-year construction process. This EIR/EIS analyzes a number of alternative methods and schedules with the anticipation that any one or some combination of methods and schedules could be selected and implemented.

C-085312

C-085312

Once construction is complete, all project facilities would be owned, operated, and maintained by GCID and/or the State of California. Operation and maintenance activities would include annual dredging and routine structural maintenance.

Three project alternatives and a no-project/no-action (hereinafter "no-project") alternative are analyzed in this EIR/EIS over an assumed 50-year project life. The preferred alternative, which includes the features and activities described above, is the *Screen Extension with Gradient Facility and Internal Fish Bypass (Return to Oxbow) Alternative*. The no-project alternative includes increased restrictions on Hamilton City Pumping Plant operations and actions by GCID to replace reduced supplies from the pump station. The estimated construction costs~~, excluding mitigation,~~ of the project alternatives range from $15.1 to $40.7 ~~$14.6 to $39.2~~ million and the estimated cost of the no-project alternative and associated activities which would be undertaken by GCID is $13.~~0~~3 million. ~~Mitigation costs for the project and no-project alternatives could exceed $1 million. Final mitigation cost estimates will be included in the Final EIR/EIS.~~

Significant benefits and impacts are identified, including unavoidable impacts, and mitigation measures are recommended. If an action alternative is selected, construction would begin in early 1998.~~and would be completed in the year 2001.~~

This EIR/EIS is intended to satisfy California Environmental Quality Act and National Environmental Policy Act compliance requirements to support all State and Federal construction and permit actions.

TABLE OF CONTENTS

C-085315

C-085315

Chapter/Section | Page

CHAPTER 3 - AFFECTED ENVIRONMENT (CONTINUED)

C-085316

C-085316

C-085317

C-085317

C-085318

C-085318

Chapter/Section **Page**

C-085319

C-085319

APPENDICES
(BOUND SEPARATELY)

C—085320

C-085320

LIST OF FIGURES

C-085321

C-085321

LIST OF FIGURES (CONTINUED)

LIST OF TABLES

C-085322

C-085322

LIST OF TABLES
(CONTINUED)

C-085323

C-085323

LIST OF TABLES (CONTINUED)

C-085324

C-085324

SUMMARY

C-085325

INTRODUCTION

This ~~Draft~~ Final Environmental Impact Report/Environmental Impact Statement (EIR/EIS) describes the potential beneficial and adverse environmental effects of alternatives for a proposed fish screen improvement project at the Glenn-Colusa Irrigation District's (GCID) Hamilton City Pumping Plant (HCPP). Potential environmental effects of construction and long-term operation and maintenance of the project are described in accordance with California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) requirements. ~~Following public and agency review and comment, this Draft EIR/EIS will be finalized and considered before a decision is made whether to approve the project for construction.~~ Public and agency comments on the Draft EIR/EIS, and how the comments were considered in preparing this Final EIR/EIS, are also described in this document. Revisions to the Draft EIR/EIS are shown in underline/strikeout format in this Final EIR/EIS.

PROJECT LOCATION

The proposed project would be located on the Sacramento River and adjacent side channel (referred to in this document as an oxbow) between approximately River Mile (RM) 205 and RM 206, near the intersection of Butte, Tehama, and Glenn counties. The HCPP supplies water to irrigated lands and National Wildlife Refuges to the west of the Sacramento River between Hamilton City and Williams. HCPP operations affect Sacramento River flows between Red Bluff and Knights Landing. **Figure S-1** shows the project location.

PURPOSE OF THE PROJECT

The lead agencies under CEQA (GCID and the California Department of Fish and Game (CDFG)) and the lead agencies under NEPA (United States Department of the Interior (Interior), Bureau of Reclamation (Reclamation) and the U.S. Army Corps of Engineers (Corps)) and other participating agencies have identified two primary purposes of the project. The first is to minimize losses of all fish in the vicinity of the pumping plant diversion, including endangered winter-run chinook salmon. The second is to maximize GCID's capability to divert the full quantity of water it is entitled to divert to meet its water supply delivery obligations.

NEED FOR THE PROJECT

The need for the project has long been recognized by GCID and resource agencies, such as CDFG and National Marine Fisheries Service (NMFS), because past fish screening efforts have not provided adequate protection. The project was first required by Corps permits issued in 1988 to GCID for dredging activities under Section 10 of the River and Harbor Act and Section 404 of the Clean Water Act. The permits required that GCID assure the development and implementation of "state-of-the-art" fish protection at HCPP. The fish protection requirement in 1988 was primarily for the protection of the chinook salmon because of its economic importance

C-085326

C-085326

C-085327

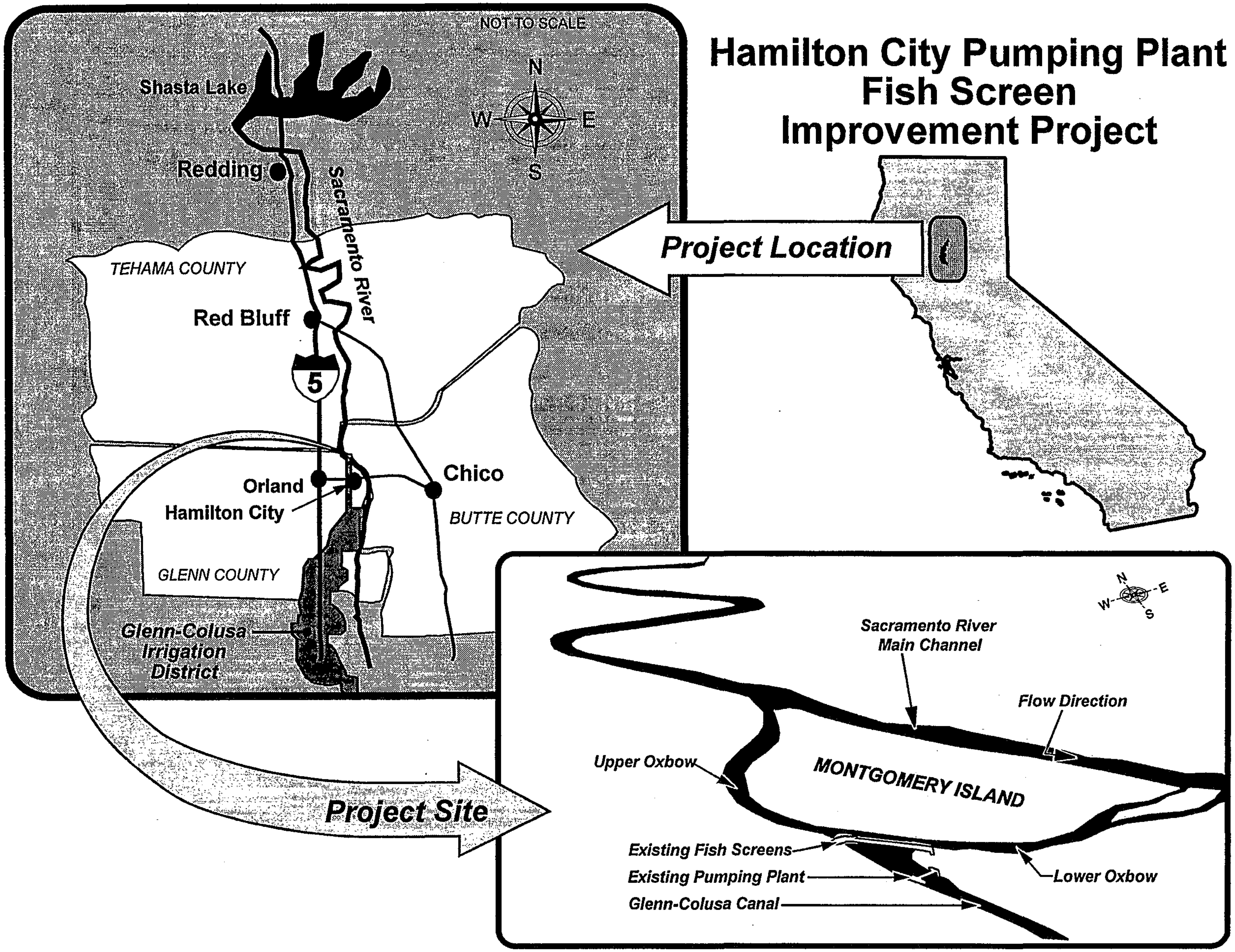

FIGURE S-1. PROJECT LOCATION MAP

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to the fishing industry. Winter-run chinook salmon were thereafter listed as endangered under the California Endangered Species Act (CESA) in 1989 and as threatened and then endangered under the Endangered Species Act of 1973, as amended (ESA), in 1990 and 1994, respectively. Pursuant to Section 7 of the ESA, the Corps conducted a consultation with the NMFS in 1991 regarding the issuance of a permit to GCID for dredging activities within the GCID oxbow. GCID rejected the draft permit's requirements for improving protection for winter-run chinook salmon at the HCPP. Increasing concerns by NMFS prompted the agency to request the Federal District Court (Eastern District) to enjoin GCID from taking the threatened winter-run chinook salmon in violation of the ESA. The legal action filed by NMFS resulted in the Federal District Court issuing a permanent injunction against GCID, restricting the amount of water GCID could pump at HCPP during the downstream migration period (August through November) for the threatened winter-run chinook salmon.

NMFS's legal action, in which CDFG joined as a party, resulted in a 1992 stipulated agreement among the parties (NMFS, CDFG and GCID) that was subsequently amended in 1993 to develop jointly a long-term solution to address both fishery resource protection and a reliable water supply. Screen approach velocity and bypass flow requirements in the 1993 Joint Stipulation of Parties limit GCID's irrigation season diversions at HCPP to about 75 percent of its combined 720,000 acre-feet (ac-ft) base supply and 105,000 ac-ft CVP project water.

Interim measures taken by GCID (e.g., flat-plate screens installed in 1993 and use of alternative water supplies, including groundwater pumping) have increased fish protection at the HCPP and temporarily met water supply needs. Even with these measures in place, however, key fish screen criteria (i.e., screen approach velocity of 0.33 feet per second (ft/s) as specified by CDFG and bypass flows of 500 cubic feet per second (cfs) as specified by the Corps 1996 permit) cannot be met under the various river flows and pumping conditions. Further, the interim water supply measures (use of alternative water supplies, including groundwater pumping) are not viable on a long-term basis. Therefore, a fish screen system is needed that meets fish protection requirements and HCPP operations for the range of river flows expected over the 50-year life of the project.

PROJECT OBJECTIVES

To accomplish the above purposes in the most effective and environmentally sound manner possible, the lead agencies intend to accomplish several specific objectives. These objectives are summarized below (but not necessarily listed in order of importance).

- A project that provides state-of-the-art fish screen protection that is reliable, cost-effective, and minimizes all fish losses, including endangered winter-run chinook salmon, while minimizing adverse impacts to other environmental resources;

- A project that (1) enables GCID to meet instantaneous (peak) demands (within the existing capacity of the HCPP) and (2) provides long-term reliability for GCID water deliveries through the HCPP; and

C-085328

C-085328

- A project that minimizes the potential risk of screen performance failure due to local changes in river gradient and alignment over the project's 50-year life.

The above objectives were considered in evaluating alternatives, designing the project, and determining the relative merits of project features.

HISTORY OF HCPP DIVERSIONS AND FISH SCREENS

Water is delivered to GCID's service area through a conveyance system that includes the HCPP, the 65-mile-long Glenn-Colusa Canal, interties with the Tehama-Colusa Canal (TCC), and over 430 miles of laterals from the main canal. Since the 1950s, this system has at times delivered in excess of 800,000 ac-ft of surface water per year and, during peak demand years, over 900,000 ac-ft.

Since the 1920s, numerous efforts have been made to screen the HCPP diversion. These efforts have been largely unsuccessful. The first screen was installed in 1920 but was subsequently washed away by high water flows. A replacement screen was required to be installed by a State Court of Appeals in 1932. While the replacement screen met the requirements of the time, it was inadequate to prevent entrainment and impingement of salmon fry. Like its predecessor, the screen was rendered ineffective by flood events in 1935. It remained in place, however, until CDFG decided to construct new rotary drum screens in the late 1960s.

The performance of the new rotary drum screens was compromised even before completion due to a major drop in river water surface elevation. In January 1970, widespread flooding caused significant changes in Sacramento River channel alignment and water levels. A large meander just downstream of the pumping plant was cut off during the flood, shortening the river in the immediate vicinity by nearly a mile and a half. Despite these major changes in river morphology, construction of the rotary drum screens was completed as designed in 1972. The design performance of the screens was never realized as a result of hydraulic changes (i.e., reduced water surface elevation at the pumping plant). In addition, design flaws, particularly in the bypass system, were later discovered through subsequent operations. By 1984, the river changes initiated by flooding in 1970 had dropped the water surface elevation by about three feet in front of the screens.

The 1992 and 1993 Joint Stipulation of Parties and Corps dredge permits imposed stringent flow and velocity requirements for operation of the screen. The increased restrictions on approach velocity created water supply shortages within the GCID service area. Installation of flat-plate screens in 1993 improved conditions for fish, but still would not allow GCID to meet all fish screen criteria under a full range of operating and river flow conditions.

Until the early 1990s, GCID obtained nearly all of its water supplies through the HCPP. GCID responded to the HCPP restrictions by instituting a severe water conservation program that included both incentive and penalty provisions, a groundwater pumping program and arranging for deliveries of some of its Sacramento River water rights through the TCC, as conveyance capacity was available. In addition, GCID increased its agricultural runoff reuse and worked with growers to stagger crop plantings to reduce peak irrigation demands. Other actions were taken by growers who were directly or indirectly dependent upon water supplies provided through the HCPP. These actions included the following:

- increasing irrigation run-off reuse and Colusa Basin Drain recapture;
- increasing down-river diversions by Maxwell, Princeton-Codora-Glenn, and Provident irrigation districts to make up for the loss of return flows from GCID's service area; and
- increasing groundwater pumping.

The actions taken by GCID and other water users in the Colusa Basin have generally succeeded, as interim measures only, in assisting GCID in meeting its water delivery obligations. However, the interim measures have been costly and have adversely affected the quality of water supplied to the lower GCID service area and lower Colusa Basin area. The long-term viability of the interim measures is questionable in light of the following specific adverse consequences:

- salinity levels have increased in water supplied to the lower GCID service area and lower Colusa Basin;
- increased groundwater pumping and Colusa Basin Drain recapture pumping have been required in both the GCID service area and the lower Colusa Basin;
- yields of salt-sensitive crops such as rice have decreased in areas of increased salinity levels; and
- GCID water delivery rates (i.e., costs charged to water users) have nearly doubled over pre-1992 rates, largely as a result of direct and indirect increases in costs. Indirect costs include programs such as well pumping and planning, design, and construction for the project described in this document. In addition, GCID has deferred funding its long-term facilities maintenance program to reduce rate impacts on the growers.

AUTHORIZING ACTIONS AND ROLES OF AGENCIES

GCID is obligated under the 1993 Joint Stipulation of Parties to develop a long-term solution to the fish screen problem at the HCPP. As a CEQA lead agency, GCID has primary responsibility for satisfying CEQA requirements associated with the proposed long-term solution, including developing the EIR portion of this document. GCID is also responsible for the design of and improvements to the existing fish screen, including the proposed oxbow flow control structure and bridge to Montgomery Island.

CDFG has statutory responsibilities under California State law for conservation of fishery resources (Fish and Game Code Division 6, Part 1, Chapter 3, 5900 et seq.), and protection of endangered species under the CESA. Combined with its history of participation in fish

C-085330

C-085330

protection efforts at the HCPP and its permitting responsibilities under Fish and Game Code 1600 et seq. (Streambed Alteration Agreement), CDFG is a co-lead agency under CEQA for this project.

Because of the potential for significant fishery protection enhancements, the Congress specifically identified the long-term solution at HCPP in the Central Valley Project Improvement Act (CVPIA) as an important measure that would contribute to the restoration of anadromous fish (P.L. 102-575, Title XXXIV, 3406(b)(20)). To assist in the ongoing effort, the Congress authorized Reclamation (through the Secretary of the Interior) to "participate with the State of California and other Federal agencies in the implementation of the ongoing program to mitigate fully for the fishery impacts associated with operations of the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant. Such participation shall include replacement of the defective fish screens and fish recovery facilities associated with the Hamilton City Pumping Plant." To implement the CVPIA, the California Department of Water Resources (DWR), CDFG, U.S. Fish and Wildlife Service (USFWS), and Reclamation signed a Sharing of Costs Agreement for Mitigation Projects and Improvements (SCAMPI). This agreement provides for cost-sharing between the Federal and State parties to the agreement for those projects specified in the CVPIA, including the proposed fish screen project at HCPP. As a result of the Federal legislation and coordination with other Federal agencies, Reclamation has lead Federal agency responsibility under NEPA for the proposed project. The CVPIA provides that Reclamation will pay 75 percent of project development costs, with 25 percent non-Federal funding. Reclamation is also responsible for design and construction of the fish screen extension portion of the project.

The Corps is authorized to design and construct the gradient facility in accordance with the Energy and Water Appropriations Act of 1990 (P.L. 101-101, 103 Stat. 641 (1989)) pursuant to the authority granted under the Water Resources Development Act of 1986 (WRDA). The Corps also is responsible for permitting the project under the Clean Water Act and River and Harbor Act. Because of the Corps' requirements for permitting and construction of the gradient facility, the Corps has co-lead Federal agency responsibility under NEPA for the proposed project.

Other Participating Agencies

Participating agencies are those agencies that are directly involved in the planning of the project. The following is a list of those agencies:

- National Marine Fisheries Service
- U.S. Fish and Wildlife Service
- California State Reclamation Board
- California Department of Water Resources

The NMFS and USFWS are cooperating agencies under NEPA and are actively participating in project planning. NMFS participation is largely directed by the ESA. NMFS is generally responsible for management of anadromous fisheries and has specified flow and temperature requirements in the upper Sacramento River through its Biological Opinion for the operation of the CVP and the California State Water Project. Specific to this project are NMFS's

C-085331

C-085331

responsibilities for protection of the endangered winter-run chinook salmon and the proposed-endangered steelhead. The 1993 Joint Stipulation of Parties further defines NMFS participation in the process for developing a long-term solution at HCPP. USFWS participation is authorized through its responsibilities under the ESA, and the Fish and Wildlife Coordination Act. USFWS is generally responsible for management of resident fish and wildlife. USFWS participation is also authorized under the CVPIA.

From 1988 through 1995, DWR (through The California State Reclamation Board) served as the CEQA lead agency for planning and design of the gradient facility portion of the project. This lead agency role was assumed by GCID and CDFG jointly beginning in 1995.

PROJECT DESCRIPTION AND DEVELOPMENT OF ALTERNATIVES

The need for the fish screen improvement project at HCPP has long been recognized. However, successful, long-lasting means to accomplish the purposes of the project have been elusive. The current project development efforts have utilized information and lessons learned from past efforts to meet the project objectives.

HCPP operations have provided nearly 70 years of fish screen and 100 years of diversion experience and observations on the Sacramento River. In the last two decades, new information and numerous alternatives have been evaluated, using this history, to identify fish screen designs that would not fail as the previous screen had. The recent information includes studies, monitoring programs, and numerical and physical modeling that take into account the complex and dynamic conditions present at the HCPP. Reclamation tested fish screen systems using large-scale physical models at Reclamation's Denver laboratories. The Corps has performed numerical modeling to assess gradient facility designs that would stabilize the Sacramento River water level in the vicinity of the fish screens. As part of the gradient facility design, two-dimensional numerical modeling of oxbow and river flows has also been completed. Large-scale physical models are now being constructed at Colorado State University to refine the gradient facility design. These studies have led to a set of alternatives that would, to varying degrees, accomplish the purposes and objectives of the project.

PROJECT SETTING

HCPP facilities are located on an oxbow of the Sacramento River between RM 205 and RM 206, roughly one-half mile from the river channel. GCID dredges the oxbow to maintain water flow from the river to the pump station, which is also the headworks for the Glenn-Colusa Canal. The HCPP also is part of a larger, integrated water management system that affects and is affected by operations of GCID's other facilities and other Sacramento River water managers.

Future changes in HCPP operations could occur as a result of other separate actions that may be taken by GCID, other water managers, resource agencies, or regulatory agencies (e.g., increase in water deliveries to National Wildlife Refuges associated with the CVPIA). However, such other actions are not within the scope of the proposed action for this EIR/EIS and would require separate environmental review. Until the fish screen improvements are completed, HCPP continues to operate under the 1993 Joint Stipulation of Parties and Corps dredge permit conditions.

PROJECT DESIGN CONSIDERATIONS

The project objectives are based on specific considerations for designing alternative fish screen improvements. Many of these considerations reflect issues raised during early project scoping sessions. These considerations are grouped into categories of fish protection, river and oxbow hydraulics, and water supply.

Fish losses can result from a wide range of physical conditions (e.g., high horizontal flow velocities that cause juvenile chinook salmon to impinge upon or entrain through the screen) and biological conditions (e.g., predators lying in wait in "predator holding areas" where channel structure, hydraulic, or light conditions enhance predation opportunities). Most fish loss issues are related to river and oxbow hydraulic (e.g., flow patterns and velocity) conditions in the vicinity of the fish screen structure.

The Sacramento River is actively changing its course and slope (gradient) in the project region. This process is a natural physical characteristic of a meandering river. The meander process has been partially controlled by erosion-resistant native bank materials (i.e., Modesto Formation) in some locations, intermittent rock placement on river banks (described hereafter as either riprap or revetment), and construction of levees. However, natural flood events and other hydraulic forces of the meander process continue to shift the river channel and change its gradient. History demonstrates that these dynamic processes can totally disable fish screen systems at the HCPP. A key project objective is to design a fish screen improvement project that minimizes the potential risk of screen failure due to local changes in river gradient.

One of the purposes of the project is to maximize GCID's capability to divert the full quantity of water it is entitled to divert to meet its water supply delivery obligations. To accomplish this purpose, the project would (1) enable GCID to meet instantaneous (peak) demands (within the existing capacity of the HCPP) and (2) provide long-term reliability for GCID water deliveries through the HCPP. To return diversion capability at the HCPP while protecting fish, a fish screen system is needed that allows GCID to pump up to the existing maximum capacity of the HCPP (3,000 cfs) when river flows are at least 7,000 cfs. While maximum diversions of 3,000 cfs typically would not occur when river flows are less than 7,000 cfs, river management in the future is projected to include such river flows during the irrigation season.

ALTERNATIVES

The fish protection, hydraulic, and water supply considerations above demonstrate the difficulty of developing a successful long-term solution under the dynamic and complex conditions at the HCPP. Numerous solutions, including alternative sites and various screen designs, have been proposed and considered since the screen failure of the early 1970s. Non-fish screen alternatives such as conservation and off-site storage have also been considered.

The alternatives selected for detailed study in this EIR/EIS include a no-project alternative and three fish screen improvement project alternatives. **Table S-1** presents an overview of the major features of the alternatives. **Figure S-2** shows the locations of features listed on Table S-1. **Table S-2** identifies the extent to which the project alternatives would satisfy the project objectives.

The estimated costs of the alternatives would be $13.3 million for the no-project alternative, $~~14.6~~ 15.1 million for the screen extension alternative, $~~26.4~~ 27.9 million for the screen extension with gradient facility alternative, and $~~30.9~~ 31.7 and $~~39.2~~ 40.7 million for the screen extension with gradient facility and internal fish bypass alternative (return to oxbow and return to river options, respectively). These cost estimates exclude contractor overhead and profit and construction management. ~~Environmental mitigation costs could exceed $1 million. Final cost estimates for environmental mitigation will be developed for the Final EIR/EIS.~~

In accordance with agreements and authorizing actions for the project, GCID would be responsible for 100 percent of the costs of the no-project alternative if none of the project alternatives are selected. If one of the project alternatives is selected, then State and Federal cost-sharing responsibilities would be divided 25 percent/75 percent, respectively, with GCID funding 12.5 percent, the State of California funding 12.5 percent, and Federal appropriations funding 75 percent.

No-Project Alternative

If the lead and participating agencies do not implement a long-term solution for the HCPP diversion, as authorized to do so, then the no-project alternative would occur, starting in 1998. GCID's operations would change at HCPP and throughout its water delivery system. To augment fish protection at the existing facility, it is assumed that permit requirements for the no-project alternative would require compliance with existing CDFG and NMFS screen criteria to the extent possible year round. It would be expected that approach velocity criteria (i.e., 0.33 ft/s) could likely be achieved through reduced pumping and adding baffles, but that other criteria such as sweeping velocities (i.e., greater than 2.0 ft/s), internal bypass system velocities, and screen exposure times (i.e., less than 2.5 minutes) would not likely be achieved.

A risk of this alternative would be the long-term viability of maintaining even the reduced HCPP diversions due to changes in the river that are not in the control of GCID. If future drops in gradient or water surface elevation occur at the screens, then corresponding reductions in diversions at HCPP would be required to maintain 0.33 ft/s approach velocities in front of the screens. Significant drops in gradient in the early 1980s and previously in 1970 demonstrate the risks associated with potential future changes in the river on GCID's ability to meet fish screen approach velocity and fish bypass conditions.

C-085334

C-085334

Table S-1 - Overview of Major Features by Alternative

Feature	No-Project	Screen Extension	Screen Extension with Gradient Facility	Screen Extension with Gradient Facility and Internal Fish Bypass	
				Return to Oxbow	Return to River
New or Modified ~~Water~~ Irrigation Recapture Stations	10	None	None	None	None
New or Modified Groundwater Wells	50	None	None	None	None
Total Fish Screen Area	4,800 sq. ft.	11,300 sq. ft.	11,300 sq. ft.	11,300 sq. ft.	11,300 sq. ft.
Extended Fish Screen Structure	None	600 ft.	600 ft.	600 ft.	600 ft.
Total Riprap Along Upper and Lower Oxbow Banks	2,900 ft.	3,800 ft.	3,800 ft.	3,800 ft.	3,800 ft.
Adjustable Oxbow Flow Control and Removable Bridge to Montgomery Island	Combined Structures	Combined Structures	Combined Structures	Combined Structures	Combined Structures
Modified River Channel	None	None	1,000 ft.	1,000 ft.	1,000 ft.
Minimum Gradient Between Upstream/ Downstream Ends of Montgomery Island	0.3 ft.	0.3 ft.	3.0 ft.	3.0 ft.	3.0 ft.
Riprap Along River Banks — River Channel	None	None	3,600 ft.	3,600 ft.	3,600 ft.
River Levee	None	None	4,400 ft.	4,400 ft.	4,400 ft.
Rock Dikes in River	None	None	1,600 sq. ft.	1,600 sq. ft.	1,600 sq. ft.
Internal Fish Bypass System — Bypass Bays	2	None	None	3	3
Bypass Pipes	2	None	None	3 @ 54" dia.	3 @ 54" dia.
Length of Bypass System	600 ft.	None	None	1,100 ft.	4,000 ft.
Total Construction Time	6 mo.	25 mo.	34 mo.	34 mo.	34 mo.

C—085335

C-085335

C-085336

POSSIBLE HAMILTON CITY PUMPING PLANT FISH SCREEN IMPROVEMENTS

FIGURE S-2

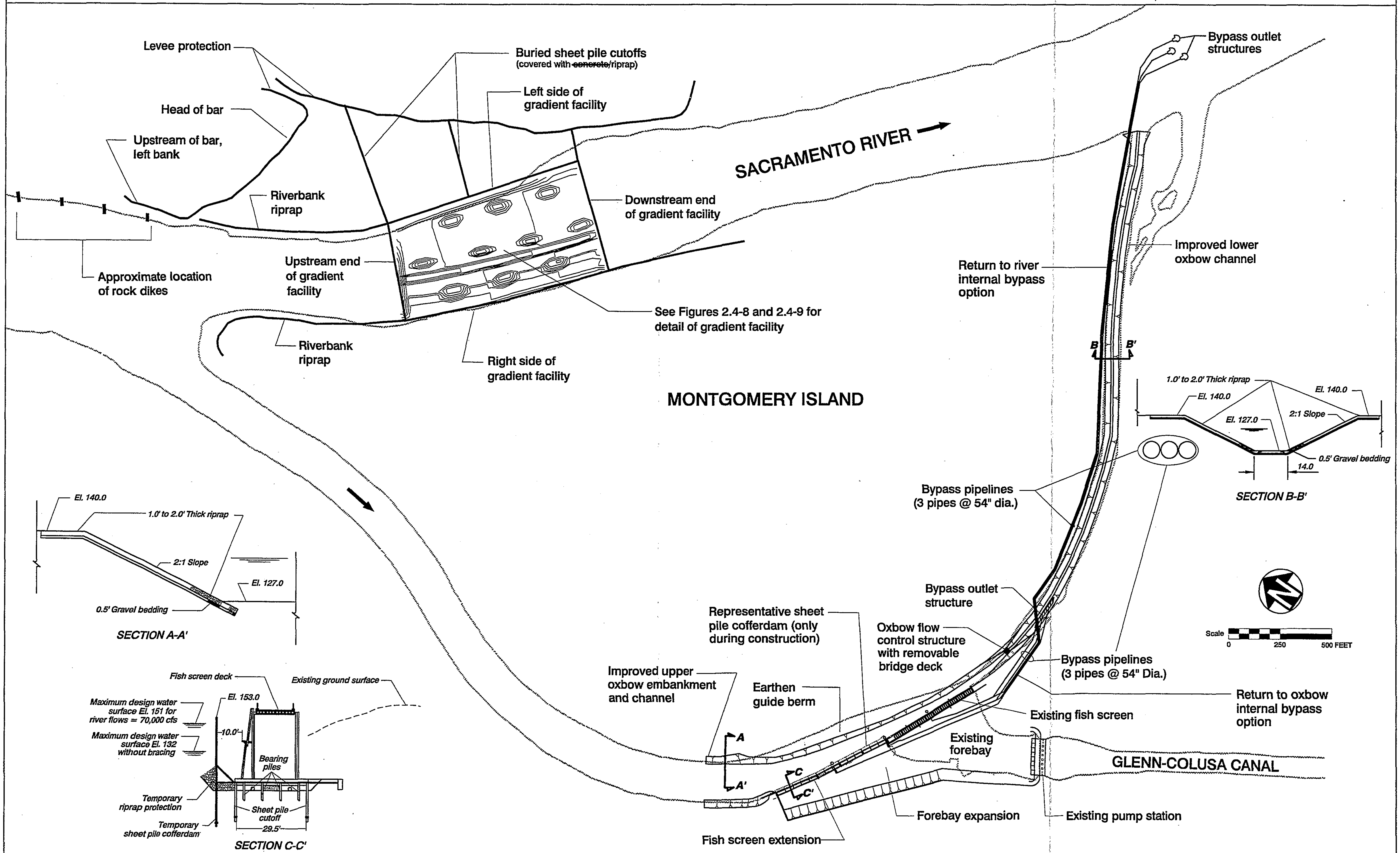

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Table S-2 - Relative Comparison of How the No-Project and Project Alternatives Meet Project Objectives					
			Screen Extension with	Screen Extension with Gradient Facility and Internal Fish Bypass	
Project Objectives	**No-Project**	**Screen Extension**	**Gradient Facility**	**Return to Oxbow**	**Return to River**
State-of-the-Art Fish Screen Protection	Low	Medium	Medium	High	Medium
Minimizes Fish Losses	Low	Medium	Medium	High	Medium
Minimizes Other Environmental Effects	High	High	Medium	Medium	Medium
Peak Pumping Capability Within Existing HCPP Capacity	Low	Medium	High	High	High
Minimizes Risk of Screen Failure Due to River Gradient Changes	Low	Low	High	High	High
Maximizes Long-Term Reliability of HCPP Operations	Low	Low	High	High	High

Under the no-project alternative, there would be substantial further reductions in HCPP capacity. For purposes of analysis in this document, it is assumed that GCID would maintain its existing priority order of water supply sources, but would need to construct and/or expand irrigation recapture and groundwater facilities and modify existing operations throughout its service area. The following is an overview of the anticipated actions that would be taken by GCID water users and GCID under the no-project alternative.

- Increasing conservation with some temporary fallowing and land use conversions due to salinity increases as occurred with the 1992 HCPP restrictions (1992 Joint Stipulation of Parties). Some long-term land use conversions would also be expected with the salinity increases.

- Increasing reliance on "as-available" conveyance capacity from TCC. Existing water agreements among GCID, Reclamation, and the TCC Authority provide for conveyance only when unused capacity is available in the TCC. TCC capacity is projected to be available only for the near-term until TCC water contractors fully utilize available capacity.

- Changing crops, including reduced planting of high water-use crops (e.g., rice) and planting of lower water-use crops (e.g., cotton). Such changes would depend upon market, regulatory, and other conditions.

- Construct new facilities to maintain peak water delivery capacities (replacement water supply sources for further reduced HCPP capacity) as follows:

    - approximately 10 new or expanded agricultural run-off recapture pump stations (late irrigation season recapture); and

    - approximately 50 new or modified groundwater wells (early irrigation season pumping).

- Improvements to upper and lower oxbow channel hydraulics through improvements to the fish screen bulkheads, installation of a new oxbow flow control structure, and narrowing the lower oxbow.

- Modifying the existing fish screen by adding baffles to improve uniformity of approach velocities and by making structural improvements to the bypass bays and pipelines.

Screen Extension Alternative

The screen extension alternative consists of an approximately 600-foot extension of the existing fish screen, upper oxbow channel improvements, an improved and extended guide berm across from the fish screens, an oxbow flow control structure with removable bridge deck, and lower oxbow channel improvements.

The 600-foot extension of the existing fish screen would enable GCID to meet screen approach velocity criteria while meeting peak demands, increasing its ability to meet its water supply obligations through the HCPP under most river flows. With increased supplies through HCPP, water supplies from other sources would be substantially reduced.

As with the no-project alternative, however, the screen extension alternative would not include measures to minimize the potential for future river gradient changes that could significantly reduce the flow rates and water levels in the oxbow. Annual variations could reduce the river gradient, even without considering major flood or other river events that could modify the gradient.

The probable occurrence of these gradient changes, combined with analyses that address current conditions, indicate that the screen extension alternative would not be reliable in meeting other key fish protection considerations (e.g., sweeping flows in front of the screen, fish exposure time to the screen, and lower oxbow flows to the river). Therefore, unlike the no-project alternative, the screen extension alternative would nearly restore existing HCPP capacity (3,000 cfs) for most river flows, but similar to the no-project alternative, it would not meet key fish protection criteria and would pose long-term risks that HCPP operations would not be viable due to future river gradient changes.

Screen Extension with Gradient Facility Alternative

The screen extension with gradient facility alternative would include the features described for the screen extension alternative plus a gradient facility on the mainstem Sacramento River adjacent to Montgomery Island. Modifications to the existing fish screen and oxbow included with the screen extension alternative would also be included with this alternative. This alternative would enable GCID to meet additional fish protection and screen performance criteria, including sweeping velocities past the screen and oxbow flows for returning bypassed fish to the river. Also different from the screen extension alternative, the screen extension with gradient facility alternative would enable GCID to meet its water supply obligations through the HCPP for river flows as low as 5,000 cfs.

C-085338

The gradient facility would be designed with the characteristics of a natural riffle, providing a "hard point" in the river that would ~~slightly increase and~~ stabilize the Sacramento River in the project reach and restore the minimum water surface elevations at the fish screen to provide adequate hydraulic gradient ~~water surface elevation at the fish screen and provide the hydraulic gradient necessary~~ for efficient screen and bypass performance. The gradient facility design would provide for hydraulic conditions that would not hinder upstream or downstream fish passage and would provide adequate depths to facilitate navigation by recreational boats. The "design riffle" concept is based on the rationale that if fish species and recreational boaters can accommodate natural riffle hydraulic conditions within the Sacramento River, then those hydraulic conditions would provide an acceptable basis for the design of the gradient facility.

The in-river portion of the gradient facility would involve placement of sheet piles at specified elevations and intervals in the river bed. The buried sheet piles would be ~~capped with concrete and~~ surrounded and covered by large riprap. Placement of riprap upstream and downstream along both the river channel and river levee banks would maintain river channel alignment through the in-river portion of the facility.

The gradient facility feature of this alternative would establish a minimum gradient between the upstream and downstream points of Montgomery Island and, therefore, enable HCPP operations to comply with nearly all fish protection criteria over the life of the project. However, as with the screen extension alternative, lack of an internal bypass system would increase fish exposure time to the screen relative to the existing screen. Therefore, a key fish protection criterion that would not be met with this alternative is the exposure time of downstream emigrating juvenile salmonids to the screen face.

A key difference of this alternative from both the no-project and screen extension alternatives is that it would minimize the risk of screen performance failure and maximize the long-term reliability of HCPP operations. Historically, major changes in river gradient have caused the failure of past screen designs. Minor gradient changes also affect screen performance, GCID's ability to meet fish protection criteria, and HCPP pumping capacity. The gradient changes are largely due to local river channel erosion and sedimentation adjacent to and downstream of the HCPP that are associated with natural river meander processes and the transport of sediments as a result of dredge spoil movement during high flows.

The lead agencies are currently in the final design phase of the project. ~~Detailed~~ Final plans have not been developed on ~~the approach and~~ the methods for construction of the gradient facility. For purposes of this EIR/EIS, a one-year, four phase dry construction method has been assumed as the proposed construction method for impact analyses. ~~Several alternative construction methods are under consideration and have been analyzed, but information is currently limited on their scope.~~ However, alternative methods and schedules could be used for construction of the gradient facility. These include variations on two basic methods: dry construction involving the use of cofferdams to exclude water from construction areas and wet construction involving the in-water placement of materials from barges. A schedule option would include a two-year construction process. This EIR/EIS analyzes a number of methods and schedules with the anticipation that any one or some combination of methods and schedules could be selected and implemented.

Screen Extension with Gradient Facility and Internal Fish Bypass Alternative

The screen extension with gradient facility and internal fish bypass alternative would include the features described for the screen extension with gradient facility alternative plus an internal fish bypass system. An internal bypass system would convey juvenile fish moving along the screen face into one of three bell-shaped entrance bays that transition to an approximately four- to five-foot diameter pipeline. One bypass bay and pipeline would be retrofitted to the midpoint of the existing fish screen, one would be constructed at the interface between the existing screen and screen extension, and one would be placed at the midpoint of the screen extension. Screen exposure distances for fish would range from about 240 feet to 300 feet.

Three concrete pipelines would separately convey bypassed fish from each of the bays to one of the two optional outfall locations. The return to oxbow option would involve slightly greater distances for the bypass pipelines relative to the existing bypass system, but would result in greater velocities and shorter overall travel time for bypassed fish. The total length of the pipelines for this option could range from approximately 800 feet to 1,400 feet, depending on final siting of the outfall structure. The pipelines would terminate at an outfall structure that would mix the total internal fish bypass flows of about 150 cfs with a minimum lower oxbow flow of 350 cfs.

The second option for internal fish bypass outfall would be near the center of the Sacramento River near its point of confluence with the lower oxbow. The concrete pipelines would follow the same general alignment as the return to oxbow option, cross under the oxbow, and then parallel the island side of the lower oxbow to the river. The total length of the three parallel pipelines could range from approximately 3,700 feet to 4,300 feet, depending on final siting of the outfall structures. The outfall structures would be placed in the main portion of the river channel at separate locations to reduce the potential for predation. The total pipeline flows would be approximately the same (i.e., 150 cfs) for the return to river option as the return to oxbow option.

This alternative would enable GCID to meet all fish protection and screen performance criteria established for this project, including exposure time (2.5 minutes or less) of downstream migrating juvenile fish passing the screen face. Minor differences in approach velocities and bypass flows would occur because this alternative would route approximately 150 cfs more oxbow flow (50 cfs for each of the three internal bypasses) toward the fish screen face and into the internal fish bypass system. There are some potentially significant differences in bypass channel flow rates between the two intermediate bypass pipeline alternatives during low flow conditions.

The gradient facility would provide the hydraulic head to operate the internal bypasses. As with the screen extension with gradient facility alternative, this alternative would minimize the risk of screen performance failure due to local river gradient changes and maximize the long-term reliability of HCPP operations. Design and construction of the gradient facility would also be the same as the screen extension with gradient facility alternative.

C—085340

C-085340

ISSUES IDENTIFIED AND CONSIDERED IN EIR/EIS PROCESS

Through the scoping process and EIR/EIS preparation, environmental and other issues have been raised concerning potential environmental impacts of the project and no-project alternatives. Analysis of these issues indicates the potential for significant environmental effects in some instances, and less than significant effects in other instances. In some cases, analysis results remain uncertain. In other cases, certain issues are considered to be of possible concern or importance to interest groups, landowners, or resource managers. Issues considered included the following:

Hydrology and Water Resources

- regional water delivery operation changes
- potential Sacramento River flow changes
- potential river temperature increases
- increases in electrical conductivity of irrigation water
- pesticide concentrations in irrigation water
- changes in river alignment and gradient
- Sacramento River sedimentation
- flooding potential during construction

Aquatic Resources

- impingement of juvenile fish on the screen
- entrainment of fish at the screen
- potential impacts of varying sweeping and bypass flows
- direct mortality, latent mortality, and disorientation of juvenile fish
- predation
- immigration of adult fish through the oxbow
- emigration of juvenile fish through the oxbow and gradient facility
- changes in habitat
- changes in aquatic resources water quality

Recreation and Navigation

- construction activity effects on recreational boating
- potential boating hazards
- operation effects on recreational boating

Terrestrial Biology

- loss and disturbance of riparian, wetland, orchard and cropland habitats
- potential impacts to special-status species
- effect of local channel stabilization on natural riparian successional processes

C-085341

Visual Resources

- soil and vegetation disturbance on the banks of the Sacramento River and Montgomery Island
- permanent presence of riprap

Land Use

- project consistency with applicable land use regulations
- change in pattern or types of crops

Noise

- construction noise from vibratory and impact pile drivers and rock placement

Transportation and Traffic Safety

- short-term changes in road maintenance and traffic safety

Air Quality

- increases in pollutant emissions during construction

IMPACT CONCLUSIONS

Presented below is an overview of the impact analysis conclusions of this EIR/EIS. **Table S-3** presents the results of selected analyses comparing the impacts among alternatives. **Table S-4** describes the scope and the significance of impacts of the project alternatives (before and after mitigation) where significant or potentially significant impacts have been identified. Due to the length of these tables, they are located at the end of this section. Mitigation measures for the no-project alternative are neither identified nor addressed in this EIR/EIS, except that potential mitigation options identified in this document could be used to ensure significant impacts to the lower oxbow bypass would not occur due to the no-project alternative. If a project alternative is not selected, then the no-project alternative would be planned and undergo separate CEQA, CESA, NEPA, and ESA review as necessary.

Hydrology and Water Resources

Relative to existing conditions, potentially significant adverse impacts could result from the no-project alternative due to reductions in HCPP diversions, local declines in the groundwater table, continued increases in salinity concentrations, and reduced drainage outflow for diluting water pesticide levels. No potentially significant adverse impacts would result to hydrology and water resources with the project alternatives. Beneficial effects would result from the project alternatives due to opportunities to improve and possibly stabilize salinity levels in the lower GCID service area and lower Colusa Basin.

C-085342

C-085342

Changes to Sacramento River flows and diversions would also result under each alternative. Under the no-project alternative, flows downstream of the Red Bluff Diversion Dam (RBDD) would decrease, due to GCID's increased reliance (as capacity is available) on deliveries via the TCC and increased reliance on groundwater and recaptured water. One exception would be August when river flows would increase slightly due to increased capacity of GCID irrigation recapture facilities under the no-project alternative. Under the project alternatives, Sacramento River flows between RBDD and Hamilton City would consistently increase because historical diversion capacity would be restored at the HCPP causing a greater percentage of GCID water supplies to remain in the Sacramento River (instead of being diverted at RBDD and delivered via the TCC). While flow changes would be substantial in summer months, river water temperature changes associated with the changes in flow would be small.

The potential for the river to meander or flood would not be substantially affected by the presence of any project features including the gradient facility. However, the alternatives including a gradient facility minimize the potential for future gradient losses and local river meander, thereby making the fish screen improvements and HCPP operations more reliable over the 50-year project life. Construction activities in the river for the gradient facility would not be expected to increase the risk of flooding, as construction would take place during relatively low flow periods.

For hydrology and water resources objectives (Table S-2), the no-project alternative would not provide peak pumping capability (within existing HCPP capacity), not minimize risks of river gradient changes, and not maximize the long-term reliability of HCPP operations. The screen extension alternative would nearly restore peak pumping capability at HCPP, but would not minimize risks of river gradient changes or maximize long-term reliability of HCPP operations. Both the screen extension with gradient facility alternative and screen extension with gradient facility and internal fish bypass alternative would meet all three of the hydrology and water resources project objectives.

Aquatic Resources

The no-project alternative would result in both beneficial and significant adverse impacts to fish. The beneficial effects would include the reduced numbers of fish that would be exposed to the existing fish screen (due to reduced flows into the oxbow) and a reduction in predator habitat associated with increased velocities in the lower oxbow. The potentially significant adverse effect of the no-project alternative would include loss of Shaded Riverine Aquatic Cover (SRA Cover) habitat.

The project alternatives would have varying levels of mostly beneficial, but also some short-term adverse effects on fishery resources. Short-term, significant adverse effects would occur to downstream juvenile migration due to delays and/or blockage (i.e., loss of juveniles stranded behind the cofferdams) caused by in-water construction activities and equipment. In addition, losses of SRA Cover habitat would also occur. These impacts of the project alternatives would be significant and unavoidable.

C-085343

C-085343

Long-term impacts of the project alternatives would be beneficial to fishery resources except for the permanent displacement of some SRA Cover habitat. The beneficial impacts would include reduced losses of juvenile fish at the fish screen due to improvements in uniformity of approach and sweeping velocities at the screen, reduced predation in the oxbow, and improved fish bypass conditions.

The gradient facility would require installation of cofferdams during peak migration of special-status fish species. The screen extension with gradient facility alternative would require substantially more cofferdams than the screen extension alternative. The beneficial impacts for juvenile fish during operation would also be greater for the screen extension with gradient facility alternative than the screen extension alternative. This would be due to improved approach and sweeping velocities at the fish screen (due to increased gradient and flow control), as well as long-term reliability of fish screen performance.

Operation of the screen extension with gradient facility and internal fish bypass (return to oxbow) alternative would have the same impacts as the screen extension with gradient facility alternative, but would also provide a means of reducing screen exposure time and associated potential for impingement for chinook salmon fry. Operation of the screen extension with gradient facility and internal fish bypass (return to river) alternative would have similar impacts as the return to oxbow alternative, with the exception of predation. The return to river alternative would have predator holding habitat in the vicinity of the bypass outfall in the river, and could increase stress of juvenile fish due to a longer transport time in the internal bypass system. The combined effects of increased travel time in the bypass system, hydraulic effects of the pipeline configuration, and a bypass outfall near a large predator holding area in the Sacramento River could result in potentially significant impacts to juvenile fish.

SRA Cover would be removed under both no-project and project alternatives, but the area disturbed would increase substantially for those alternatives with a gradient facility. Impacts to SRA Cover would be considered potentially significant, because of its classification under USFWS Mitigation Policy (1992) (Resource Category 1).

For fish protection objectives, the no-project alternative would not provide state-of-the-art protection, would not minimize fish losses, and would not minimize risk of screen failure. The screen extension alternative would provide substantial fishery resource protection beyond the existing fish screen system. However, it would not reduce the risk of screen failure nor minimize fish losses to the degree of alternatives that include a gradient facility and internal bypass. The screen extension alternative would not be expected to minimize fish losses because screen exposure time would be greater relative to existing conditions. The long-term viability of the no-project alternative and screen extension alternative is uncertain due to the potential for future river gradient changes and associated risk of screen failure.

Recreation and Navigation

Recreational boating and navigation would be able to continue in the project area during construction under all three project alternatives with limited restrictions. However, the presence

C-085344

C-085344

of construction equipment and facilities such as cofferdams could interfere with recreational boating and would represent boating hazards. More hazards would be expected for the alternatives that include the gradient facility on the Sacramento River. Significant, but mitigable, impacts would also result during operation due to the placement of new structures in the oxbow and the placement of in-river rock features for the alternatives that include a gradient facility. Posting of signs, a boater information program, and other measures would warn recreationists of potential hazards and mitigate impacts to recreation and navigation to a less-than-significant level.

Terrestrial Biology

New facilities to increase groundwater pumping and/or irrigation runoff recapture would be constructed under the no-project alternative. Recapture facilities along existing canals and drains could have the potential to impact giant garter snake habitat. Improvements to the lower oxbow could also have potentially significant impacts to riparian habitat in general, including the nesting habitat of predatory bird species and bank swallow habitat. Scrub willow and wetland habitat would not be affected by construction or operation of the no-project alternative.

Extension of the fish screen under the project alternatives would result in the permanent loss of riparian habitat. These losses would be substantially greater for the alternatives that include a gradient facility. Acreages would be small and considered potentially significant due to the scarcity of riparian habitat along the Sacramento River relative to historical levels. Riparian habitat impacts would be mitigated to a less-than-significant level.

Wetland impacts would result from alternatives that include the gradient facility. All wetland impacts would be significant but mitigable to less-than-significant levels.

The project alternatives would result in significant, but mitigable, impacts to the valley elderberry longhorn beetle (VELB) habitat. Those alternatives including a gradient facility would have substantially more impacts to VELB than the screen extension alternative.

For all species where potentially significant impacts would occur, final site surveys would be conducted to assess impacts, ~~mitigation would be finalized, and~~ avoidance measures would be implemented where feasible, and final habitat impacts would be quantified to determine habitat mitigation requirements. All impacts would be mitigated to less-than-significant levels through a combination of proposed avoidance, relocation, on-site habitat restoration, and on- and off-site habitat ~~enhancement~~ improvement measures.

An on- and off-site mitigation plan is proposed that would, to the extent feasible, restore disturbed areas and compensate for net habitat losses through the acquisition and improvement of riparian lands. This Final EIR/EIS describes the proposed acquisition of orchard land south of the lower oxbow (Parcel No. 037-100-002) for riparian, SRA Cover, and other habitat mitigation. This parcel is one of several options that the lead agencies could acquire for mitigation purposes. Acquisition of Parcel No. 037-100-002 assumes landowner willingness to sell the land. If the

C-085345

C-085345

landowner is unwilling to sell the property, then the lead agencies would seek to acquire another mitigation site option from a willing seller.

Visual Resources

Short-term significant, unmitigable impacts would result from the project alternatives due to the permanent placement of riprap along the lower oxbow and along the Sacramento River for alternatives including a gradient facility. Potentially significant, but mitigable, impacts would result from soil and vegetation disturbance during construction under all alternatives.

Land Use

The no-project alternative could have a potentially significant impact on land use. The increased reliance on recaptured water (and associated potential increases in salinity) could lead to changes in cropping patterns, and increased salinity in GCID service area recaptured water and in drainage water outflow from the GCID service area to the lower Colusa Basin. No potentially significant impacts would result from the project alternatives.

Noise

No potentially significant noise impacts would be anticipated for either the no-project or project alternatives. However, occasional use of impact pile drivers would generate intermittent noise levels for residents along Montgomery Avenue and in the Capay district over and above the noise impacts of other construction activities. Noise levels at the residences could reach 70 dBA. Vibratory pile drivers would be used to the extent feasible to minimize noise impacts. ~~The decibel (dBA) levels during construction would not be expected to exceed 75 dBA at 50 feet and 60 dBA at nearby residences for any of the alternatives.~~

Cultural Resources

No significant impacts would be expected to cultural resources for either the no-project or project alternatives. On-site surveys and subsurface testing indicate an expected absence of resources in the immediate vicinity of screen extension construction activities. Previously identified resources in the area would be avoided through on-site flagging and worker education. The lead agencies have obtained concurrence from the State Historic Preservation Office on a finding of no effect to significant historic resources.

Socioeconomics

Increased restrictions at the HCPP, and subsequent increased use of groundwater and recaptured water, substantially increased (approximately doubled) water delivery costs in the early 1990s for GCID water users. Increases in water delivery costs above those experienced in the early 1990s would be expected for the no-project alternative. Increased reliance on recaptured water under the no-project alternative could cause growers to switch to more salinity-tolerant and less water-intensive crops. Changes would be a function of market conditions, government farm programs,

C-085346

C-085346

local infrastructure, regional farm management practices, and extra-regional changes in cropping patterns.

Transportation and Traffic Safety

No potentially significant impacts to transportation and traffic safety would be expected under the no-project alternative. Under the project alternatives with a gradient facility, local access roads and private lands on the east side of the river (e.g., Wilson Landing Road) would not be expected to support construction traffic and would experience potentially significant impacts. Impacts would be mitigated to less-than-significant levels with an Access Management Plan that would be developed in consultation with affected landowners.

Air Quality

No potentially significant effects would be expected with either the no-project or project alternatives. Emissions from construction equipment and dust from staging areas and roads would result under all project alternatives, but would be mitigated through vehicle emissions control and dust control measures.

ENVIRONMENTALLY SUPERIOR ALTERNATIVE

The environmentally superior alternative is the alternative that minimizes substantial, or potentially substantial, changes in the physical environment and meets the project objectives to the extent possible. The proposed project represents fisheries mitigation for GCID's diversions on the Sacramento River at HCPP. The proposed project would have substantial, long-term beneficial impacts to fisheries. Significant and potentially significant, short-term, adverse impacts to other resources would occur from construction activities, including short-term adverse impacts to aquatic resources. On balance, the significant long-term beneficial impacts of increased fish protection would substantially outweigh the significant and potentially significant short-term adverse impacts to aquatic and other resources.

Protection of fishery resources at the HCPP includes reliability in the long-term performance of the fish screen. The history of local river gradient changes indicates that such future river changes are likely within the 50-year life of the project. The need to minimize the potential water surface gradient changes in the project vicinity is just as critical to long-term fish protection as other considerations such as screen mesh density and approach velocity.

Some level of environmental risk is associated with each of the alternatives, since it is impossible to predict with certainty the future of regional river meander and water surface gradient changes that could affect the proposed project. With such changes, the screen extension alternative could fail as previous screens have failed. Alternatives that include a gradient facility would provide substantial additional certainty to the long-term success and performance of the fish screen extension alternative. Despite the increased impacts to other environmental resources, alternatives that include a screen extension and gradient facility would be considered environmentally superior to the screen extension alternative and no-project alternative because of the significant improvements in long-term fish screen performance and protection.

Another issue in evaluating alternatives is the uncertainty in the scientific community regarding the anticipated impact of screen exposure time on juvenile chinook salmon. There is insufficient data available to reliably assess the impact trade-offs between increased screen exposure time and diverting chinook salmon fry through an internal bypass system to reduce screen exposure. The uncertainty of the relative benefits of an internal fish bypass system indicates a need for flexibility in screen design that would allow for monitoring and then operation of the fish screens with or without an internal bypass system. Alternatives including a fish bypass with the ability to open and close the internal bypass system would provide this flexibility and be environmentally superior to alternatives without this feature.

An unresolved issue is the effect of prolonged travel time on juvenile fish passing through an enclosed fish bypass system. Experts disagree on what constitutes excessive amounts of time for juvenile fish in a bypass system. The two bypass options for this project (return to oxbow and return to river) would involve substantial differences in transport time. Because of concerns that the return to river option would have longer transport times and place the fish in a location of the river where predation can be expected, the return to oxbow option has been identified as the environmentally superior option.

In summary, a gradient facility provides additional certainty to long-term fish screen performance and fish protection, and an internal fish bypass system provides flexibility to assess performance trade-offs between increased screen exposure time and routing fish through a closed bypass system. For these reasons, the screen extension with gradient facility and internal fish bypass (return to oxbow) is considered the environmentally superior alternative.

AGENCY PREFERRED ALTERNATIVE

Since 1988, technical advisory groups for the project have worked toward a design that meets the project objectives. Alternatives considered by the group have covered a broad range of screen and non-screen options. Extensive fishery resources, design feasibility, and HCPP operation studies have been completed. Existing fish screen facilities throughout the western United States have also been investigated to assess successes and failures.

In parallel with project planning activities, an Agency Management Group (AMG), consisting of management-level representatives from agencies cooperating in the planning and design of the project, has met regularly to review progress, receive briefings on key design considerations, and address policy issues. In December 1996, after eight years of study, the Technical Advisory Group (TAG) and AMG addressed the question concerning what would constitute state-of-the-art, reliable fish protection at HCPP. With the support of a TAG recommendation and the results of technical, economic, and environmental studies performed over the years, the AMG unanimously identified the screen extension with gradient facility and internal fish bypass as the agency preferred alternative. Of the return to oxbow and return to river options, the AMG endorsed the return to oxbow design as its preferred option.

ISSUES TO BE RESOLVED

Through the joint preparation of this EIR/EIS, the lead and other participating agencies have collectively worked to resolve the broad range of design and environmental issues. Certain issues are still under analysis as follows:

- **Gradient facility construction method and schedule.**

The EIR/EIS impact analyses assume a one-year, four-phase gradient facility construction process ~~for temporary cofferdam installation~~ (dry construction method) in the mainstem of the Sacramento River. Project engineers and resource specialists are evaluating options that could better satisfy construction sequencing and environmental objectives, including minimizing adverse effects on special-status fish species. ~~This Draft EIR/EIS describes the optional methods and schedules for the construction of the gradient facility~~. It is uncertain at this time whether the proposed one-year, four-phase dry construction method could be accomplished in one year. The potential impacts of alternative methods, including the in-river wet construction method, are discussed in this EIR/EIS. Either the dry or wet construction method could ultimately be implemented.

- **The need for periodic dredging of the Sacramento River to maintain effective operation of the gradient facility.**

Modeling studies are ongoing at Colorado State University to assess the potential extent of sedimentation that could result in the vicinity of the gradient facility. This could include either or both upstream sediment accumulation or deposition of sediment within the design "fish pools" within the gradient facility. Such sedimentation could require an unknown amount and frequency of dredging in the vicinity of the gradient facility.

- **The final design and siting of the rock dikes that would help maintain alignment of the river in the vicinity of the gradient facility.**

Rock dikes have been proposed with those alternatives that include a gradient facility (Figure S-2) to help ensure the river does not meander locally around the gradient facility during flood events. The placement and design of the rock dikes are preliminary and undergoing design review. Final size, placement, and composition of the rock dikes will be refined as project design progresses.

- **Mitigation program for terrestrial habitat and SRA Cover impacts.**

The extent of riparian, SRA Cover, elderberry shrub, and other habitat impacts will change as project design is refined and construction plans are finalized. ~~Comprehensive mitigation plans will be completed following final design.~~ This Final EIR/EIS describes the proposed acquisition of orchard land south of the lower oxbow (Parcel No. 037-100-002) for riparian, SRA Cover and other habitat mitigation. This parcel is one of several options that the lead agencies could acquire for mitigation purposes. Acquisition of Parcel No. 037-100-002 assumes landowner willingness

C—085349

C-085349

to sell the land. If the landowner is unwilling to sell the property, then the lead agencies would seek to acquire another mitigation site option from a willing seller. Coordination activities with resource agencies are ongoing regarding the type and location of specific habitat improvements that would be accomplished on Parcel No. 037-100-002 to compensate for net habitat losses from the project. ~~mitigation that could be adopted for project impacts. This includes discussions regarding the need for mitigation of SRA Cover impacts along the lower oxbow channel where predation is a concern for juvenile chinook salmon.~~

- **Final operating conditions for the fish screen and internal fish bypass system.**

The Fish Protection Evaluation and Monitoring Program (FPEMP) is proposed to monitor the performance success of the project during initial years of operation. One of the key issues to be addressed is possible differences in fish protection with and without one or more of the three internal bypasses operating along the screen face.

- **Dredge spoil handling site and method.**

GCID is considering options for processing and stockpiling dredge spoils produced during annual dredging of the oxbow. The options, which are considered in the EIR/EIS, include a new stockpile location on GCID's parcel across from the HCPP service yard at the corner of First Avenue and Cutler Avenue. Another option would be sorting by size portions or all of the stockpiled material either on Montgomery Island or on GCID's parcel across from the HCPP service yard. The sorting would involve separating materials greater than or equal to 3/4-inch in size from smaller material, and possibly leaving the larger material on the northern tip of Montgomery Island to be returned to the river during high flows.

AREAS OF CONTROVERSY

One area of continuing scientific discussion concerns the relative impacts and benefits of the two options for internal fish bypass outfalls (i.e., return to oxbow or return to river). For example, there are differing technical expert opinions on issues such as differences in the extent of predation between the bypass return options.

This EIR/EIS concludes that the return to oxbow option would be expected to have greater overall benefits for successful fish passage. The FPEMP to be implemented with project operation is expected to provide further information regarding the actual benefits of the return to oxbow option.

ENVIRONMENTAL COMMITMENTS AND MITIGATION AND MONITORING

Two distinct monitoring and evaluation programs are proposed. The Environmental Compliance and Mitigation Monitoring Program (ECMMP) is the master program for tracking the requirements, implementation schedule, and responsibility for mitigation measures adopted for the approved project. The ECMMP would also assess the success of mitigation activities as required by Public Resources Code (CEQA Statutes) Section 21081.6 and Council on Environmental Quality Regulations Sections 1505.2(c) and 1505.3. It would further ensure that the project is in compliance with conditions of permits issued.

The second monitoring program, the FPEMP, would specifically focus on the performance of the fish screen, gradient facility and fish bypass system. The FPEMP would evaluate the success of project features over the initial years of operation with regard to meeting certain project objectives (i. e., minimizing losses of all fish in the vicinity of the pumping plant diversion).

MITIGATION MEASURES RECOMMENDED FOR PROJECT FEATURES

In addition to the general environmental commitments identified above, the lead agencies (GCID, CDFG, Corps, and Reclamation) propose to minimize environmental impacts and to restore disturbed lands using all practicable means. Where avoidance would not be possible, specific measures have been recommended to protect environmental resources and to mitigate to a less-than-significant level when feasible. Recommended mitigation measures are presented in Table S-4 for each potentially significant and significant environmental consequence of the project alternatives.

Lead agency project approvals would include specific mitigation requirements based on design plans. Upon final design, mitigation measures and compensation requirements would be finalized based on final impact acreages, construction methods, and design features. Mitigation measures would also be modified to include commitments and conditions for permits, memoranda of agreement, and correspondence with other agencies and private entities.

C-085351

C-085351

C-085352

Table S-3 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions

Impact Topic		No Project[a]		Screen Extension[a]		Screen Extension With Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River	
		Change	Signif.	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Hydrology and Water Resources											
Simulated Average Monthly Flow (Percent Change) in the Sacramento River Downstream of RBDD **Existing Hydrology** (cfs)[c]	October	0	LS	0	LS	0	LS	0	LS	0	LS
	November	0	LS	0	LS	0	LS	0	LS	0	LS
	December	0	LS	0	LS	0	LS	0	LS	0	LS
	January	0	LS	0	LS	0	LS	0	LS	0	LS
	February	0	LS	0	LS	0	LS	0	LS	0	LS
	March	0	LS	0	LS	0	LS	0	LS	0	LS
	April	0	LS	0	LS	0	LS	0	LS	0	LS
	May	-262 (-2.6%)	LS	+78 (0.8%)	LS	+79 (0.8%)	LS	+79 (0.8%)	LS	+79 (0.8%)	LS
	June	-649 (-6.5%)	LS	+386 (3.8%)	LS	+387 (3.8%)	LS	+387 (3.8%)	LS	+387 (3.8%)	LS
	July	-583 (-5.1%)	LS	+205 (1.8%)	LS	+205 (1.8%)	LS	+205 (1.9%)	LS	+205 (1.9%)	LS
	August	+100 (1.1%)	LS	+761 (8.3%)	LS	+765 (8.3%)	LS	+765 (8.3%)	LS	+765 (8.3%)	LS
	September	0	LS	0	LS	0	LS	0	LS	0	LS
Simulated GCID Average Annual Deliveries by Supply Source - **Existing Hydrology** (1000s ac-ft)	HCPP[c]	-137	PS	+80	B	+80	B	+80	B	+80	B
	Stony Creek[c]	+14	LS	0	LS	0	LS	0	LS	0	LS
	Recapture[c]	+18	LS	-3	LS	-3	LS	-3	LS	-3	LS
	TCC[c]	+83	LS	-65	LS	-65	LS	-65	LS	-65	LS
	Groundwater	+23	PS	-10	B	-10	B	-10	B	-10	B
Electrical Conductivity (Salinity) in the Colusa Basin Drain		Potential for Increase	PS	Potential to stabilize	B	Potential to stabilize	B	Potential to stabilize	B	Potential to stabilize	B

B = Beneficial impact
LS = Less-than-significant impact
PS = Potentially significant impact
S = Significant impact
NA = Not applicable
na = Not available
ND = Not detectable, less than 1% change

C—085352

C-085353

Table S-3 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

		No-Project[a]		Screen Extension[a]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River	
Impact Topic		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Hydrology and Water Resources (Continued)											
Pesticide Exceedances		Potential for Increase	PS	Potential to stabilize	B	Potential to stabilize	B	Potential to stabilize	B	Potential to stabilize	B
River Channel Stability		Continued risk of meander	PS	Continued risk of meander	PS/PS	Reduced risk of meander	B	Reduced risk of meander	B	Reduced risk of meander	B
Flooding Potential During Construction		None		None		Low risk	LS	Low risk	LS	Low risk	LS
Aquatic Resources											
Maximum Approach Velocity	12/1 - 4/30[d]	-0.27	B	-0.27	B	-0.27	B	-0.27	B	-0.27	B
	5/1 - 5/15[d]	-0.07	B	-0.07	B	-0.07	B	-0.07	B	-0.07	B
	5/15 - 8/1[d]	-0.27	B	-0.27	B	-0.27	B	-0.27	B	-0.27	B
	8/1 - 11/30[d]	0	LS	0	LS	0	LS	0	LS	0	LS
Average Approach Velocity (ft/s)[e]	5,000 cfs[e]	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Decrease	B
	7,000 cfs[f]	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Decrease	B
	10,000 cfs[f]	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Decrease	B
	20,000 cfs[f]	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Decrease	B
Average Sweeping Velocity	5,000 cfs	na	na	No difference	LS	Increase	B	Increase	B	Increase	B
	7,000 cfs	na	na	No difference	LS	Increase	B	Increase	B	Increase	B
	10,000 cfs	na	na	No difference	LS	Increase	B	Increase	B	Increase	B
	20,000 cfs	na	na	No difference	LS	Increase	B	Increase	B	Increase	B
Maximum Screen Exposure Time Between Bypasses (minutes)[h]		No Change		+7	PS/PS	+7	PS/PS	+1	LS	+1	LS
Impingement		Somewhat Improve	B	Improve	B	Improve	B	Improve	B	Improve	B
Entrainment		Somewhat Improve	B	Improve	B	Improve	B	Improve	B	Improve	B
Time of Transport in Internal Bypass System (minutes)[i]		na	na	No bypass		No bypass		-1 to +1	LS	+8 to +17	PS/PS

C—085353

C-085354

Table S-3 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

Impact Topic		No-Project[a] Change	No-Project[a] Signif.[b]	Screen Extension[a] Change	Screen Extension[a] Signif.[b]	Screen Extension with Gradient Facility Change	Screen Extension with Gradient Facility Signif.[b]	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow Change	Return to Oxbow Signif.[b]	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River Change	Return to River Signif.[b]
Aquatic Resources (Continued)											
Predation	Construction	Negligible Increase	LS	Increase	LS	Increase	LS	Increase	LS	Increase	LS
	Operations										
	5,000 cfs	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
	7,000 cfs	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
	10,000 cfs	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
	20,000 cfs	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
SRA Cover [l]	Acres/ Linear Feet	-0.55/2,412	PS	-0.72/3,127	PS/PS	-1.5/6,522	PS/PS	-1.5/6,522	PS/PS	-1.5/6,522	PS/PS
Chinook Salmon Percent Change in Rearing Habitat between RBDD and HCPP (Juveniles/Fry) [m] **Existing Hydrology**	April	0	LS	0	LS	0	LS	0	LS	0	LS
	May	ND/+2	LS	ND/+2	B	ND/+2	B	ND/+2	B	ND/+2	B
	June	-1/-11	LS	ND/+2	B	ND/+2	B	ND/+2	B	ND/+2	B
	July	ND/-2	LS	ND/+2	B	ND/+2	B	ND/+2	B	ND/+2	B
	August	ND/ND	LS	+2/+7	B	+2/+7	B	+2/+7	B	+2/+7	B
	September	0	LS	0	LS	0	LS	0	LS	0	LS
Estimated Early Life Stage Mortality for Chinook Salmon in the Upper Sacramento River [n]	All Four Runs Chinook Salmon	No change	LS	Potential to decrease	B	Potential to decrease	B	Potential to decrease	B	Potential to decrease	B
Downstream Migration of Juvenile Fish	Construction	Some change	~~B~~LS	Disrupt	PS/PS	Disrupt	S/S	Disrupt	S/S	Disrupt	S/S
	Operations	Improved	B	Improved	B	Improved	B	Improved	B	Improved	B
Recreation and Navigation											
Months of Disruption to Recreational Boating	Construction	3	PS	18	PS/LS	23	S/LS	23	S/LS	23	S/LS
Potential Boating Hazards in River	Construction	No change	LS	No change	LS	Increase	S/LS	Increase	S/LS	Increase	S/LS
	Operation	No change	LS	No change	LS	Increase	S/LS	Increase	S/LS	Increase	S/LS

C-085354

Table S-3 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

Impact Topic		No-Project[a]		Screen Extension[a]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River	
		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Recreation and Navigation (Continued)											
Potential Boating Hazards in Oxbow	Construction	Increase	PS	Increase	PS/LS	Increase	PS/LS	Increase	PS/LS	Increase	PS/LS
	Operation	Increase	LS	Increase	LS	Increase	LS	Increase	LS	Increase	LS
Terrestrial Biology											
Riparian Habitat (acres)[o,p]	Permanent	-0.5	LS	-1.9	PS/LS	-10.2	PS/LS	-10.2	PS/LS	-10.2	PS/LS
Wetland Habitat (acres)[o,p]	Permanent	No change	LS	No change	LS	-2.3	S/LS	-2.3	S/LS	-2.3	S/LS
Scrub/Willow Habitat (acres)[o,p]	Permanent	No change	LS	No change	LS	-1.0	PS/LS	-1.0	PS/LS	-1.0	PS/LS
Elderberry Stems (Lost or Trans-planted)[o]	Permanent	No change	LS	-153	S/LS	-442	S/LS	-442	S/LS	-442	S/LS
Swainson's Hawk Nests[o]	Temporary	2 nest sites potentially affected	PS	2 nest sites potentially affected	PS/LS	2 nest sites potentially affected	PS/LS	2 nest sites potentially affected	PS/LS	2 nest sites potentially affected	PS/LS
Bank Swallow Nesting Sites[o]	Permanent	1 potential site affected	PS	1 potential site affected	PS/LS	2 potential sites affected	PS/LS	2 potential sites affected	PS/LS	2 potential sites affected	PS/LS
Visual Resources											
Soil and Vegetation Disturbance (# of Key Viewpoints)	Oxbow	1	PS	1	PS/LS	1	PS/LS	1	PS/LS	1	PS/LS
	Sacramento River	0	LS	0	LS	3	PS/LS	3	PS/LS	3	PS/LS
	Montgomery Island	0	LS	0	LS	2	PS/LS	2	PS/LS	2	PS/LS
Riprap (linear ft)	Sacramento River	0	LS	0	LS	8,000	S/S[q]	8,000	S/S[q]	8,000	S/S[q]
	Lower Oxbow	2,600	S	2,600	S/S[q]	2,600	S/S[q]	2,600	S/S[q]	2,600	S/S[q]

C-085356

Table S-3 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

		No-Project[a]		Screen Extension[a]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River	
Impact Topic		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Land Use											
Change in Land Use	Operation	Shift to Salt-Tolerant Crops	PS	No change	LS	No change	LS	No change	LS	No change	LS
Potential Conflict with County Zoning	Construction	No change	NA	Zoning change	LS	Zoning change	LS	Zoning change	LS	Zoning change	LS
Noise											
Construction Activity Noise	Construction	75 dB at 50 ft.	LS	75 dB at 50 ft.	LS	75 dB at 50 ft.	LS	75 dB at 50 ft.	LS	75 dB at 50 ft.	LS
Transportation and Traffic Safety											
Traffic Volume on Public Roads During Construction (trips/day)	Canal Road	+100	LS	+150	LS	+200	LS	+200	LS	+200	LS
	Wilson Landing Road	No change	LS	No change	LS	+200	PS/LS	+200	PS/LS	+200	PS/LS
Traffic Volume on Private Roads (trips/day)	Parcel 047-400-003	No change	LS	No change	LS	+200	PS/LS	+200	PS/LS	+200	PS/LS
Air Quality											
Emissions	Construction	Somewhat increase	LS	Increase	LS	Increase	LS	Increase	LS	Increase	LS
Dust and Particulate Matter (PM_{10})	Construction	Somewhat increase	LS	Increase	LS	Increase	LS	Increase	LS	Increase	LS

C—085356

C-085357

Footnotes to Table S-3 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions

B = Beneficial impact	NA = Not applicable
LS = Less-than-significant impact	na = Not available
PS = Potentially significant impact	ND = Not detectable, less than 1% change
S = Significant impact	

[a] The impacts shown under this alternative are based on current river gradient. If the river gradient were to lower substantially, further changes would be expected. No-project design, impacts, and mitigation would be considered in a separate CEQA review process if none of the project alternatives are selected for implementation.

[b] Impact significance before/after mitigation. Where impacts would be less than significant (LS), no mitigation is recommended. Certain impact designations represent consideration of two or more impact conclusions as presented in Chapter 4, Impact Analyses.

[c] Changes shown for indirect impact assessment. Impacts from flow and temperature are described in the Aquatic Resources section.

[d] Based on physical model studies (Reclamation 1996e).

[e] 1,000 cfs diversion rate.

[f] 3,000 cfs diversion rate.

[g] Based on data provided by Ayres Associates (1996d and 1997a). Quantitative data for the no-project and screen extension alternatives are not available.

[h] This estimate is based on a river flow of 7,000 cfs and a diversion rate of 3,000 cfs.

[i] These estimates assume a 3-10 ft/s bypass flow.

[j] The bypass system would have improved hydraulics at the bypass bays, within the bypass pipe, and at the outfall.

[k] Calculations shown are based on data provided by Ayres Associates (1997b). Data shown for percentage of oxbow greater than 2 ft/s were used to make the impact determination under "predation."

[l] Shoreline impacts were analyzed under two categories: Resource Category 1 SRA Cover and natural erodible shoreline.

[m] Based on change in weighted usable area (WUA) (DWR 1993).

[n] Based on modeled temperature decreases in the upper Sacramento River.

[o] These numbers and the actual occurrence of a species in question would be verified during final site surveys based on final design.

[p] For the purposes of this analysis, all riparian and wetland impacts are considered permanent. In the development of mitigation, scrub/willow habitat would be combined with riparian habitat.

[q] Significance shown for short-term impacts. Long-term impacts would be less than significant after natural revegetation.

C-085357

C-085358

Table S-4 - Measures Recommended to Mitigate Significant or Potentially Significant Impacts of the Project Alternatives

Impact [a]	Before Mitigation	Recommended Mitigation Measure	After Mitigation
Hydrology and Water Resources *- No significant or potentially significant impacts identified for the project alternatives.*			
Aquatic Resources			
4.2-5, 4.2-11 and 4.2-22 - Construction of the oxbow modifications, fish screen extension, and gradient facility would result in the permanent loss of SRA Cover, which has been defined as a Resource Category 1 by the USFWS.	Potentially Significant	SRA Cover mitigation would be included as part of the on-site and off-site habitat mitigation plan, which includes the proposed acquisition of Parcel No. 037-100-002 south of the lower oxbow. Because of the classification of SRA Cover as a USFWS mitigation policy (Resource Category 1), permanent displacement of this habitat could not be fully mitigated.	Potentially Significant
4.2-9 - Construction activities within the oxbow could result in the temporary disruption (i.e., delay and/or blockage) of juvenile fish emigration through the oxbow.	Potentially Significant	Monitoring and rescue seining would be conducted within the areas enclosed by the cofferdams as soon as possible following completion of cofferdam installation, and prior to water removal.	Potentially Significant
4.2-20 - Construction of the gradient facility could temporarily disrupt (i.e., delay and/or block) juvenile fish emigration in the Sacramento River.	Significant	Implement mitigation measure for Impact 4.2-9	Significant
4.2-35 - Operation of the internal fish bypass (return to river option) would permanently change the availability and distribution of potential predator holding habitat within the oxbow and in the Sacramento River at the gradient facility.	Potentially Significant	This impact could be reduced through design of the pipeline and outfall to minimize potential hydraulic effects and to site the outfall in the river in an area that would minimize predation.	Potentially Significant
Geology and Soils *- No significant or potentially significant impacts identified for the project alternatives.*			
Recreation and Navigation			
4.4.1 and 4.4.3 - Construction activities in the oxbow and river could temporarily interfere with recreational boating and increase boating hazards.	Potentially Significant	As necessary, temporary barriers and signs would be erected along the oxbow channel and river to limit access to construction areas and to warn recreationists of potential hazards. The California Department of Boating and Waterways would be consulted for recommendations concerning the placement of these barriers and signs.	Less Than Significant

C—085358

C-085359

Table S-4 - Measures Recommended to Mitigate Significant or Potentially Significant Impacts of the Project Alternatives (Continued)			
Impact [a]	**Before Mitigation**	**Recommended Mitigation Measure**	**After Mitigation**
Recreation and Navigation (Continued)			
4.4-4 - Potential recreation boating hazards could increase in the river due to the presence of the gradient facility.	Significant	Seasonal or permanent buoys would be used to define the limits of the low-water navigation channel in the Sacramento River channel. All proposed facilities that could be submerged during high or low flow conditions would be marked in accordance with Section 659 of the Harbors and Navigation Code. Warning signs would be placed along both banks of the river upstream and downstream of the facility at distances of 500, 1,000, and 1,500 feet. The California Department of Boating and Waterways would be consulted for recommendations concerning the placement of markers and development of a boater information program.	Less Than Significant
Terrestrial Biology			
4.5-1 - Construction activities would permanently alter riparian habitat.	Potentially Significant	Riparian habitat would be avoided to the greatest extent practicable. A ten-foot buffer zone would be clearly marked around all riparian avoidance areas during construction. Surveys for active yellow-billed cuckoo nesting sites would be conducted within a 50-yard radius of all project facilities. Construction activities would be planned to avoid construction within 50 yards of active nests between June and September 15 or until the birds have fledged. The Environmental Compliance and Mitigation Monitoring Program includes plans for on-site and off-site replacement of lost riparian habitat values. The lead agencies propose to acquire Parcel No. 037-100-002 south of the lower oxbow for riparian, SRA Cover, and other habitat mitigation. During final design of the gradient facility, the lead agencies would evaluate the feasibility of left-bank armoring in the orchard to reduce impacts to riparian vegetation on the river banks.	Less Than Significant

C-085359

C-085360

Table S-4 - Measures Recommended to Mitigate Significant or Potentially Significant Impacts of the Project Alternatives (Continued)

Impact [a]	Before Mitigation	Recommended Mitigation Measure	After Mitigation
Terrestrial Biology (Continued)			
4.5-2 - Construction activities could temporarily affect the nesting habitat of predatory bird species of concern.	Potentially Significant	Prior to construction, surveys for active Swainson's hawk nesting sites would be conducted within a 0.5 mile radius of all project facilities. Construction would avoid activities within 0.25-0.5 mile of active nests between March 1 and September 31 to the extent feasible. Riparian habitat would be avoided and compensated as discussed in the mitigation measure for Impact 4.5-1.	Less Than Significant
4.5-3 - Construction activities would permanently alter vertical erosion prone banks, which could provide suitable nesting habitat for bank swallows.	Potentially Significant	Surveys would be conducted for nesting bank swallows. Project features and construction areas would avoid suitable nesting habitat for bank swallows where feasible. Measures would be taken to prevent bank swallows from nesting within 0.25 mile of construction sites between April and August.	Less Than Significant
4.5-4 - Construction activities would result in a reduction in abundance of elderberry shrubs, which could affect the valley elderberry longhorn beetle.	Significant	The ECMMP includes plans for mitigating impacts to valley elderberry longhorn beetle (VELB) in accordance with USFWS (1996d) guidelines.	Less Than Significant
4.5-5 - Construction of the gradient facility would permanently impact wetland/freshwater marsh habitat on the eastern bank of the Sacramento River.	Significant	Prior to construction, surveys would be conducted of the impacted emergent wetland/freshwater marsh site to develop a plant species list and to determine the presence or absence of the special concern species Sanford's arrowhead and the rose mallow. Should surveys identify Sanford's arrowhead and/or the rose mallow, they would be collected and relocated to a site deemed appropriate by USFWS. Impacts to wetland ecosystems would be mitigated through the terrestrial habitat mitigation plan.	Less Than Significant
Visual Resources			
4.6-1, 4.6-2, and 4.6-6 - Stockpiling and placement of riprap along banks of Sacramento River, the oxbow, and Montgomery Island.	Significant	Long-term visual changes brought by riprap placement would be mitigated through natural and project revegetation. Revegetation of areas adjacent to riprap would also be encouraged by seeding with native riparian groundcovers, including grasses, and, where feasible, native trees and shrubs. Short-term visual impacts could not be reduced below a level of significance.	Significant Short-Term; Less Than Significant Long-Term

C-085360

C-085361

Table S-4 - Measures Recommended to Mitigate Significant or Potentially Significant Impacts of the Project Alternatives (Continued)

Impact [a]	Before Mitigation	Recommended Mitigation Measure	After Mitigation
Visual Resources (Continued)			
4.6-4 and 4.6-5 - Soil and vegetation disturbance and removal on banks of Sacramento River and on Montgomery Island in vicinity of gradient facility.	Potentially Significant	To mitigate disturbance to soils and vegetation, clearing and grading would be minimized and edges would be blended with the existing riparian vegetation. Grading and revegetation methods would be implemented as part of the terrestrial habitat mitigation plan.	Less Than Significant
4.6-7 - Temporary placement of cofferdams for construction of underground bypass pipeline and outlet structure in the Sacramento River for the internal fish bypass (return to river option).	Potentially Significant	No measures recommended.	Potentially Significant
***Land Use** - No significant or potentially significant impacts identified for the project alternatives.*			
***Noise** - No significant or potentially significant impacts identified for the project alternatives.*			
Cultural Resources			
4.9-2 - Potential construction-related disturbance (e.g., fish screen extension) and compaction to yet undocumented and unidentified cultural resources.	Potentially Significant	If previously unidentified cultural materials are encountered, construction in that area would be halted and archaeological consultation would be sought immediately.	Less Than Significant
Transportation and Traffic Safety			
4.11-3 and 4.11-4- Local access road conditions on parcel 047-400-003 would not support access to gradient facility construction areas and increased traffic in front of residences located on Wilson Landing Road west of Hamilton Nord Cana Highway could pose safety hazards for residents.	Potentially Significant	To promote efficient, safe access to construction staging areas on the east bank of the Sacramento River, an access management plan would be developed and implemented prior to the initiation of construction activities.	Less Than Significant
***Air Quality** - No significant or potentially significant impacts identified for the project alternatives.*			

[a] Impact numbers correspond to those identified in Chapter 4, Impact Analyses.

C-085361

Chapter 1
Introduction

C-085362
C—085362

1.0 INTRODUCTION

This ~~Draft~~ Final Environmental Impact Report/Environmental Impact Statement (EIR/EIS) describes the potential beneficial and adverse environmental effects of alternatives for a proposed fish screen improvement project at the Glenn-Colusa Irrigation District's (GCID) Hamilton City Pumping Plant (HCPP). Potential environmental effects of construction and long-term operation and maintenance of the project are described in accordance with California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) requirements. ~~Following public and agency review and comment, this Draft EIR/EIS will be finalized and considered before a decision is made whether to approve the project for construction.~~ Public and agency comments on the Draft EIR/EIS, and descriptions of how the comments were considered in preparing this Final EIR/EIS, are also presented in this document. Revisions to the Draft EIR/EIS are shown in underline/strikeout format in this Final EIR/EIS.

1.1 Project Location

The proposed fish screen improvements would be located on the Sacramento River and adjacent side channel (referred to in this document as an oxbow) between approximately River Mile (RM) 205 and RM 206, near the intersection of Butte, Tehama, and Glenn counties. The HCPP supplies water to irrigated lands and National Wildlife Refuges to the west of the Sacramento River between Hamilton City and Williams. HCPP operations affect Sacramento River flows between Red Bluff and Knights Landing. Figure S-1 in the Summary shows the general study area. **Figure 1.1-1** shows the GCID service area and related water conveyance facilities in the study area. **Figure 1.1-2** shows the immediate vicinity of the proposed project features. The specific locations of the proposed project features are presented in Section 2.4 (Alternatives).

1.2 Purpose of the Project

The lead agencies under CEQA (GCID and the California Department of Fish and Game (CDFG)) and the lead agencies under NEPA (United States Department of the Interior (Interior), Bureau of Reclamation (Reclamation) and the U.S. Army Corps of Engineers (Corps)) and other participating agencies have identified two primary purposes of the project. The first is to minimize losses of all fish in the vicinity of the pumping plant diversion, including endangered winter-run chinook salmon. The second is to maximize GCID's capability to divert the full quantity of water it is entitled to divert to meet its water supply delivery obligations.

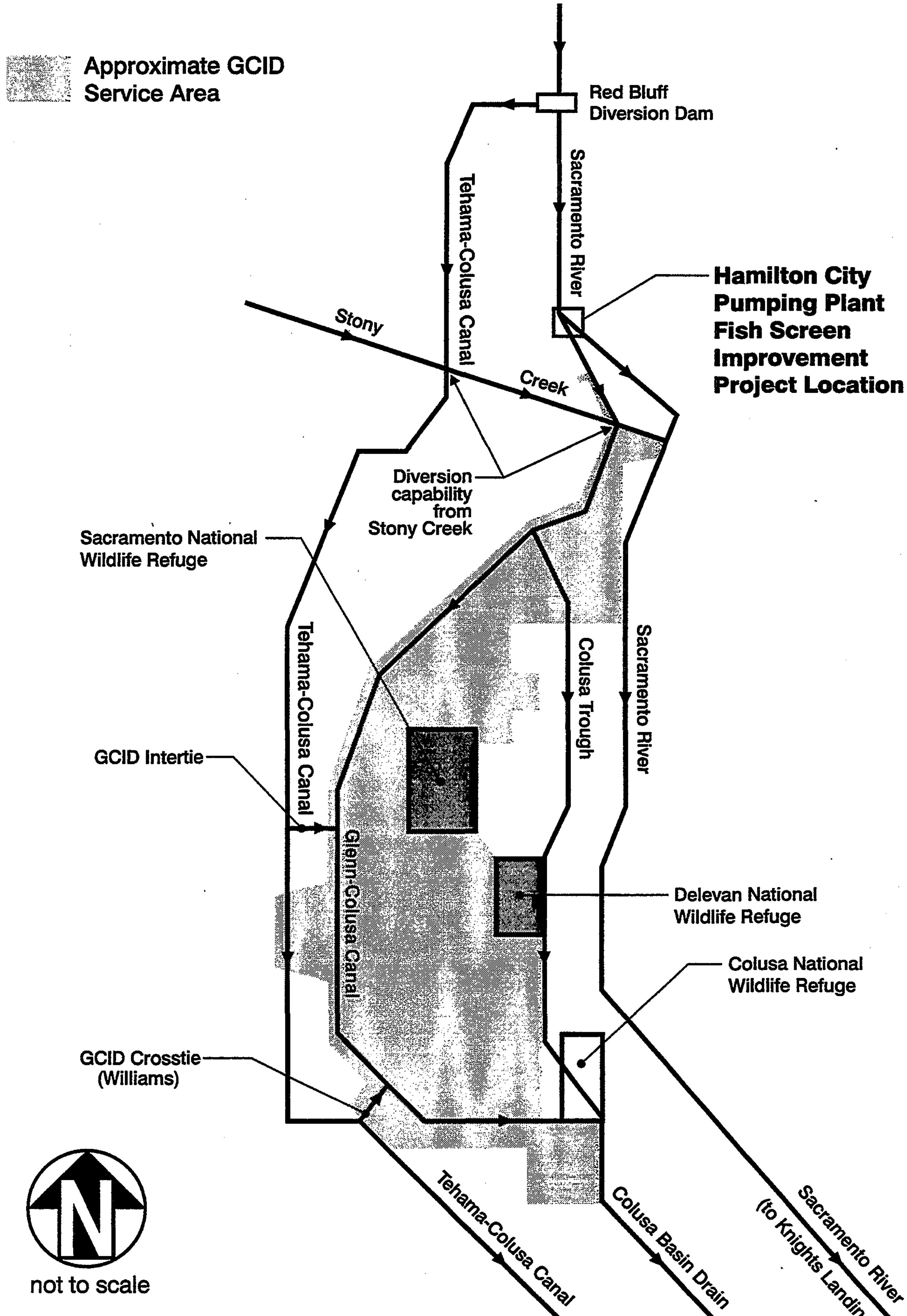
1.3 Need for the Project

The need for the project has long been recognized by GCID and resource agencies, such as CDFG and National Marine Fisheries Service (NMFS), because past fish screening efforts have not provided adequate protection (see Section 1.5, History of HCPP Diversions and Fish Screens). The project was first required by Corps permits issued in 1988 to GCID for dredging activities under Section 10 of the River and Harbor Act and Section 404 of the Clean Water Act.

C-085363

C-085363

FIGURE 1.1-1. HAMILTON CITY PUMPING PLANT FISH SCREEN IMPROVEMENT PROJECT AREA RELATIVE TO KEY WATER CONVEYANCE FACILITIES AND THE GCID SERVICE AREA



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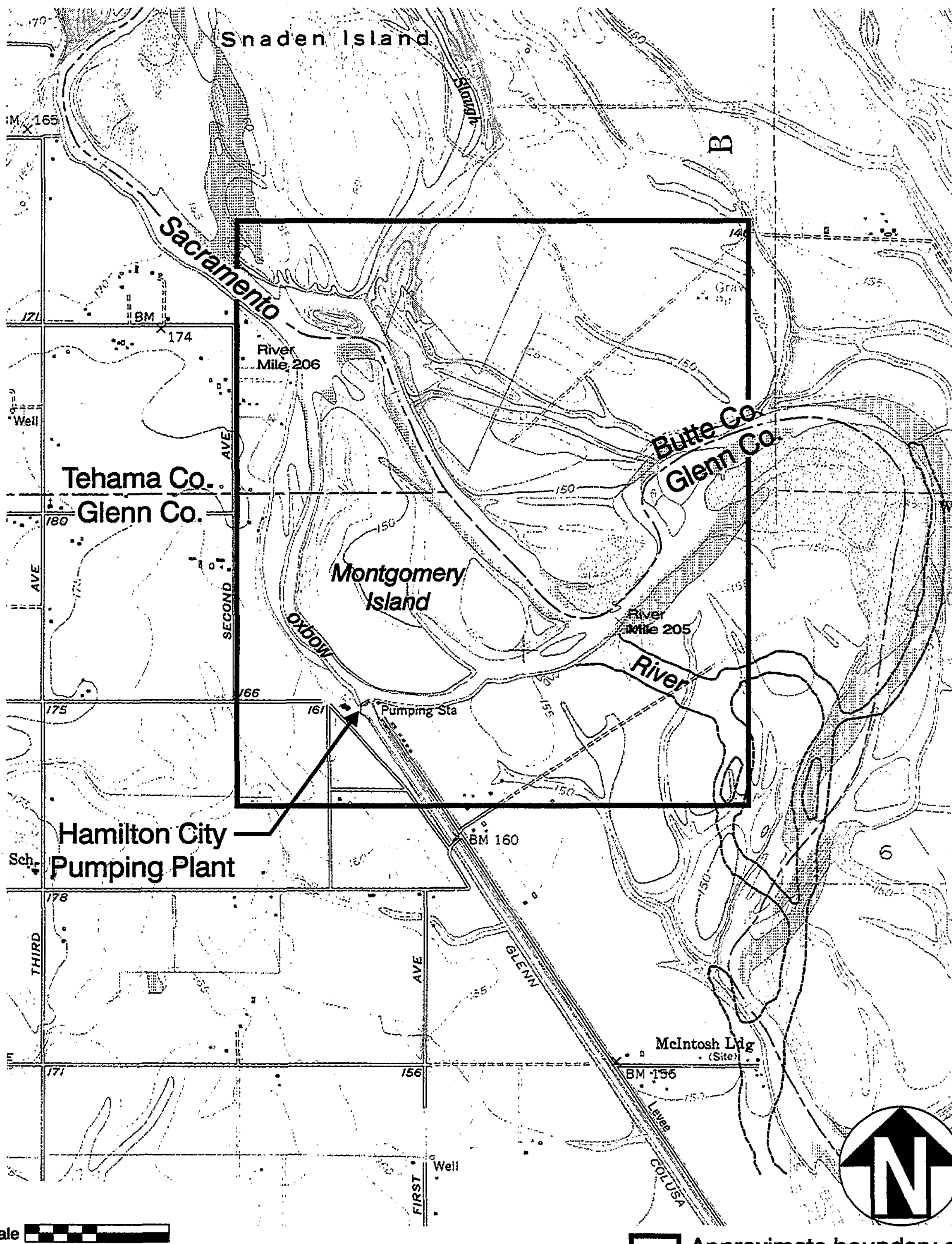
C-085364

C-085364

FIGURE 1.1-2. LOCATION OF PROPOSED HAMILTON CITY PUMPING PLANT FISH SCREEN IMPROVEMENT PROJECT



NOTE: The elevation contours are generally accurate, however the Sacramento River alignment changed significantly in 1970 at River Mile 205. See Section 3.1, Hydrology and Water Resources.

Source: Foster Island 7.5" Quadrangle, USGS, 1969

Approximate boundary of proposed project

Approximate boundary of current river alignment below River Mile 205

C—085365

C-085365

The permits required that GCID assure the development and implementation of "state-of-the-art" fish protection at HCPP. The fish protection requirement in 1988 was primarily for the protection of the chinook salmon because of its economic importance to the fishing industry. Winter-run chinook salmon were thereafter listed as endangered under the California Endangered Species Act (CESA) in 1989 and as threatened and then endangered under the Endangered Species Act of 1973, as amended (ESA), in 1990 and 1994, respectively.

Pursuant to Section 7 of the ESA, the Corps conducted a consultation with the NMFS in 1991 regarding the issuance of a permit to GCID for dredging activities within the GCID oxbow. GCID rejected the draft permit's requirements for improving protection for winter-run chinook salmon at the HCPP. Increasing concerns by NMFS prompted the agency to request the Federal District Court (Eastern District) to enjoin GCID from taking the threatened winter-run chinook salmon in violation of the ESA. The legal action filed by NMFS resulted in the Federal District Court issuing a permanent injunction against GCID, restricting the amount of water GCID could pump at HCPP during the downstream migration period (August through November) for the threatened winter-run chinook salmon.

NMFS's legal action, in which CDFG joined as a party, resulted in a 1992 stipulated agreement among the parties (NMFS, CDFG and GCID) that was subsequently amended in 1993 to develop jointly a long-term solution to address both fishery resource protection and a reliable water supply (Joint Stipulation of Parties 1993). Screen approach velocity and bypass flow requirements in the 1993 Joint Stipulation of Parties limit GCID's irrigation season diversions at HCPP to about 75 percent of its combined 720,000 ac-ft base supply and 105,000 ac-ft Central Valley Project (CVP) project water.

Interim measures taken by GCID (e.g., flat-plate screens installed in 1993 and use of alternative water supplies, including groundwater pumping) have increased fish protection at the HCPP and temporarily met water supply needs. Even with these measures in place, however, key fish screen criteria (i.e., screen approach velocity of 0.33 feet per second as specified by CDFG (1993) and bypass flows of 500 cubic feet per second (cfs) as specified by the Corps permit (1996)) cannot be met under the various river flows and pumping conditions. Further, the interim water supply measures (use of alternative water supplies, including groundwater pumping) are not viable on a long-term basis. Therefore, a fish screen system is needed that meets fish protection requirements and HCPP operations for the range of river flows expected over the 50-year life of the project.

1.4 Project Objectives

To accomplish the above purposes in the most effective and environmentally sound manner possible, the lead agencies intend to accomplish several specific objectives. These objectives are summarized below (but not necessarily listed in order of importance).

- A project that provides state-of-the-art fish screen protection that is reliable, cost-effective, and minimizes all fish losses, including endangered winter-run chinook salmon, while minimizing adverse impacts to other environmental resources;

C-085366

- A project that (1) enables GCID to meet instantaneous (peak) demands (within the existing capacity of the HCPP) and (2) provides long-term reliability for GCID water deliveries through the HCPP; and

- A project that minimizes the potential risk of screen performance failure due to local changes in river gradient and alignment over the project's 50-year life.

The above objectives were considered in evaluating alternatives, designing the project, and determining the relative merits of project features.

1.5 History of HCPP Diversions and Fish Screens

Various attempts have been made historically to arrive at a successful solution to fish passage problems at the HCPP. In the following section (Section 1.5.1, History of HCPP Diversions), a brief history of GCID entitlement to water and diversions at the HCPP is presented. Section 1.5.2 (History of Fish Screens) reviews the sequence of actions that have been taken to provide fish protection at the HCPP and the problems associated with those efforts. This historical information provides the background necessary to understand the project development process and selection of alternatives considered and evaluated. It is summarized in Figure 1.5-5 (at the end of Section 1.5.2).

1.5.1 History of HCPP Diversions

GCID claims a water right, under pre-1914 postings, to divert water from the natural flow of the Sacramento River. The asserted right dates back to 1883, when William Green posted notices for the appropriation and diversion of irrigation water on the west bank of the Sacramento River near the upstream end of the oxbow where the HCPP is located (Figure 1.1-2). GCID also has adjudicated pre-1914 water rights under the Angle Decree handed down in 1930 by the Federal District Court for the Northern District of California in the case *The United States of America v. H.C. Angle, et al.* to divert water from the natural flow of Stony Creek, a tributary of the Sacramento River. Information on the history of irrigation district development in the area is presented in Chapter 3, Affected Environment (Section 3.9, Cultural Resources).

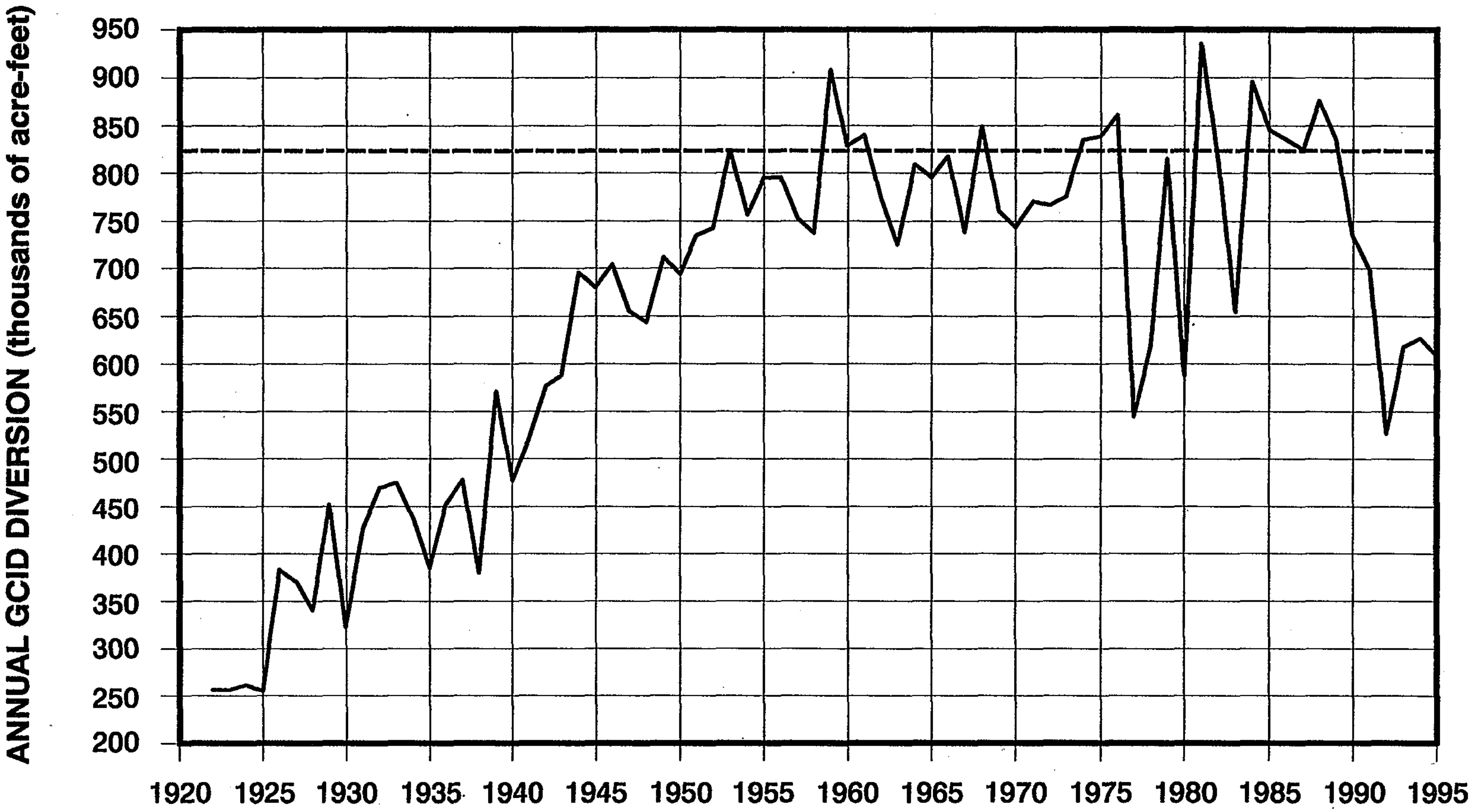
Water is delivered to GCID's service area through a conveyance system (Figure 1.1-1) that includes the HCPP, the 65-mile-long Glenn-Colusa Canal, interties with the Tehama-Colusa Canal, and over 430 miles of laterals from the main canal. Since the 1950s, this system has at times delivered in excess of 800,000 acre-feet (ac-ft) of surface water per year and, during peak demand years, over 900,000 ac-ft (**Figure 1.5-1**).

The GCID surface water supply entitlement is currently addressed in a contract entered into with Reclamation in 1964, Contract No. 14-06-200-855A (Contract 855A). This contract provides for an agreement between GCID and the United States on GCID's diversion of water from both the Sacramento River and Stony Creek. Contract 855A was part of a negotiated settlement with the Secretary of Interior (Secretary) following construction of Shasta Dam. Both GCID's entitlement

C-085367

C-085368

FIGURE 1.5-1. ANNUAL GCID SACRAMENTO RIVER AND STONY CREEK DIVERSIONS, 1922 - 1995



------- Water diverted above 825,000 acre-feet represents additional purchased water diverted at Hamilton City Pumping Plant.

Source: DWR Database, unpublished

C-085368

to Sacramento River water and its entitlement to water from Stony Creek under the Angle Decree, are recognized in the water quantities Reclamation and GCID agreed that Reclamation would make available to GCID each year from the Sacramento River under Contract 855A. Pursuant to provisions of the contract, Reclamation can require GCID to divert from the Sacramento River water quantities equal to and in lieu of its entitlement under the Angle Decree. Such water, along with Sacramento River water, is made available to GCID under Contract 855A for diversion at its HCPP.

Contract 855A provides for a maximum total of 825,000 ac-ft per year, of which 720,000 ac-ft is considered to be base supply and 105,000 ac-ft is ~~Central Valley Project (~~CVP~~)~~ water. The contract also provides that additional project water can be purchased if surplus water is available. So long as it receives project water under this contract, GCID must comply with Federal Reclamation laws and pay the United States only for the CVP water. The contract covers the total quantity of water that may be diverted by GCID for the term of the contract from its source of supply each month during the period April through October each year. Water from both Stony Creek and water diverted from the Sacramento River at the HCPP is counted as water diverted under Contract 855A. For purposes of the contract, it was determined that GCID's Angle Decree rights yielded, on the average, about 15,000 to 18,000 ac-ft per year. This yield was added to GCID's Sacramento River entitlement and the two total the 720,000 ac-ft of base supply. The contract also has a provision for the purchase of additional CVP water, when it is available as determined by the Contracting Officer (i.e., Reclamation). GCID has on occasion, in the past, purchased additional CVP water above the 105,000 ac-ft amount provided for in the contract. Nothing in Contract 855A prevents GCID from diverting water for beneficial use during the months of November through March, to the extent authorized under California law. Contract 855A expires in 2004 and will be subject to renewal and renegotiation between GCID and the United States.

Figure 1.5-1 illustrates historic annual diversions to the GCID service area (including deliveries to the National Wildlife Refuges) for the period 1922 through 1995. The annual volumes include diversions from Stony Creek, the Sacramento River via the HCPP, and the Sacramento River via the Red Bluff Diversion Dam through the Tehama-Colusa Canal interties. Stony Creek water represents a negligible amount (less than five percent) of the average annual diversions.

Figure 1.5-1 shows a gradual increase in diversions from 1922 until the late 1950s when GCID's demand for water began to peak. Figure 1.5-1 also shows several years when diversions exceeded 825,000 ac-ft. The annual variability in diversion is due to a number of factors, including precipitation, water supply availability, and agricultural market conditions. The difficulty in predicting the magnitude and occurrence of these factors with any precision is reflected in the range of diversions over the years. The 10-year average annual diversion for 1981-1990 was 825,000 ac-ft. The average for 1990-1995 was 615,000 ac-ft. The decline in diversions in the 1990s coincides with the imposed pumping restrictions at the HCPP to protect fishery resources (refer to Section 1.5.2, History of Fish Screens, for additional discussion).

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C-085369

GCID's monthly diversions prior to the HCPP pumping restrictions generally followed the pattern shown on **Figure 1.5-2**. Typically, Sacramento River water was diverted from the beginning of April through mid-November; however, diversions at the HCPP have occurred in all months (GCID 1995a, 1996a). **Table 1.5-1** summarizes the historic variation in the diversion rate during the peak irrigation season. Diversions would peak in mid-April to mid-May to irrigate early plantings and flood rice fields, and then peak again in June through August to meet summertime irrigation demands. Diversions would decline in late-August to early-September, but continue for rice decomposition and refuges. As shown in Table 1.5-1, peak diversions in May have reached 3,000 cfs and have exceeded 2,750 cfs 40 percent of the time. Pumping rates of 3,000 cfs have also occurred in late-June through early-August.

Table 1.5-1 - Percent of Time GCID Pumping Met or Exceeded Specified Rates (1970-1987)[a]

	HCPP Pumping Rate (cfs)					
Period	**3,000**	**2,750**	**2,600**	**2,250**	**2,000**	**1,500**
March						
1-15	0	0	0	0	0	0
16-31	0	0	0	0	0	0
April						
1-15	0	0	0	0	0	0
16-30	0	10	14	32	48	69
May						
1-15	1	40	53	67	81	86
16-31	1	15	25	51	62	87
June						
1-15	0	10	25	52	75	93
16-31	1	23	37	68	87	94
July						
1-15	1	20	43	67	85	100
16-31	1	15	40	68	84	100
August						
1-15	1	13	35	68	75	100
16-31	0	5	20	65	76	94
September						
1-15	0	0	0	7	34	80
15-30	0	0	0	0	0	7
October						
1-15	0	0	0	0	0	0
16-31	0	0	0	0	0	0

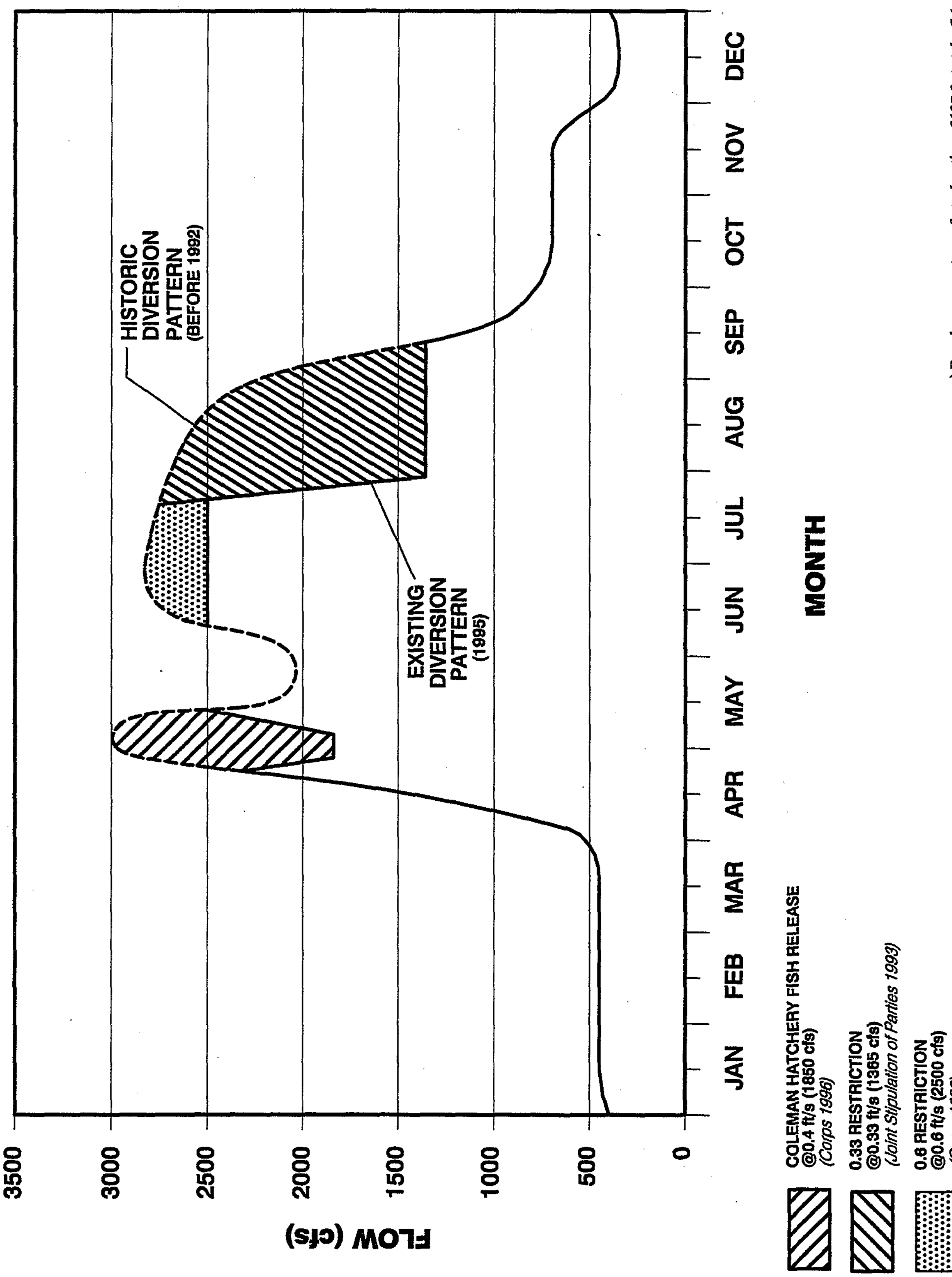
[a] GCID also pumped water from HCPP for the period October 1 through April 15; however, the pumping rate has been less than 1,500 cfs.

Source: CH2M Hill 1996.

C-085370

C-085370

FIGURE 1.5-2. HAMILTON CITY PUMPING PLANT HISTORIC AND EXISTING DIVERSION PATTERNS[a]



a) Based upon a water surface elevation of 137 feet at the fish screen. The minimum water surface elevation required by the pumping plant in the forebay is 135.1 feet, corresponding to a pumping rate of 1,100 cfs.

Source: GCID (1995a and 1996a) and CH2M Hill (1989)

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Until the early 1990s, GCID obtained nearly all of its water supplies through the HCPP. At that time, GCID was sued and prevented from diverting water unless it met bypass flow and screen approach velocity requirements. In addition to restrictions imposed by the Joint Stipulation of Parties (1992 and 1993) between NMFS, CDFG and GCID, the Corps had previously required lower approach velocities for the then-existing rotary drum fish screens and increased bypass flows through the lower oxbow channel downstream of the fish screens. The Corps' requirements were a condition of approving GCID's dredge permits for the intake channel of the oxbow upstream of the fish screens.

Installation of flat-plate screens in 1993 improved conditions for fish, but would not allow GCID to meet all fish screen criteria under a full range of operating and river flow conditions. Therefore, as described in Section 1.5.2 (History of Fish Screens), the requirement to meet flow and velocity requirements continued (Figure 1.5-2) according to the criteria specified in the Joint Stipulation of Parties (1993) and GCID's dredge permits (Corps 1992). The Corps' current dredge permit to GCID (Corps 1996) contains the same conditions as the 1992 permit. **Figures 1.5-3 and 1.5-4** are examples of the river flow and HCPP diversion conditions under existing approach velocity restrictions and required bypass flows for early and late irrigation season periods, respectively.

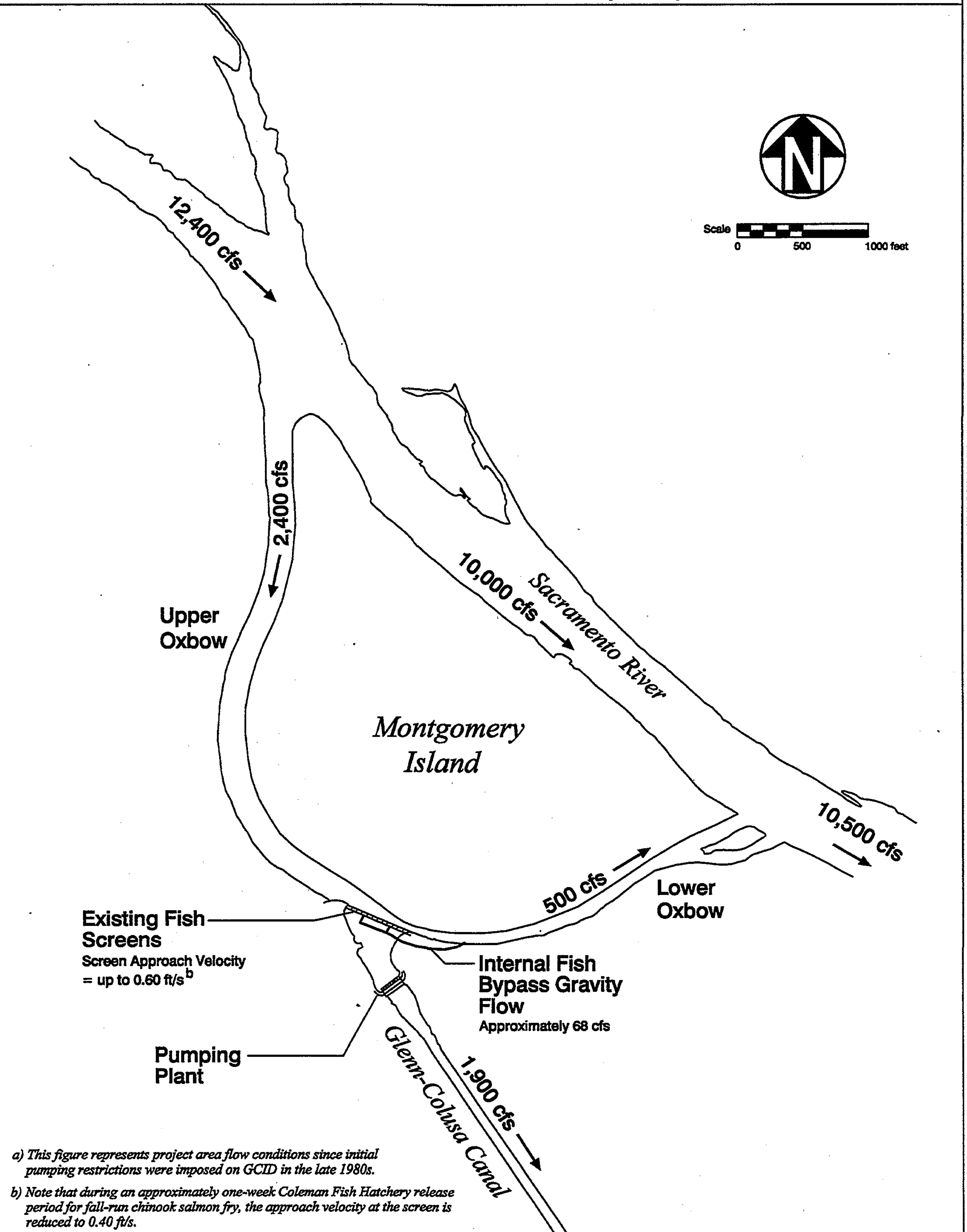
The increased (from the 1988 permit) restrictions on approach velocity imposed through the Joint Stipulation of Parties (1992 and 1993) resulted in GCID's inability to meet its peak water supply demands through diversions at the HCPP. These requirements immediately created water supply shortages within the GCID service area.

GCID responded to the HCPP restrictions by instituting a severe water conservation program that included both incentive and penalty provisions, a groundwater pumping program and arranging for deliveries of some of its Sacramento River water rights through the Tehama-Colusa Canal, as conveyance capacity was available. In addition, GCID increased its agricultural runoff reuse and worked with growers to stagger crop plantings to reduce peak irrigation demands. Other actions were taken by growers who were directly or indirectly dependent upon water supplies provided through the HCPP. These actions included the following:

- increasing irrigation run-off reuse and Colusa Basin Drain recapture;
- increasing down-river diversions by Maxwell, Princeton-Codora-Glenn, and Provident irrigation districts to make up for the loss of return flows from GCID's service area; and
- increasing groundwater pumping.

The actions taken by GCID and other water users in the Colusa Basin have generally succeeded, as interim measures only, in assisting GCID in meeting its water delivery obligations. A description of these interim programs and the existing mix of water supply sources are described in Chapter 3, Affected Environment (Section 3.1, Hydrology and Water Resources). However, the interim measures have been costly and have adversely affected the quality of water supplied

FIGURE 1.5-3. EXAMPLE OF EXISTING PROJECT AREA FLOW CONDITIONS DURING EARLY IRRIGATION SEASON (APRIL) HCPP DIVERSIONS[a]



a) This figure represents project area flow conditions since initial pumping restrictions were imposed on GCID in the late 1980s.

b) Note that during an approximately one-week Coleman Fish Hatchery release period for fall-run chinook salmon fry, the approach velocity at the screen is reduced to 0.40 ft/s.

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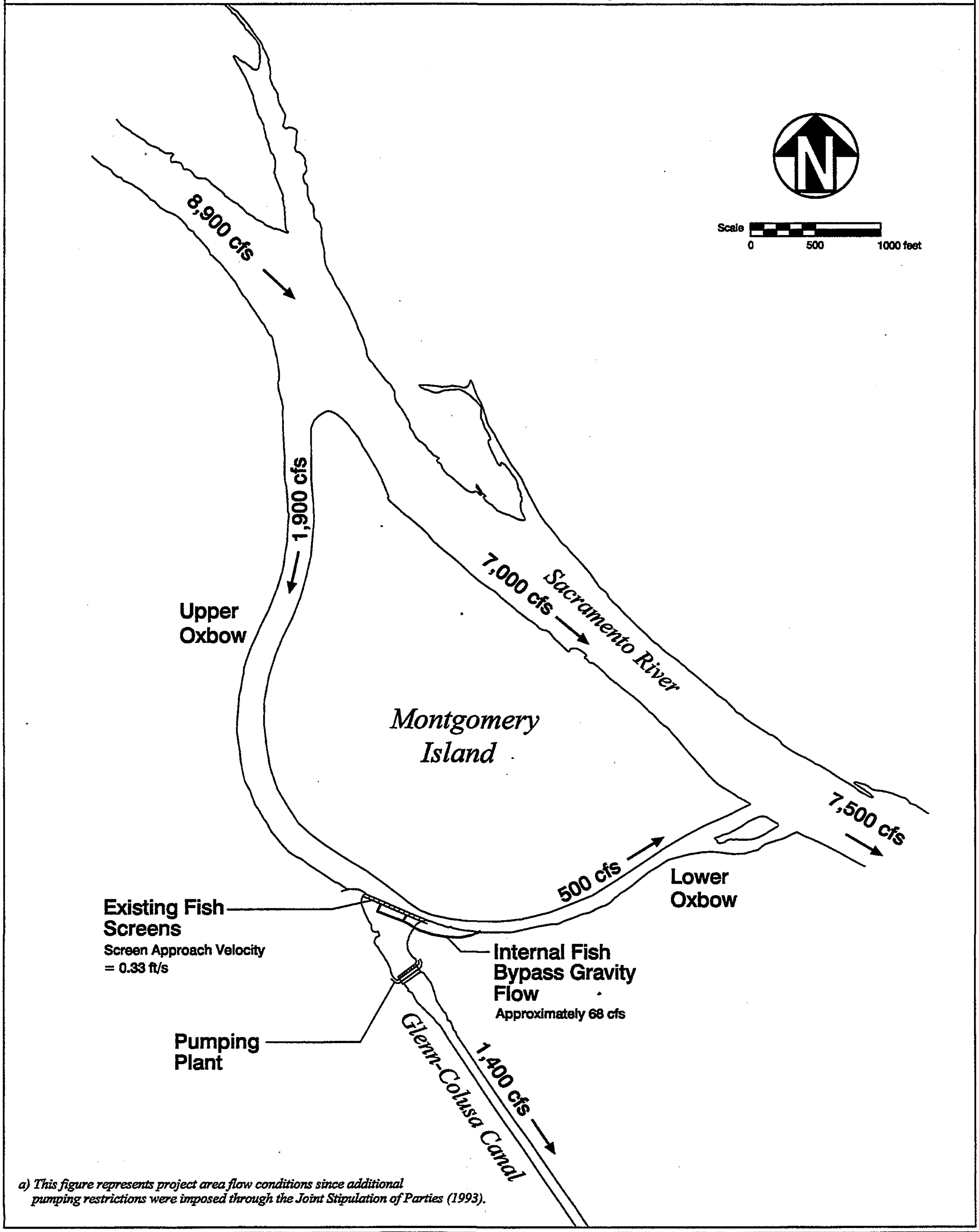
FIGURE 1.5-4. EXAMPLE OF EXISTING PROJECT AREA FLOW CONDITIONS DURING LATE IRRIGATION SEASON (AUGUST) HCPP DIVERSIONS[a]



a) This figure represents project area flow conditions since additional pumping restrictions were imposed through the Joint Stipulation of Parties (1993).

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C-085374

to the lower GCID service area and lower Colusa Basin area. The long-term viability of the interim measures is questionable in light of the following specific adverse consequences:

- salinity levels have increased in water supplied to the lower GCID service area and lower Colusa Basin;

- increased groundwater pumping and Colusa Basin Drain recapture pumping have been required in both the GCID service area and the lower Colusa Basin;

- yields of salt-sensitive crops such as rice have decreased in areas of increased salinity levels; and

- GCID water delivery rates (i.e., costs charged to water users) have nearly doubled over pre-1992 rates, largely as a result of direct and indirect increases in costs. Indirect costs include programs such as well pumping and planning, design, and construction for the project described in this document. In addition, GCID has deferred funding its long-term facilities maintenance program to reduce rate impacts on the growers.

Given these considerations, and the fact that the existing fish screen does not meet fish protection criteria, the interim operations at HCPP are not viable in the future.

1.5.2 History of Fish Screens

Since the 1920s, numerous efforts have been made to screen the HCPP diversion. (An overview of the major historical events related to the fish screens at the HCPP is presented in **Figure 1.5-5** at the end of this section.) These efforts have been largely unsuccessful. The first screen was installed in 1920 but was subsequently washed away by high water flows. A replacement screen was required to be installed by a State Court of Appeals in 1932. While the replacement screen met the requirements of the time, it was inadequate to prevent entrainment and impingement of salmon fry. Like its predecessor, the screen was rendered ineffective by flood events in 1935. It remained in place, however, until CDFG decided to construct new rotary drum screens in the late 1960s.

Acknowledging that the existing screen "failed to function in an efficient manner," CDFG and GCID entered into an agreement in 1968 that established the process for planning, designing, constructing, and operating the proposed rotary drum screens. Under the 1968 agreement, CDFG was to design and construct the screens and related facilities on rights-of-way granted by GCID. The screens were to operate during GCID's irrigation season; however, it was also agreed that its season of operation could be shortened in any year to coincide with the period of actual migration of salmon and steelhead, as determined by CDFG.

The rotary drum screens were intended to prevent downstream migrating fish, primarily chinook salmon fry, from entering the HCPP forebay. By design, fish approaching the pumping plant would encounter the fish screens and be effectively diverted back to the Sacramento River without harm. However, the performance of the new rotary drum screens was compromised even

C-085375

C-085375

before completion due to a major drop in river water surface elevation. In January 1970, widespread flooding caused significant changes in Sacramento River channel alignment and water levels (HDR 1994). A large meander just downstream of the pumping plant was cut off during the flood, shortening the river in the immediate vicinity by nearly a mile and a half. Despite these major changes in river morphology, construction of the rotary drum screens was completed as designed in 1972. The design performance of the screens was never realized as a result of hydraulic changes (i.e., reduced water-surface elevation at the pumping plant). In addition, design flaws, particularly in the bypass system, were later discovered through subsequent operations. By 1984, the river changes initiated by flooding in 1970 had dropped the water surface elevation by about three feet in front of the screens.

Conflict between GCID and the resource agencies began in the mid-1980s over how to address fish losses while still providing water to meet GCID's delivery obligations. In 1986, GCID applied for a renewal of its Corps maintenance dredging permit. Conditions were added to the permit that required development and implementation of a long-term solution to the fish screen problems. GCID entered into a Memorandum of Understanding (MOU) with CDFG outlining a study plan for developing a long-term solution. The MOU established a Technical Advisory Committee made up of representatives of GCID, CDFG, NMFS, the Corps, Reclamation, the U.S. Fish and Wildlife Service (USFWS), two members of the agricultural community, one member representing the commercial fishery industry, and one representative of the sport fishery, to evaluate progress being made on the new state-of-the-art fish screen.

With indications of progress and commitment to a long-term solution, the Corps issued new dredge permits in 1988. In addition to requiring certain operational changes, the permits established a timeframe for completing the feasibility studies and developing a long-term solution.

The joint investigations by GCID and CDFG confirmed performance problems with the operation of the rotary drum fish screens. These studies attributed fish mortality at the screen to a number of factors: high approach velocities, inadequate bypass flows, screen and internal bypass design deficiencies, and predation.

Differences in technical opinions and a dispute over the financial responsibility to replace the screens, however, prevented the agencies from reaching consensus on a long-term solution. The debate escalated when winter-run chinook salmon were designated as endangered under the CESA in 1989 and then designated as threatened under the ESA in 1990. These designations resulted in a heightened concern and stricter requirements for fish screen and fish bypass performance.

Pursuant to Section 7 of the ESA, the Corps completed a formal consultation with the NMFS in 1991 on the proposed issuance of a permit to conduct dredging activities within the GCID oxbow channel. The resulting biological opinion issued by NMFS on May 28, 1991 required GCID to proceed with development and implementation of a new state-of-the-art fish screen facility such as the preferred alternative identified in a 1989 feasibility study (CH2M Hill 1989) to protect the threatened winter-run chinook salmon. GCID would not accept the requirements in the biological opinion and rejected the Corps' permit. In mid-August, GCID had yet to agree to protection measures recommended by NMFS and NMFS sought a Federal District Court order under the ESA to enjoin GCID from taking winter-run chinook salmon during the peak downstream migration period. In January 1992, the Federal District Court held that GCID was in violation of the ESA and permanently enjoined GCID from pumping water from the Sacramento River at the HCPP during the threatened winter-run chinook salmon's annual peak downstream migration period (August 1 through November 30).

To avoid a complete shut-down in pumping during the period between August 1 and November 30 as a result of the permanent injunction issued in January 1992, GCID began to negotiate a stipulation with NMFS and CDFG that would establish terms and conditions allowing continued, but reduced, diversions by GCID during the peak winter-run chinook salmon migration period. A Joint Stipulation of Parties was approved by the Federal District Court in 1992. The Joint Stipulation of Parties restricted pumping to approximately 1,100 cfs during a time when GCID pumped over 2,000 cfs (Table 1.5-1). It also required GCID to construct an earthen berm in front of the screens (on the opposite bank) to improve water (sweeping) velocities past the screens and to dredge the lower oxbow channel to ensure sufficient bypass flows. The Joint Stipulation of Parties (1992) also gave GCID until June 1994 to complete all necessary studies and preconstruction preparation for replacing the rotary drum screens.

To fulfill the terms of the 1992 Joint Stipulation of Parties and to make additional improvements to the existing facility, GCID was required to apply for new dredge permits. As conditions of the dredge permits, additional restrictions were placed on GCID's pumping during the non-winter-run period for the protection of other races of chinook salmon. These restrictions included a maximum screen approach velocity during the entire irrigation season and establishing certain bypass flows in the lower oxbow channel.

The need for improved fishery protection at the HCPP also was gaining the attention of State and Federal legislators during this period. California State Senate Bill (SB) 1086, which was passed in 1986, resulted in the preparation of the "Upper Sacramento River Fisheries and Riparian Habitat Management Plan" (Resources Agency 1989). This plan provided for the construction of a new fish screen, gradient facility, and other measures to minimize fish losses at the HCPP. Elements of this plan, including HCPP fish screen improvements, later became part of the Reclamation Projects Authorization and Adjustment Act (Public Law (P.L.) 102-575) of 1992. Title XXXIV (Central Valley Project Improvement Act (CVPIA) of P.L. 102-575) authorizes amendments to the Department of Interior's Central Valley Project to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic uses. Congress specifically identified the long-term solution at the HCPP as an important measure that would contribute to the restoration of anadromous fish. To assist in the ongoing effort, Congress authorized Reclamation (through the Secretary of the Interior) to "participate with the State of California and other Federal agencies in the implementation of the ongoing program to mitigate fully for the fishery impacts associated with operations of the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant. Such participation shall include replacement of the defective fish screens and fish recovery facilities associated with the Hamilton City Pumping Plant."

C-085377

C-085377

When the 1992 Joint Stipulation of Parties expired in February 1993, GCID, NMFS, and CDFG amended the agreement to address not only the conditions for continuing HCPP operations until a new screen could be built, but also the timely completion of a long-term conservation measure for winter-run chinook salmon. Specifically, the 1993 Joint Stipulation of Parties includes:

- bypass flows and approach velocity requirements for the screen structure;
- a timeframe under which GCID is to have participated in an ESA Section 7 consultation or obtained an ESA Section 10 permit on the long-term solution;
- a requirement that GCID fully fund any of the necessary environmental analysis, selection, design and construction activities associated with the implementation of a long-term solution;
- strict reporting requirements on GCID's operations, including sampling for entrained fish;
- a requirement to conscientiously maintain the existing screens to reduce losses of winter-run chinook salmon; and
- a statement that the Federal Court's order enjoining all diversions at the HCPP would become effective if the Joint Stipulation of Parties (1993) is violated.

The Joint Stipulation of Parties was amended again in 1994 to address the new flat-plate screen installed in 1993 and the method for calculating compliance with the required screen approach velocity. These amendments improved operational flexibility for GCID during the August 1 through November 30 period.

Since then, the involved agencies have conducted additional extensive evaluations of new fish screen design alternatives that have ultimately led to the proposed action described in Chapter 2 (Project Description and Development of Alternatives) of this document. A discussion of the multi-agency groups and current representatives involved in the planning and design efforts is presented below in Section 1.7, Public and Agency Consultation and Coordination.

C-085378

FIGURE 1.5-5. HAMILTON CITY PUMPING PLANT FISH SCREEN HISTORY

Significant Events		Agency Decisions and Actions
The first irrigation water rights and diversion notices are posted by William Green on an oak tree on the west bank of the Sacramento River near the upstream end of the oxbow.	**1883**	
The Wright Act is passed, allowing irrigation districts to be formed.	**1887**	
The Central Canal and Irrigation Company is formed to complete a portion of the main canal.	**1903**	
Water was first diverted at the present site of the HCPP.	**1906**	
An intake structure and pumping plant are completed near Hamilton City.	**1910**	
Farmers organize the Glenn-Colusa Irrigation District to supply water from Hamilton City to Willows.	**1918**	
The first fish screens are placed at the site to prevent fish from entering the irrigation canal.	**1920s**	
GCID installs a new fish screen, but subsequent floods undermine the structure, rendering it ineffective.	**1935**	State Court of Appeals mandates new fish screen.
	1968	GCID and CDFG negotiate agreement to build new drum-type fish screen.
Sacramento River flooding causes degradation (lowering) of upstream water surface elevation due to river bend cut-off between approximately RM 203 and RM 205.	**1970**	
Drum-type fish screens are completed.	**1972**	CDFG and GCID agree to share the maintenance and operation costs of the screens.
	1974-1975	CDFG conducts an evaluation of the drum-type fish screens and finds that the fish bypasses are not functioning efficiently due to changes in river water levels and water surface gradient.
The water surface at the screens had lowered by over 3 feet, resulting in a difference in water surface elevation of only 1.3 feet between the north and south end of Montgomery Island.	**1984**	CDFG and GCID agree to jointly fund a study to find a long-term solution for water supply reliability and fish protection.
	1987	CDFG and GCID enter into a Memorandum of Understanding that outlines a study plan. The Corps issues a new dredge permit requiring operational changes for fish protection and implementation of long-term solution.
With continued lowering of river water surface and a corresponding increase in approach velocity at screens, GCID reduces pumping rates to protect fish in accordance with Corps permit.	**1988**	A Technical Advisory Committee is established by agencies to work with CDFG and GCID to develop a long-term solution.

C-085379

FIGURE 1.5-5. HAMILTON CITY PUMPING PLANT FISH SCREEN HISTORY (CONTINUED)		
Significant Events		**Agency Decisions and Actions**
	1989	CDFG lists winter-run chinook salmon as "endangered" under CESA. An agreement is signed between CDFG, USFWS, and NMFS for designing river gradient control structure and fish protection facilities. Corps directed by Congress to proceed with engineering and design of river gradient control structure near RM 206. GCID and CDFG prepare Fish Screen Replacement and Gradient Facility Feasibility Study (CH2M Hill 1989).
	1990	NMFS lists the winter-run chinook salmon as "threatened" under the ESA.
	1991	GCID rejects Corps dredge permit because of permit conditions. NMFS seeks court action pursuant to the ESA to minimize taking of winter-run chinook salmon.
	1992	January – NMFS obtains an injunction in Federal District Court that prevents GCID from pumping from August 1 through November 30 every year. March and April – Joint Stipulation of Parties and Amendment between NMFS and GCID allows limited pumping, subject to GCID's improvement of the upper and lower oxbow. October 30 – Miller-Bradley Bill signed – CVPIA authorizes the Secretary of Interior to participate with the State to replace/improve fish screens. Public Scoping Session held.
	1993	Notice of Preparation and Notice of Intent published announcing preparation of EIR/EIS. Reclamation and GCID agree that Reclamation will be a lead Federal agency and initiate design of the facilities and environmental studies. Public Scoping Session held.
GCID installs flat-plate screens and later removes the rotary drum screens to improve fish protection and allow higher diversion rates while a long-term solution is developed.	**1993**	Amended Joint Stipulation of Parties modifies interim provisions for pumping plant operations until new fish screens are installed.

FIGURE 1.5-5. HAMILTON CITY PUMPING PLANT FISH SCREEN HISTORY (CONTINUED)

Significant Events		Agency Decisions and Actions
Complete Fish Screen Modification Feasibility Report (HDR 1994). Initiated engineering concept studies and models to address fish protection and water supply issues.	**1994**	NMFS re-classifies winter-run chinook salmon as "endangered."
	1995	CDFG, GCID, and Reclamation agree to serve as joint lead agencies for preparing an EIR/EIS for fish screen improvements. Eight cooperating agencies agree to establish an executive-level Agency Management Group and a Technical Advisory Group to advise the designers.
	1996	Reclamation, Corps, GCID, and CDFG initiate Draft EIR/EIS. Eight cooperating agencies unanimously identify the preferred alternative.
	1997	Draft EIR/EIS released for public review and comment.

C-085381

C-085381

1.6 Authorizing Actions and Roles of Agencies

The proposed fish screen improvement project has included the active participation of many public agencies. The roles of these agencies have evolved through the planning process due to several reasons, including changes in the law and past litigation.

This section summarizes current authorizations and roles of agencies involved in the project. While it would be informative to review in detail the full history of mandates concerning the proposed action, such a review is not necessary to understand the environmental consequences of the proposed project. These mandates were summarized in previous sections of this chapter. Many of the agencies participating in the project also have specific permitting responsibilities for the fish screen improvements. These responsibilities are presented later in this chapter in Section 1.7.5, Applicable Environmental Laws and Regulations.

CEQA and NEPA Lead Agencies

GCID is obligated under the Joint Stipulation of Parties (1993) to develop a long-term solution to the fish screen problem at the HCPP. As a CEQA lead agency, GCID has primary responsibility for satisfying CEQA requirements associated with the proposed long-term solution, including developing the EIR portion of this document. GCID is also responsible for the design of and improvements to the existing fish screen, including the proposed oxbow flow control structure and bridge to Montgomery Island.

CDFG has statutory responsibilities under California State law for conservation of fishery resources (Fish and Game Code Division 6, Part 1, Chapter 3, 5900 et seq.), and protection of endangered species under the CESA. Combined with its history of participation in fish protection efforts at the HCPP and its permitting responsibilities under Fish and Game Code 1600 et seq. (Streambed Alteration Agreement), CDFG is a co-lead agency under CEQA for this project.

Because of the potential for significant fishery protection enhancements, the Congress specifically identified the long-term solution at HCPP in the CVPIA as an important measure that would contribute to the restoration of anadromous fish (P.L. 102-575, Title XXXIV, 3406(b)(20)). To assist in the ongoing effort, the Congress authorized Reclamation (through the Secretary of the Interior) to "participate with the State of California and other Federal agencies in the implementation of the ongoing program to mitigate fully for the fishery impacts associated with operations of the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant. Such participation shall include replacement of the defective fish screens and fish recovery facilities associated with the Hamilton City Pumping Plant." To implement the CVPIA, DWR, CDFG, USFWS and Reclamation signed a Sharing of Costs Agreement for Mitigation Projects and Improvements (SCAMPI). This agreement provides for cost-sharing between the Federal and State parties to the agreement for those projects specified in the CVPIA, including the proposed fish screen project at HCPP. As a result of the Federal legislation and coordination with other Federal agencies, Reclamation has lead Federal agency responsibility under NEPA for the proposed project.

C-085382

C-085382

The CVPIA provides that Reclamation will pay 75 percent of project development costs, with 25 percent non-Federal funding. Reclamation is also responsible for design and construction of the fish screen extension portion of the project.

The Corps is authorized to design and construct the gradient facility in accordance with the Energy and Water Appropriations Act of 1990 (P.L. 101-101, 103 Stat. 641 (1989)) pursuant to the authority granted under the Water Resources Development Act of 1986 (WRDA). The Corps also is responsible for permitting the project under the Clean Water Act and River and Harbor Act. Because of the Corps' requirements for permitting and construction of the gradient facility, the Corps has co-lead Federal agency responsibility under NEPA for the proposed project.

Other Participating Agencies

Participating agencies are those agencies that are directly involved in the planning of the project. The following is a list of those agencies:

- National Marine Fisheries Service
- U.S. Fish and Wildlife Service
- California State Reclamation Board
- California Department of Water Resources

The NMFS and USFWS are cooperating agencies under NEPA and are actively participating in project planning. NMFS participation is largely directed by the ESA. NMFS is generally responsible for management of anadromous fisheries and has specified flow and temperature requirements in the upper Sacramento River through its Biological Opinion for the operation of the CVP and the California State Water Project (NMFS 1993). Specific to this project are NMFS's responsibilities for protection of the endangered winter-run chinook salmon and the proposed-endangered steelhead. The Joint Stipulation of Parties (1993) further defines NMFS participation in the process for developing a long-term solution at HCPP. USFWS participation is authorized through its responsibilities under the ESA, and the Fish and Wildlife Coordination Act. USFWS is generally responsible for management of resident fish and wildlife. USFWS participation is also authorized under the CVPIA.

From 1988 through 1995, the California Department of Water Resources (DWR) (through The California State Reclamation Board) served as the CEQA lead agency for planning and design of the gradient facility portion of the project. This lead agency role was assumed by GCID and CDFG jointly beginning in 1995. The DWR is a party to the SCAMPI agreement. The review and permitting roles of these agencies are further discussed in Section 1.7.5 (Applicable Environmental Laws and Regulations).

1.7 Public and Agency Consultation and Coordination

Throughout the planning process, efforts have been made by the agencies to solicit active involvement of the full range of interested parties. This section summarizes formal public and agency involvement, as well as informal information and coordination activities. It begins with a

C-085383

C-085383

review of scoping and informational meetings and is followed by a review of agency/expert consultations, work groups and project coordination meetings. Relevant Federal, State, regional, and local environmental laws, permits, and regulations that could be applicable to the project are then identified.

1.7.1 Public Involvement Activities

Public involvement activities were conducted with an emphasis on using early and open communications to determine the scope of issues to be addressed, and to identify the significant issues related to the project. Appendix D (Scoping Report) documents the initial scoping process for this project and includes a review of scoping activities, background information on the project, and the two public scoping meetings held on October 8, 1992 and October 27, 1993. The Federal Register Notice of Intent (NOI) for the project was published October 8, 1993. Written comments on the NOI were due November 12, 1993; oral comments were received at the public meeting on October 27, 1993. The State Clearinghouse Notice of Preparation (NOP) was submitted to the Office of Planning and Research on June 8, 1993. The comment review period for the NOP was June 14, 1993 through July 14, 1993.

Appendix D presents the noticing and advertising prepared for the meetings, information presented at the meetings, agendas used, and comments received. Other relevant documentation, including lists of attendees at the two meetings, is included as attachments to the scoping report. As described later under Section 1.7.2 (Public Information Meetings and Public Hearings), public meetings were again held on the project in 1996 to seek additional input on project issues.

At the 1992 and 1993 scoping meetings, several comments and issues were presented by the public and agencies. A summary list of the comments and issues is presented below:

- Include/account for landowners and 30 acres of land on the west side of the Sacramento River.
- Consider important habitat.
- Will this be a joint EIR/EIS?
- Examine economic impacts thoroughly.
- Consider sonic, light, and deflector wall technologies.
- What level of scrutiny is being given to other facilities pumping water from the Sacramento River?
- Will impacts to migratory birds be addressed?
- Will recreational impacts be addressed?
- Will impacts to elderberry bushes and habitat for valley elderberry longhorn beetle be addressed?

C-085384

- Air quality, noise, and transportation impacts should be minimal.
- State Lands Commission lease or permit may be required.
- Will additional information on the magnitude of the gradient restoration facility be analyzed?
- Will turbidity and sediment deposition impacts be addressed?
- Will fish migration impacts be analyzed?
- Will endangered species, critical habitat, fish bypass and related impacts be analyzed?

These items have been considered and addressed in this EIR/EIS as indicated in Chapter 2, Project Description and Development of Alternatives (Section 2.6, Issues Identified and Considered in EIR/EIS Process).

Since the initial scoping meetings, informal small-group public meetings have also been held to help inform potentially interested parties. Invitations to meetings have gone to the following:

- Participants in the scoping meetings;
- Fishery associations such as the American Fisheries Society, Cal Trout, and Trout Unlimited;
- The Central Valley Project Improvement Act Restoration Fund Roundtable;
- Farm industry representatives and landowners;
- Congressional representatives' staff;
- California Fish and Game Commission; and
- Sacramento River Landowners Association.

Participants in the small-group meetings were provided information, which included a description of the purpose and need for the project, a brief history of fish protection, various efforts to solve the problem, possible alternatives, and a synopsis of outstanding issues. The meeting dates, participants, and locations of the small-group public meetings are identified below in **Table 1.7-1.**

C-085385

C-085385

Table 1.7-1 - Small Group Public Meetings		
Date	**Location**	**Participants**
December 8, 1995	Willows, California	Golden Gate Fisherman's Association Guides & Sportsmen Sacramento River Preservation Trust
December 20, 1995	Sacramento, California	Northern California Water Association California Rice Industry Provident Irrigation District Princeton-Codora-Glenn Irrigation District Sutter Mutual Water Company Banta-Carbona Browns Valley Irrigation District M&T Ranch Western Canal Water District
January 12, 1996	Hamilton City Pumping Plant, California	California Sportfishing Protection Alliance

In addition to the above meetings, a briefing was given to the Fish and Game Commission on March 7, 1996.

1.7.2 Public Information Meetings and Public Hearings

Since the 1992 and 1993 scoping meetings, ~~two~~ four additional public meetings were hosted ~~in 1996~~ by the lead agencies: two informational meetings in 1996: (September 23, 1996 at Granzella's Inn, Williams, California at 1:00 p.m. and 7:00 p.m.) and two public hearings/information open houses on the Draft EIR/EIS in 1997 (November 4, 1997 at Granzella's Inn, Williams, California at 1:00 p.m. and at Hamilton High School, Hamilton City, California at 7:00 p.m.). The purposes of the 1996 public meetings were to update the public on the project, the alternatives under review, and the issues to be addressed, and to find out from the public whether there were other issues that needed to be discussed in the EIR/EIS. The meetings provided a forum in which the public could ask questions and provide input on these and related subjects. Individuals and representatives attending the meetings included the following:

- Local Homeowners
- Fishermen
- North State Land Management Trust
- Ivy G. Zumwalt and Associates
- Princeton-Codora-Glenn Irrigation District
- University of California Cooperative Extension Farm Advisory
- Colusa Drain Mutual Water Company
- Senator Maurice Johannessen
- Sacramento River Preservation Trust
- Assemblyman Tom Woods
- Central Valley Project Water Association
- Colusa-Glenn Farm Credit

The 1996 meetings opened with a description of the project purpose, history, and current status. The roles and responsibilities of the lead agencies, as well as cooperating agencies, were then outlined. Project alternatives and features, operational scenarios, and potential impacts were

C-085386

C-085386

subsequently reviewed. The meetings concluded with a presentation of a timeline for the environmental review, final design, and construction (Public Meeting Summary 1996).

During the question and answer period, questions were raised about the impacts of the various alternatives. Specific issues raised by the attendees were:

- erosion impacts to the banks of the Sacramento River;
- impacts to waterfowl;
- alternative designs and their impacts to recreational uses of the river;
- socioeconomic impacts beyond land values and cost of water; and
- criteria by which alternatives were selected or eliminated from further consideration.

Closing comments at the 1996 meetings by the lead agencies included references to preparation of a Draft EIR/EIS on the project, and consideration of the above issues in the project analyses.

In 1997, two public hearings/information open houses were held on the Draft EIR/EIS. The hearings/open houses were held on November 4, 1997 in Williams (1:00 p.m. at Granzella's Inn) and in Hamilton City (7:00 p.m. at Hamilton High School). The purpose of the meetings was to both provide a forum for interested public members and agency representatives to obtain information on the proposed project, and to submit comments on the Draft EIR/EIS and permit application to the Corps of Engineers for the project. A court reporter was present throughout each of the hearings/open houses to receive oral comments. Self-addressed comment forms were distributed to attendees for submitting written comments. All written and oral comments submitted on the Draft EIR/EIS, and the lead agencies' responses to those comments, are presented in Chapter 10 (Comments/Responses to Comments on Draft EIR/EIS).

1.7.3 Agency and Expert Consultations

Table 1.7-2 is a partial listing of individuals, agency representatives, and technical experts who have been consulted since 1992 regarding information used either in conducting field studies, analyzing data, or otherwise completing this EIR/EIS. The "Personal Communications" listing in Chapter 8, Literature Cited, lists additional experts consulted. For the purposes of this document, agency consultations and coordination are discussed beginning with 1992 when the formal scoping period began for the EIR/EIS.

C-085387

C-085387

Table 1.7-2 - Partial List of Public and Agency Consultation		
Name	**Affiliation/Title**	**Topic of Consultation**
Jim Aird	Glenn-Colusa Irrigation District/Fisheries Technician	Screw trap data
Dennis Dorratcague	Montgomery Watson/Principal Engineer	Archimedes Screw and Helical Pumps
Frank Fisher	CDFG/Fisheries Biologist	Chinook salmon data; fisheries occurrence at GCID
Patrick Foley	University of California, Davis/Fisheries Biologist	Sturgeon identification at GCID
Kim Forrest	National Wildlife Refuges/Manager	Deliveries to National rather than State Wildlife Refuges
Gene Geary	Pacific Gas & Electric Company, San Ramon/Biologist	Archimedes screw pumps
Ranjit Grewal	California Environmental Protection Agency/Associate Air Resources Engineer	Air quality concerns
Dave Kolhorst	CDFG/Fisheries Biologist Bay-Delta	Sturgeon data
Gary Kramer	National Wildlife Refuges/Manager	Deliveries to National rather than State Wildlife Refuges
Kristy Layton	Glenn County Planning Department/Land Use Planner	Land use concerns
Keith Marine	Natural Resources Consulting Scientists/Fisheries Biologist	Fisheries studies at GCID
Dennis McEwan	CDFG/Fisheries Biologist Steelhead Restoration Project	Steelhead data
Deborah McKee	CDFG/Fisheries Biologist Inland Fisheries Division	Winter-run chinook salmon/project construction windows
Peter Moyle	University of California, Davis/Fisheries Biologist	Fish species occurrence at GCID
Ivar Plescov	California Department of Boating and Waterways	Sacramento River navigation requirements
Steve Rainey	NMFS Portland/Fish Passage Engineer	Fish passage issues
Kevin Tokunaga	Glenn County Air Pollution Control District/Air Pollution Specialist	Air quality issues and mitigation

Further information on early agency and expert consultations is provided in Final Feasibility Report GCID/CDFG Fish Protection and Gradient Restoration Facilities (CH2M Hill 1989) and in Fish Screen Modification Feasibility Report (HDR 1994). Since 1994, agency consultations have occurred primarily through policy, project management, technical, and EIR/EIS work group meetings. These groups are described below.

C—085388

C-085388

1.7.4 Project Coordination Groups

As noted previously, a Technical Advisory Committee was originally established in 1988 by GCID and CDFG. From July 1992 to October 1993, a steering committee met to facilitate agency and expert consensus regarding the scope of the alternatives to be considered for a possible long-term solution. In 1993 and 1994, initial efforts were made by the agencies to prepare a Draft EIR/EIS, but several technical issues remained unresolved that prevented completion of that document. Work was reinitiated on the present document in 1996.

With the assumption of major cost-sharing, design, and environmental responsibilities, Reclamation, in January 1995, requested that the participants in the planning studies reorganize into an executive-level Agency Management Group (AMG) and a Technical Advisory Group (TAG) consisting of representatives from agencies that either are cost-sharing in or have significant regulatory authority over the project. These groups were to provide input on concept designs, identification of a preferred alternative, a Draft EIR/EIS, and other issues.

During 1995 and 1996, a Project Managers Group (PMG) and an EIR/EIS Work Group (EWG) were formed and met as needed to facilitate coordination and development of the project. An overview of each group and a list of representatives is presented below.

Agency Management Group

The AMG consists of representatives who have decision-making authority from agencies that either are cost-sharing in or have significant regulatory authority over the project. "The AMG provides overall management guidance; reviews major findings, conclusions, recommendations, budget and schedule changes and progress; and makes all major decisions regarding the project through reaching mutual agreement on the proposals brought to it" according to the establishment letter. The members of the AMG are listed in **Table 1.7-3.**

Table 1.7-3 - Agency Management Group

Affiliation	Name/Title
California Department of Fish and Game	Al Petrovich, Deputy Director of Policy
California State Reclamation Board	Pete Rabbon, General Manager
Department of Water Resources	Bill Bennett, Deputy Director
Glenn-Colusa Irrigation District	Don Bransford, Chairman, Board of Directors
National Marine Fisheries Service	Jim Lecky, Chief of Protected Species Division
U.S. Army Corps of Engineers	Major Brandon Muncy, Deputy District Engineer
U.S. Bureau of Reclamation	Kirk Rodgers, Deputy Regional Director
U.S. Fish and Wildlife Service	Joel Medlin, Deputy Field Supervisor

C-085389

C-085389

Project Managers Group

The PMG consists of project managers from the various agencies represented on the AMG which are managing the day-to-day activities of the project (**Table 1.7-4**).

Table 1.7-4 - Project Managers Group

Affiliation	Name/Title
California Department of Fish and Game	Nick Villa, Senior Fishery Biologist
Department of Water Resources	Stacy Cepello, Biologist
Glenn-Colusa Irrigation District	O.L. "Van" Tenney, General Manager
Glenn-Colusa Irrigation District	Sandra Dunn, Attorney
National Marine Fisheries Service	Gary Stern, Biologist
U.S. Army Corps of Engineers	Larry Johnson, Project Manager
U.S. Bureau of Reclamation	Lauren Carly, Project Manager
U.S. Fish and Wildlife Service	Steve Hirtzel, Biologist

Technical Advisory Group

The TAG provides peer review, data analysis, input on alternatives development, and technical expert consultation to the design team. The TAG consists of biologists and engineers from the participating agencies and consulting firms (see **Table 1.7-5** for members), and meets periodically to discuss various technical aspects of fish screen alternatives.

Table 1.7-5 - Technical Advisory Group

Affiliation	Name/Title
Ayres Associates	Mark Peterson, Engineer Tom Smith, Engineer
California Department of Fish and Game	Julie Brown, Fishery Biologist George Heise, Senior Hydraulic Engineer Dan Odenweller, Senior Fishery Biologist Nick Villa, Senior Fishery Biologist Paul Ward, Associate Fishery Biologist
CH2M Hill	Ken Iceman, Engineer Howard Wilson, Engineer
Department of Water Resources	Stacy Cepello, Environmental Specialist Darrell Hayes, Hydraulic Engineer
Glenn-Colusa Irrigation District	O.L. "Van" Tenney, General Manager Ben Pennock, Chief Engineer
HDR Engineering	Mike Stansbury, Engineer
Mussetter Engineering, Inc.	Dr. Mike Harvey, Professional Geologist
National Marine Fisheries Service	Gary Stern, Biologist Marcin Whitman, Engineer Rick Wantuck, Engineer
Natural Resource Scientists, Inc.	Dave Vogel, Senior Scientist
Surface Water Resources, Inc.	Paul Bratovich, Senior Fisheries Biologist

Table 1.7-5 - Technical Advisory Group (Continued)	
Affiliation	**Name/Title**
U.S. Army Corps of Engineers	Bob Junell, Civil Engineer Bud Pahl, Project Manager Peter Valentine, Technical Manager Matt Davis, Environmental Planner
U.S. Bureau of Reclamation	Lauren Carly, Project Manager Arthur Glickman, Principal Designer Wendell Carlson, Geologist Brent Mefford, Engineer Rick Christensen, Engineer
U.S. Fish and Wildlife Service	Steve Hirtzel, Biologist

EIR/EIS Work Group

The EWG (see **Table 1.7-6** for members) was formed in early 1996 to facilitate completion of the environmental documentation (EIR/EIS) process. Made up of representatives of the CEQA and NEPA lead, responsible, and cooperating agencies and environmental consultants, the group's mission is to coordinate and address issues regarding the environmental compliance processes, and to guide development of this document.

Table 1.7-6 - EIR/EIS Work Group	
Affiliation	**Name/Title**
California Department of Fish and Game	Nick Villa, Senior Fishery Biologist Chris Beale, Staff Counsel Julie Brown, Fishery Biologist
Glenn-Colusa Irrigation District	Sandra Dunn, Attorney
Department of Water Resources	Stacy Cepello, Environmental Specialist Darrell Hayes, Hydraulic Engineer
National Marine Fisheries Service	Gary Stern, Biologist
Surface Water Resources, Inc.	Paul Bratovich, Senior Fisheries Biologist Rick Lind, Senior Project Manager
The Reclamation Board	Ricardo Pineda, Chief Engineer
U.S. Army Corps of Engineers	Bob Junell, Civil Engineer Matt Davis, Environmental Planner
U.S. Bureau of Reclamation	Lauren Carly, Project Manager Kurt Flynn, NEPA Compliance Specialist Arthur Glickman, Principal Designer
U.S. Fish and Wildlife Service	Steve Hirtzel, Biologist

C—085391

C-085391

1.7.5 Applicable Environmental Laws and Regulations

Several laws and regulations that apply to the fish screen require that permits be obtained from several agencies. A comprehensive list of the agencies participating in the project and/or providing a permit or review assistance is given in **Table 1.7-7.**

Agencies are categorized as either lead, responsible, cooperating, or reviewing agencies. The lead agencies (GCID, CDFG, Corps, and Reclamation), as described under Section 1.6 (Authorizing Actions and Roles of Agencies), have primary responsibility for project approval and compliance with CEQA and NEPA. The definitions of the remaining categories of agency terms follow below.

A responsible agency under CEQA is a public agency that proposes to carry out or approve a project (such as through a permit) for which a lead agency is preparing or has prepared an EIR or Negative Declaration. The term "responsible agency" includes all public agencies, other than the lead agency, that have discretionary approval over the project (State CEQA Guidelines § 15381).

Under NEPA, a cooperating agency can be any Federal agency that has jurisdiction by law over any aspect of the proposed action. Additionally, any Federal agency with special expertise on issues that should be addressed in the EIS may be a cooperating agency when requested (40 Code of Federal Regulations 150.5, 1508.5, 1508.16, 516 DM 2.4).

Several of the lead and participating agencies described under Section 1.6 (Authorizing Actions and Roles of Agencies) also have permitting or other approval authorities. These authorities include CDFG's jurisdiction pursuant to Section 1600 et seq. of the Fish and Game Code (Streambed Alteration Agreement); the Corps' jurisdiction under River and Harbor Act Section 10 and Clean Water Act Section 404 requirements; and, CDFG's, NMFS's, and USFWS's jurisdiction under the CESA and ESA.

~~Final permitting requirements will be determined through agency reviews of this Draft EIR/EIS and other agency procedures.~~ Permit applications are being prepared and ESA consultations are being performed concurrent to the EIR/EIS process.

In addition to lead, responsible, and cooperating agencies, other agencies have resource management, land use, or policy interests in the area that may be affected by the project. Under CEQA, these are termed "trustee" agencies. These agencies, which may not have approval or permit authority over the project, are termed reviewing agencies in this EIR/EIS and are also identified in Table 1.7-7.

C-085392

C-085392

Table 1.7-7 - Agencies Participating in the HCPP Fish Screen Improvement Project EIR/EIS

Agency	CEQA/NEPA, Permit or Other Environmental Regulations	Contact Person(s)
Lead Agencies		
Glenn-Colusa Irrigation District	CEQA Lead Agency	O.L. "Van" Tenney Sandra Dunn
California Department of Fish and Game	CEQA Lead Agency California Endangered Species Act [Fish and Game Code Section 2050 et. Seq.] [a] Streambed Alteration Agreement [Fish and Game Code Section 1600 et seq.] [a]	Nick Villa Chris Beale Dan Odenweller Julie Brown Paul Ward George Heise
U.S. Army Corps of Engineers	NEPA Lead Agency Section 10 of River and Harbor Act [33 U.S.C. 401-413] [a] Section 404 of Clean Water Act [33 U.S.C. 1251 et seq.][a]	Bob Junell Susan Ramos Peter Valentine Matt Davis
U.S. Bureau of Reclamation	NEPA Lead Agency	Lauren Carly Kurt Flynn
CEQA Responsible Agencies		
Regional Water Quality Control Board	NPDES Permit [Section 402 Clean Water Act (33 U.S.C. § 1344)] [b] General Construction Activity Storm Water Permit [b] Clean Water Act [33 U.S.C. 1251 et seq.] Section 401, Water Quality Certification [b]	Katherine Gassney Ethan Heilman
(State) The Reclamation Board	Encroachment Permit [Cal. Water Code Section 8590] if project has the possibility of impacting a Federal Flood Control Project Levee [b] Encroachment Permit for all work within the Sacramento River Designated Floodway[a] California Code of Regulations, Title 23, Waters, Division 1. The Reclamation Board, Article 5 - Designated Floodways[a].	Pete Rabbon
California State Lands Commission	Land use lease for in-river structures [Public Resources Code Section 6000 et seq.], [Government Code Section 65928] [b]	Linda Fiack Mary Griggs Dwight Sanders
NEPA Cooperating Agencies		
National Marine Fisheries Service	Federal ~~Endangered Species Act~~ ESA Section 7 requirements for marine and anadromous fish, other marine wildlife and plants [PL 93-205; 16 U.S.C. § 1536][a] Fish and Wildlife Coordination Act (PL 85-624: 16 CFR § 661-667) [a]	Gary Stern Jim Bybee Craig Wingert Rick Wantuck

Table 1.7-7 - Agencies Participating in the HCPP Fish Screen Improvement Project EIR/EIS (Continued)		
Agency	**CEQA/NEPA, Permit or Other Environmental Regulations**	**Contact Person(s)**
NEPA Cooperating Agencies (Continued)		
U.S. Fish and Wildlife Service	Federal ESA Section 7 requirements for fish, wildlife, and plants [PL 93-205; 16 U.S.C. § 1536] [a] Fish and Wildlife Coordination Act [PL 85-624; 16 CFR § 661-667] [a]	Kelly Hornaday Steve Hirtzel Mark Littlefield
Reviewing Agencies		
Advisory Council on Historic Preservation	National Historic Preservation Act issues (where consensus cannot be reached with State Office of Historic Preservation) [Section 106 of the National Historic Preservation Act (PL 89-665, 95-515)] [b]	Steve Lamphrey
Air Pollution Control District	Burn Permit [b]	Kevin Tokunaga
Butte County	Checks whether the proposed action is consistent with the County's general plan and zoning	Board of Supervisors
Colusa County	Checks whether the proposed action is consistent with the County's general plan and zoning	Charles Johnson
Department of Boating and Waterways	Comments on river-oriented features such as potential for navigation hazards, relation to existing or planned boating facilities, and the public trust doctrine	Mike Sotelo
Department of Conservation	Reviews project in relation to prime agricultural land	Tom Campbell Karen Yowell
Department of Parks and Recreation	Reviews project in relation to State recreation facilities	R. McGaugh Richard Rayburn
Department of Transportation	Encroachment permit [Streets and Highways Code Sections 660-734][b]	Jody Lonerger Joan Pontius
Department of Water Resources	Reviews project and comments in relation to Reclamation Board jurisdiction and State Water Project operations	Stacy Cepello Darrell Hayes
Glenn County	Checks whether the proposed action is consistent with the County's general plan and zoning	Christine Leighton John Benoit
Office of Historic Preservation	Reviews project for possible impacts to State and Federal registered historical resources [Section 106 of the National Historic Preservation Act][b]	Steve Lamphrey Cherilyn Widell
U.S. Bureau of Indian Affairs (Native American Heritage Commission)	When Indian Trust Assets are changed or impacted, the Bureau of Indian Affairs is normally delegated "approval" responsibility[b]	Larry Meyers Frank Fryman
U.S. Environmental Protection Agency	Reviews jurisdiction over Corps of Engineers Clean Water Act compliance (Section 404 of CWA [33 U.S.C. 1251 et seq.])[b] Reviews and provides public comments on environmental impacts of Federal actions in compliance with Section 309 of the Clean Air Act	Tom Inoye Karen Sundheim

[a] Permits or approvals that are expected to be required.
[b] Permits or approvals that could be required depending on final project design, construction method, or other consideration.

C-085394

C-085394

During the EIR/EIS preparation process, the agencies listed on Table 1.7-7 were notified of when the Draft EIR/EIS was expected to be distributed for public and agency review. These individuals and agencies are included on the list of Individuals and Organizations Receiving the ~~Draft~~ EIR/EIS (Chapter 9). Individuals and public agencies that submitted comments on the Draft EIR/EIS were transmitted copies of this Final EIR/EIS. Notices regarding the availability and completion of this Final EIR/EIS were distributed to all other individuals and organizations that received the Draft EIR/EIS and/or associated notices of availability/completion.

1.7.6 Compliance with Applicable Laws and Regulations

This section explains how this EIR/EIS complies with major Federal and State laws, rules, regulations, and executive orders that are identified in Section 1.7.5 (Applicable Environmental Laws and Regulations) and discussed in the regulatory setting sections of Chapter 3 (Affected Environment). ~~Comments are requested from regulatory agencies reviewing this Draft EIR/EIS on the applicability and scope of necessary permits. Comments received will be used to help finalize the description of permitting requirements in the Final EIR/EIS.~~

1.7.6.1 Federal Statutes and Regulations

National Environmental Policy Act

This EIR/EIS is in support of a proposed fish screen improvement project that would comply with Corps river permits issued in 1988, the Joint Stipulation of Parties (1993), and Title XXXIV (CVPIA) of Public Law 102-575. The document provides the information required by NEPA for the decision-makers to consider the environmental consequences of the proposed action and alternatives. Reclamation and the Corps are the lead Federal agencies under NEPA for this project.

Endangered Species Act of 1973, as Amended

The lead agencies requested and received, from the USFWS, a list of endangered, threatened, and proposed species. This list was updated most recently in September 1997 (Appendix C, Fish and Wildlife Coordination Act Report (CAR)). The lead agencies have been informally consulting with the USFWS and the NMFS since 1988 on this project.

A Biological Assessment was prepared and transmitted to the USFWS and NMFS on June 13, 1997 to initiate formal consultation under the ESA. The Biological Assessment was revised to reflect minor changes in project design and redistributed to USFWS and NMFS. Impact analyses show that certain species listed or proposed for listing under the ESA and CESA (e.g., winter-run chinook salmon, yellow-billed cuckoo, and valley elderberry longhorn beetle) would be adversely affected by the project. A Biological Opinion on the project has been ~~will be~~ prepared by the USFWS. A Biological Opinion will also be prepared by the ~~and~~ NMFS. ~~that will include a determination on whether the proposed action would "jeopardize" endangered or threatened species incidental to the proposed action. The Biological Opinion is expected to be issued in late October 1997.~~

C-085395

C-085395

Fish and Wildlife Coordination Act

The lead agencies have been coordinating with USFWS and NMFS on the scope and content of the CAR under preparation by USFWS. The CAR integrates the recommendations of the USFWS, NMFS, and CDFG regarding impacts to ~~listed species and species not listed under the ESA.~~ fish and wildlife resources on federally funded or permitted water resource development projects. Appendix C (Fish and Wildlife Coordination Act Report) presents the USFWS analysis of impacts and mitigation recommendations. ~~based upon the agencies' recommendations.~~ The ~~draft~~ final CAR ~~will be finalized~~ has been included as Appendix C to ~~with the~~ this Final EIR/EIS.

National Historic Preservation Act

The evaluations of cultural resources as part of this EIR/EIS comply with the National Historic Preservation Act as it applies to the proposed action and alternatives. Relevant and available documentation from existing Class I (literature and archival research) and Class III (on-ground) surveys in the Area of Potential Effect (APE) are summarized in this EIR/EIS. The lead agencies have consulted with the State Historic Preservation Office (SHPO) staff to discuss the scope of the project APE, the evaluations performed, and the mitigation appropriate for the project. For this project, the SHPO, by letter dated May 13, 1997, has concurred with the lead agencies' finding of no effect to significant cultural resources.

American Indian Religious Freedom Act of 1978, Antiquities Act of 1906, Archeological Resources Protection Act of 1979, and Archeological and Historic Preservation Act of 1974

The proposed project would comply with the provisions of these acts. Known prehistoric and historic sties in the project area would be avoided. Subsurface testing in the vicinity of the proposed fish screen extension indicates no evidence of potential new sites. The project would not affect Native American religious practices. Measures are proposed during construction that would minimize impacts to new sites if such sites are encountered.

Indian Trust Assets Policy

The lead agencies' Indian Trust Assets (ITA) policy and NEPA implementing procedures provide for the protection of ITAs from adverse impacts resulting from Federal programs and activities. Potential impacts on ITAs resulting from the proposed actions have been reviewed. The lead agencies have confirmed that no adverse effects would occur to ITAs.

Farmland Protection Policy Act

The Farmland Protection Policy Act is administered by the Natural Resources Conservation Service. The intent of the Act is, among other purposes, to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses. Conversion of farmlands to public facility use due to construction and

C-085396

operation of the project has been minimized (conversion of less than one acre). The project would be in compliance with this act.

Environmental Justice

Executive Order 12898 on Environmental Justice requires that environmental analyses of proposed Federal actions address any disproportionately high and adverse human health or environmental effects on minority and low-income communities. Federal agencies' responsibility under this order shall also apply equally to Native American programs. In addition, each Federal agency must ensure that public documents, notices, and hearings are readily accessible to the public. No disproportionately high or adverse human health or environmental effects on minority and low-income communities have been identified; impacts of the project alternatives would affect the farming community and those economically linked to the farming community, equally. Mailing notices and distribution of other project information includes property owners and potentially affected persons and institutions without any distinction based on minority or income status.

Clean Water Act and River and Harbor Act

Permits and certifications required under the Federal Clean Water Act (Sections 404 and 401) and River and Harbor Act (Section 10) would be obtained from the Corps and the Regional Water Quality Control Board for construction of the project. The permits required under these Acts would include provisions related to work in the river during construction and dredging during operation of the project.

Construction of the preferred project alternative would require the placement of fill and dredged materials into waters of the United States and associated wetlands. Because these waters are protected under the Clean Water Act, the proposed project must comply with applicable provisions of Section 404 of the Act. The placement of fill materials requires an evaluation of water quality considerations to determine compliance with 404(b)(1) Guidelines as developed by the Environmental Protection Agency (40 CFR 230), which dictates that dredged or fill materials should not be discharged into the aquatic system, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact on the aquatic ecosystem.

The evaluations contained in Section 4.1 (Hydrology and Water Resources) and Section 4.2 (Aquatic Resources) of Chapter 4 (Impact Analyses) provide the analyses to demonstrate that the preferred project alternative is in compliance. Table 5.1-1 of Chapter 5 (Comparison of Alternatives) summarizes the results of these and related analyses. The evaluations in these sections, combined with the review of alternatives considered and eliminated in Section 2.5 (Alternatives Considered and Eliminated From Further Analysis) show:

- as a water-dependent project, there are no practicable alternatives available that would have less adverse impact on the aquatic ecosystem;

C-085397

- testing of riverbed materials in the project area shows the project would not violate State water quality standards or toxic effluent standards;
- the project would not contribute to significant degradation of "waters of the United States"; and
- actions would be taken to minimize potential adverse impacts of project construction and operation activities on the aquatic ecosystem.

Wild and Scenic Rivers Act

No rivers designated under the Wild and Scenic Rivers Act would be affected by the proposed project.

Executive Order 11988 - Floodplain Management

The proposed project requires the construction of new and modification of existing facilities within the main channel and floodplain of the Sacramento River. The project purpose and objectives cannot be accomplished without improvements to the existing fish screen structure that is located within an artificially maintained side channel (oxbow) of the river. Alternatives to the proposed action (Section 2.5, Alternatives Considered and Eliminated from Further Analysis) were considered but eliminated because of their inability to achieve basic project goals or because they were determined to be infeasible due to environmental, economic, or technical reasons.

Executive Order 11990 - Wetlands

Wetlands have been avoided to the extent possible through the design and siting of the proposed project. Unavoidable impacts to approximately 2.3 acres of wetlands would result with those project alternatives that include a gradient facility. Recommended mitigation would reduce wetland impacts to a less-than-significant level. The project would be in compliance with this executive order.

Other Relevant Federal Statutes and Regulations

Additional Federal laws and regulations apply to the proposed action as identified in Table 1.7-7. It is anticipated that the list of laws and regulations will change as the project design is refined and permitting requirements are finalized.

1.7.6.2 State Statutes and Regulations

California Environmental Quality Act

The CEQA lead agencies for this project are Glenn-Colusa Irrigation District and California Department of Fish and Game. This EIR/EIS has been prepared jointly with the Federal lead

C-085398

C-085398

agencies to meet State lead agency CEQA requirements and Federal lead agency NEPA requirements. Upon certifying the document, the CEQA lead agencies will adopt a reporting or monitoring program for the changes made to the project or the conditions of project approval to mitigate or avoid significant effects on the environment.

California Endangered Species Act

In addition to serving as CEQA lead agency, CDFG is also responsible for implementing the CESA. With its evaluation of the adequacy of this EIR, CDFG will issue a written finding based upon its determination of whether the proposed project would jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of habitat essential to the continued existence of the species. CDFG has been consulting with USFWS and NMFS and will coordinate its finding with the conclusions of the Federal agencies on similar species.

Streambed Alteration Agreement

Fish and Game Code 1600 et seq. requires a Streambed Alteration Agreement for construction activities associated with the proposed action. In addition to its responsibilities under CEQA as lead agency and under CESA, CDFG is also responsible for issuance of this agreement.

Clean Water Act

Prior to the Corps' issuance of a Clean Water Act Section 404 Dredge Permit, Section 401 water quality certification would first be obtained from the Regional Water Quality Control Board (RWQCB). The 401 certification would confirm compliance of the project with applicable water quality standards. The RWQCB could also be responsible for issuing a National Pollutant Discharge Elimination System Permit (Section 402) and a General Construction Activity Storm Water Permit.

Land Use Lease and Dredging Permit

The fish screen, oxbow channel, and/or gradient facility construction activities could require a land use lease from the State Lands Commission. Such leases are required for development of projects on State-owned sovereign lands, such as the bed of the Sacramento River. Operation of the proposed project could also require a dredging permit from the State Lands Commission. Dredging of the Sacramento River could be required to maintain the efficiency of the gradient facility and its fish passage and navigation passage design features.

Encroachment Permit

The proposed project could include the installation of permanent sheet pile and/or placement of riprap on or through existing sections of levees or revetment. If the affected levees are Federal Flood Control Project levees, then an encroachment permit could be required from The Reclamation Board, ~~a~~ the State agency responsible for administering Federal funds allocated for

C-085399

C-085399

such flood control levees. Otherwise, The Reclamation Board would require an encroachment permit for all work within the Sacramento River Designated Floodway.

Other Relevant Sate Statutes and Regulations

Additional State laws and regulations apply to the proposed action as presented in Table 1.7-7. It is anticipated that the list of applicable laws and regulations will change as the project design is refined and permitting requirements are finalized.

C-085400

C-085400

C-085401

C—085401

2.0 PROJECT DESCRIPTION AND DEVELOPMENT OF ALTERNATIVES

This project is a fish screen improvement project at the Hamilton City Pumping Plant (HCPP). This chapter of the EIR/EIS:

- describes information and studies used to select the alternatives analyzed in this EIR/EIS (Section 2.1, Development of Alternatives);
- introduces the geographic scope of the project (Section 2.2, Project Setting);
- explains key project design considerations used to formulate the alternatives that are analyzed in detail (Section 2.3, Project Design Considerations);
- describes the no-project/no-action (hereinafter referred to as no-project alternative) and project alternatives (Section 2.4, Alternatives);
- summarizes alternatives eliminated from further analysis (Section 2.5, Alternatives Considered and Eliminated From Further Analysis); and
- identifies issues that were either eliminated from further analysis or carried forward for further analysis in this EIR/EIS (Section 2.6, Issues Identified and Considered in EIR/EIS Process).

2.1 Development of Alternatives

The need at HCPP to minimize all fish losses while enabling Glenn-Colusa Irrigation District (GCID) to divert the full extent of its existing water entitlements has been well-established. However, successful, long-lasting means to meet these needs have been elusive. The current project development efforts have utilized information and lessons learned from past efforts to meet the objectives presented in Section 1.4 (Project Objectives).

HCPP operations have provided nearly 70 years of fish screen and 100 years of diversion experience and observations on the Sacramento River. In the last two decades, new information and numerous alternatives have been evaluated, using this history, to identify fish screen designs that would not fail as the previous screen had. The recent information includes studies, monitoring programs, and numerical and physical modeling that take into account the complex and dynamic conditions present at the HCPP. The Bureau of Reclamation (Reclamation) tested fish screen systems using large-scale physical models at Reclamation's Denver laboratories (Reclamation 1996a; Reclamation 1996d; Reclamation 1996e). The U.S. Army Corps of Engineers (Corps) has performed numerical modeling to assess gradient facility designs that would stabilize the Sacramento River water level in the vicinity of the fish screens (Ayres 1996d; RCE 1994a). As part of the gradient facility design, two-dimensional numerical modeling of

C—085402

C-085402

oxbow and river flows has also been completed (Ayres 1996d). Large-scale physical models ~~are now being constructed~~ at Colorado State University are being used to refine the gradient facility design (TAG Meeting April 16, 1997). These studies have led to a set of alternatives that would, to varying degrees, accomplish the purposes and objectives of the project.

The alternatives selected for detailed study in this EIR/EIS represent a range of actions. Some of the evaluations that directly contributed to formulating the project alternatives and refining project design include the following (full citations for these references are presented in Chapter 8, Literature Cited).

- CH2M Hill. 1989. Final Feasibility Report. GCID/CDFG Fish Protection and Gradient Restoration Facilities.
- ECOS. 1991. Final Environmental Assessment of Streambed Gradient Restoration Structures in the Sacramento River at River Mile 206. Unpublished.
- Water Engineering and Technology (WET). 1991. Riverbed Gradient Restoration Sacramento River Mile 206 California, 30% Basis of Design Report.
- Resource Consultants & Engineers, Inc. (RCE). 1994a. Draft: Riverbed Gradient Restoration Structures for the Sacramento River at the Glenn-Colusa Irrigation District Intake, California, 2-Dimensional Modeling of a Natural Riffle and Gradient Restoration Facility.
- HDR Engineering, Inc. (HDR). 1994. Fish Screen Modification Feasibility Report.
- Resource Consultants & Engineers, Inc. 1994b. Construction Sequence/Scenario for a Gradient Restoration Facility at the Glenn-Colusa Irrigation District Intake, California.
- Ayres Associates. 1995. Riverbed Gradient Restoration Structures for the Sacramento River at the Glenn-Colusa Irrigation District Intake, California. Supplemental Hydraulic Report.
- Ayres Associates. 1996b. Gradient Restoration Facility - Glenn-Colusa Irrigation District, Preferred Location.
- Reclamation. 1996d. Glenn-Colusa Irrigation District Fish Screen Modifications/ Replacement Conceptual Design Study.
- Ayres Associates. 1996d. Draft Technical Memorandum. Riverbed Gradient Facility for the Sacramento River at the Glenn-Colusa Irrigation District Intake, California.
- Reclamation. 1997d. Draft Fish Screen Structure Extension Technical Specifications.
- Ayres Associates. 1997e. Draft Gradient Facility Letter Report.

C-085403

C-085403

The descriptions of the project alternatives are based primarily on Reclamation's (1996d; 1997a) Conceptual Design Study and Ayres Associates (1996d) Draft Technical Memorandum. The no-project alternative includes additional operational constraints to the existing HCPP fish screen beginning in 1998. It also includes actions that GCID would be expected to implement to replace lost diversion capacity from the HCPP (Section 2.4, Alternatives). The project alternatives are assumed to have a 50-year life.

2.2 Project Setting

HCPP facilities are located on an oxbow of the Sacramento River between River Mile (RM) 205 and RM 206, roughly one-half mile from the river channel. GCID dredges the oxbow to maintain water flow from the river to the pump stations, which is also the headworks for the Glenn-Colusa Canal. This is considered the local study area.

The HCPP also is part of a larger, integrated water management system that affects and is affected by operations of GCID's other facilities and other Sacramento River water managers. This larger area of influence is considered the regional study area. As a result, this EIR/EIS addresses both regional and local study areas.

Regionally, most potential impacts from project alternatives would be long-term and result from changes in operations at HCPP and GCID's other water supply sources. Locally, potential impacts from alternatives would be both short-term from construction activities and long-term from operating the proposed fish screen system.

Future changes in HCPP operations could occur as a result of other separate actions that may be taken by GCID, other water managers, resource agencies, or regulatory agencies (e.g., increase in water deliveries to National Wildlife Refuges associated with the Central Valley Project Improvement Act (CVPIA)). However, such other actions are not within the scope of the proposed action for this EIR/EIS and would require separate environmental review. Until the fish screen improvements are completed, HCPP continues to operate under the Joint Stipulation of Parties (1993) and Corps (1996) dredge permit conditions.

2.2.1 Regional Study Area

Figures S-1 and 1.1-1 display the general extent of the regional study area. This area includes:

- the upper Sacramento River from approximately Keswick Dam to its confluence with the Colusa Basin Drain near Knights Landing;
- the GCID service area (majority of Glenn and Colusa counties);
- portions of Butte and Tehama counties;
- lower Colusa Basin lands and facilities that directly or indirectly depend on GCID deliveries or service area outflows into Colusa Trough or the Colusa Basin Drain; and

C-085404

C-085404

- other lands and facilities that provide water to or receive water from GCID, including Red Bluff Diversion Dam (RBDD), Tehama-Colusa Canal, Stony Creek, and three National Wildlife Refuges (Sacramento, Colusa and Delevan) that receive water wheeled through GCID's distribution system.

Water diversions and deliveries by GCID are part of a larger water management system operated by Reclamation, California Department of Water Resources (DWR), and several irrigation districts throughout the upper Sacramento Valley. These related operations are described in Section 3.1 (Hydrology and Water Resources).

2.2.2 Local Study Area

Figure 1.1-2 shows the local study area. The local study area includes areas of potential project features (e.g., fish screen extension and river gradient facility), primary access routes to the project site, and local residences and land uses potentially affected by construction and operation of the project.

The local study area is about 3.5 miles north of Hamilton City at the end of Canal Road on the west side of the Sacramento River, and about 4 miles west of the Hamilton Nord Cana Highway at the end of Wilson Landing Road on the east side of the river. Sacramento River flows split at the head of Montgomery Island into two channels, the oxbow channel, dredged almost annually by GCID, and the main river channel. Both channels reconverge at the downstream end of the island. A portion of the oxbow flows (up to 3,000 cubic feet per second (cfs)) can be diverted by the HCPP into the Glenn-Colusa Canal.

2.3 Project Design Considerations

The project objectives (Section 1.4) are based on specific considerations for designing alternative fish screen improvements. Many of these considerations reflect issues raised during early project scoping sessions. These considerations are grouped into categories of fish protection, river and oxbow hydraulics, and water supply. Complete descriptions of considerations for designing the fish screen improvements are presented in the Fish Screen Modifications/Replacement Conceptual Design Study (Reclamation 1996d), the Draft Technical Memorandum (Ayres 1996d), and the Fish Screen Improvement Project Concept Design Study Executive Summary (Reclamation 1997a).

2.3.1 Fish Protection Considerations

The first purpose of the project (Section 1.2, Purpose of the Project) is to minimize losses of all fish in the vicinity of the pumping plant diversion, including endangered winter-run chinook salmon. Fish losses can result from a wide range of physical conditions (e.g., high horizontal flow velocities that cause juvenile chinook salmon to impinge upon or entrain through the screen) and biological conditions (e.g., predators lying in wait in "predator holding areas" where channel structure, hydraulic, or light conditions enhance predation opportunities).

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C-085405

Most fish loss issues are related to river and oxbow hydraulic (e.g., flow patterns and velocity) conditions in the vicinity of the fish screen structure. Specific fish protection design considerations for this project site include:

- *fish passage upstream* (for adults) of all fish species past the screen, through the oxbow, and through the main channel of the Sacramento River;
- overall *survival of downstream migrants*;
- *exposure time* of downstream migrating juveniles to the face of the screen;
- screen bypass, which is a function of *approach* (towards the screens) *and sweeping* (past the screens) *velocities* for fish moving through the oxbow;
- *entrainment* of juvenile fish into the Glenn-Colusa Canal;
- *impingement* of juvenile fish on the screen due to high approach velocities in front of and/or low sweeping velocities past the screens;
- *sediment accumulation patterns* in the oxbow and behind the screens in the pumping plant forebay (sediment accumulation in front of or behind the screens modifies local approach velocity, sweeping velocity, and predation patterns);
- *internal fish bypass system performance* (effects on fish diverted into pipes at the screen face and returned to the oxbow downstream of the fish screens to reduce screen exposure time);
- *predator holding areas* that could be created by localized hydraulic effects of the fish screen, oxbow flow control structure, and related facilities;
- *entrapment* of juvenile fish in eddies or other hydraulic anomalies where predation could occur;
- elevated predation levels due to several possible conditions, including the *concentration of juveniles* in the lower oxbow (reduced oxbow volumes and channel area, but the same number of fish downstream of the HCPP fish screen);
- *disruption of normal fish shoaling (schooling) behavior* caused by HCPP operations, fish screen facilities, or channel modifications; and
- the *point release of juveniles* from an internal fish bypass system.

Due to the number of variables and their interrelationships, data collection and analyses of the effectiveness of proposed alternatives to protect fish have been complex, difficult, often inconclusive, and the subject of much scientific discussion (e.g., Vogel et al. 1988; Vogel and Marine 1995a; Ward 1989). A review of the past and current efforts to understand these factors related to fish losses at the HCPP is presented in Section 3.2 (Aquatic Resources).

2.3.2 River and Oxbow Hydraulics

The Sacramento River is actively changing its course and slope (gradient) in the project region. This process is a natural physical characteristic of a meandering river. The meander process has been partially controlled by intermittent rock placement on river banks (described hereafter as either riprap or revetment) and construction of levees. However, natural flood events and other hydraulic forces of the meander process continue to shift the river channel and change its gradient. History demonstrates (Section 1.5, History of the HCPP Diversions and Fish Screens) that these dynamic processes can totally disable fish screen systems at the HCPP.

To meet both project purposes, a key project objective (Section 1.4, Project Objectives) is to design a fish screen improvement project that minimizes the potential risk of screen failure due to local changes in river gradient. Channel geometry, water depth (i.e., wetted screen area), and flow conditions affect fish screen performance, fish bypass success, and water diversion capability at the HCPP. Historic river hydraulic changes in the vicinity of the HCPP (**Figure 2.3-1**) demonstrate the need to address the risk and probability of similar future hydraulic changes (Ayres 1996d and Mussetter 1997). River and oxbow channel hydraulic design considerations include:

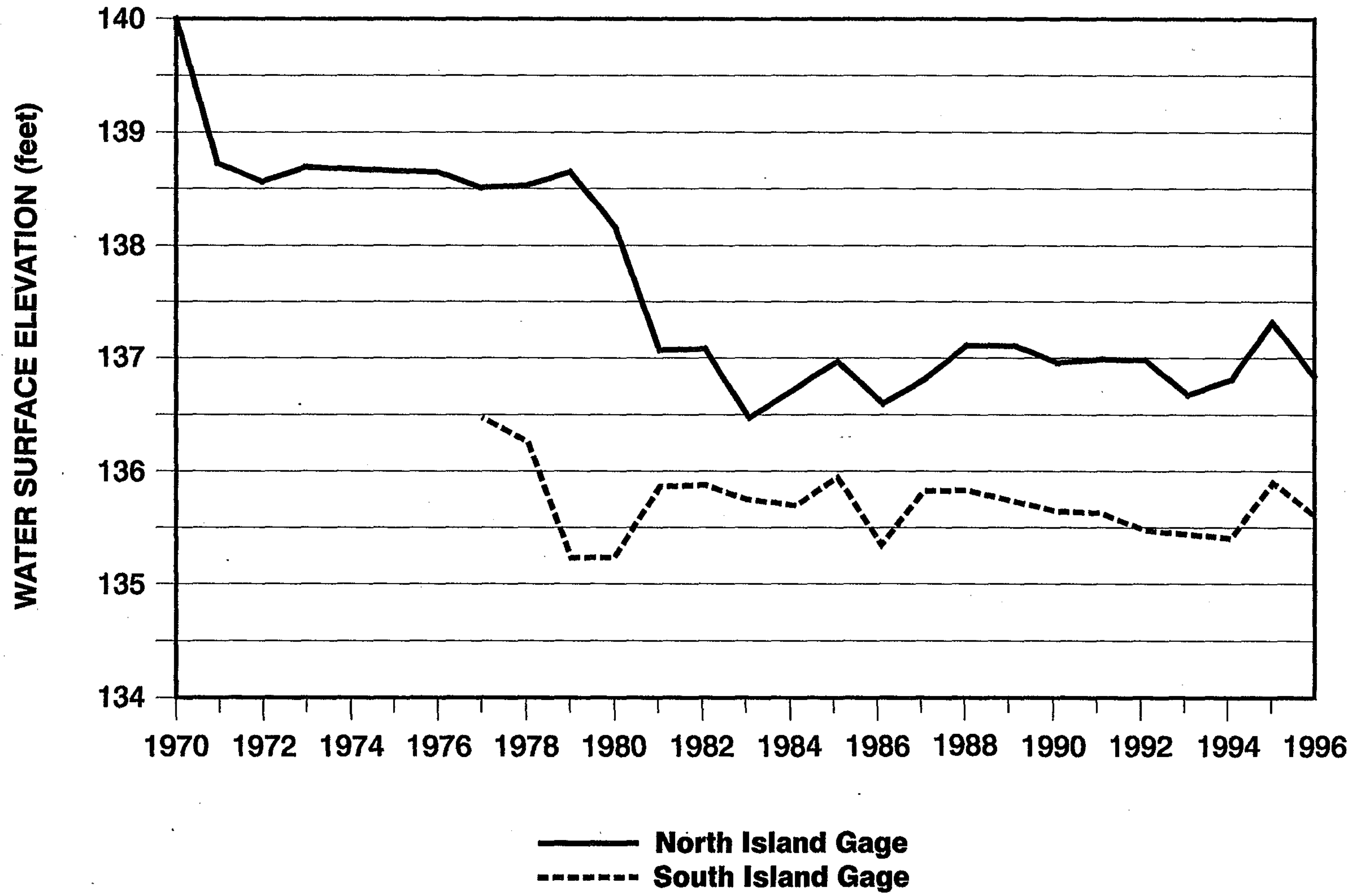
- the *water surface elevations* needed for maintaining sufficient wetted screen area and pumping;
- minimum water surface elevations required for operating the pumps (Elevation 135 feet);
- minimum sweeping velocity equal to or greater than twice the screen approach velocity;
- minimum velocity of 2 feet per second (ft/s) in the lower oxbow;
- minimum velocity of 3 ft/s through the internal (pipe) fish bypass;
- uniform hydraulic conditions across the entire screen face;
- channel plan form and cross sections that affect flow and velocity patterns in the intake and return channels and in front of the fish screens;
- the *channel geometry* (plan form and cross section) relative to fish and boaters passing upstream or downstream through the project area;
- the *sediment transport and accumulation patterns* that are affected by channel geometry and gradient;
- the potential extent and effect of *upstream and downstream river meander processes*; and
- the influence of a gradient facility on *local meander processes*.

C-085407

C-085407

C-085408

FIGURE 2.3-1. RIVER WATER ELEVATIONS AT NORTH AND SOUTH ISLAND GAGES FOR RIVER FLOWS OF 7,000 CFS (1970 - 1996)



Source: Ayres (1996d)

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A review of past and current river and oxbow hydraulic changes is presented in Section 3.1 (Hydrology and Water Resources).

2.3.3 HCPP Diversion Capability Considerations

The second purpose of the project (Section 1.2, Purpose of the Project) is to maximize GCID's capability to divert the full quantity of water it is entitled to divert to meet its water supply delivery obligations. To accomplish this purpose, the project would (1) enable GCID to meet instantaneous (peak) demands (within the existing capacity of the HCPP) and (2) provide long-term reliability for GCID water deliveries through the HCPP.

To return diversion capability at the HCPP while protecting fish, a fish screen system is needed that allows GCID to pump up to the existing maximum capacity of the HCPP (3,000 cfs) when river flows are at least 7,000 cfs. While maximum diversions of 3,000 cfs typically would not occur when river flows are less than 7,000 cfs, river management in the future is projected to include such river flows during the irrigation season (see Appendix B, Hydrology and Water Resources Technical Report).

Many water supply diversion issues are interrelated to fish protection. Both water supply diversion and fish protection issues depend on regional and local river conditions. The water supply diversion design considerations include:

- the ability of GCID *to meet current seasonal peak demands* while complying with project fish design criteria;
- the ability of GCID *to divert at HCPP when river flows are as high as 60,000 cfs* to accommodate non-irrigation season demands;
- the *risk of major Sacramento River channel changes* over the design life (50 years) of the project that could impact screen performance and therefore pumping operations;
- the *minimum river flow* required for operating HCPP at its existing capacity (projections of future river management conditions during the irrigation season);
- the need *to stabilize and reverse current trends in rising salinity levels*, within both GCID's lower service area and the lower Colusa Basin; and
- the effects of *future resource management decisions* (by water managers, fisheries agencies, and others) regarding future fish protection needs, water supply and conveyance rights, water user demands, regulatory changes, and economic conditions.

Further review of GCID's water supply is presented in Section 3.1 (Hydrology and Water Resources) and Appendix B (Hydrology and Water Resources Technical Report).

C-085409

2.4 Alternatives

The fish protection, hydraulic, and water supply considerations above demonstrate the difficulty of developing a successful long-term solution under the dynamic and complex conditions at the HCPP. Numerous solutions, including alternative sites and various screen designs, have been proposed and considered since the screen failure of the early 1970s. Work groups involving cooperating and responsible agencies and other interested parties (Section 1.7, Public and Agency Consultation and Coordination) have actively participated in developing and evaluating possible solutions over the last two decades.

The proposed fish screen improvements would enable GCID to meet instantaneous (peak) demands within the existing capacity of the HCPP. Reclamation PROSIM analyses used for this study forecast some changes in deliveries to GCID and other water users as analyzed under the future (2020) condition in this EIR/EIS. HCPP operations would not be expected to change substantially from historical (i.e., pre-1992) conditions, but would increase over current conditions. Total GCID water supply deliveries would not change significantly (Appendix B, Hydrology and Water Resources Technical Report). GCID would reduce its reliance on interim water supplies (e.g., Tehama-Colusa Canal (TCC) deliveries and groundwater pumping) used to make up for recent years of HCPP restrictions.

The alternatives selected for detailed study in this EIR/EIS include a no-project alternative and three fish screen improvement project alternatives. **Table 2.4-1** shows the major temporary and permanent physical features of the no-project and project alternatives. **Table 2.4-2** presents the gross maximum operational capacity of the HCPP for each alternative based upon a screen approach velocity criteria of 0.33 ft/s. Other fish design criteria are not necessarily met. The alternatives would satisfy the project objectives and purposes to varying degrees as shown in **Table 2.4-3**. The estimated costs of these alternatives are presented in **Table 2.4-4**.

Certain design features are common to more than one alternative. For example, it is anticipated that improvements would occur to the lower oxbow channel under all (no-project and project) alternatives (Table 2.4-1).

Table 2.4-5 shows the anticipated operation and maintenance activities for each alternative. Estimated costs of operation and maintenance activities would depend upon final project design, mitigation, and monitoring requirements. Because the proposed alternatives do not include significant differences in mechanical and technical components, annual operating and maintenance costs would not be expected to differ significantly among the alternatives.

Table 2.4-3 shows that no alternative completely meets all project objectives. The alternatives selected for detailed study represent a range of alternatives that would, however, meet most of the project objectives. The no-project alternative includes activities expected to be undertaken by GCID and regulatory agencies if the proposed fish screen improvements are not implemented.

Table 2.4-1 - List and Approximate Size of Major Features by Alternative

Feature	No-Project	Screen Extension	Screen Extension with Gradient Facility	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River
New or Modified ~~Water~~ Irrigation Recapture Stations [a]	10	None	None	None	None
New or Modified Groundwater Wells [a]	50	None	None	None	None
Total Fish Screen Area	4,800 sq. ft.	11,300 sq. ft.	11,300 sq. ft.	11,300 sq. ft.	11,300 sq. ft.
Extended Fish Screen Structure [b]	None	600 ft.	600 ft.	600 ft.	600 ft.
Forebay Expansion	None	Yes	Yes	Yes	Yes
Adjustable Fish Screen Baffles	Yes	Yes	Yes	Yes	Yes
Extended Left Bank Oxbow Earthen Guide Berm	None	600 ft.	600 ft.	600 ft.	600 ft.
Improved Upper Oxbow Channel [c]	150 ft.	300 ft.	300 ft.	300 ft.	300 ft.
Improved Lower Oxbow Channel [c]	2,600 ft. Trapezoidal Channel	2,600 ft. Trapezoidal Channel	2,600 ft. Trapezoidal Channel	2,600 ft. Trapezoidal Channel	2,600 ft. Trapezoidal Channel
Total Riprap Along Upper and Lower Oxbow Banks [c]	2,900 ft.	3,800 ft.	3,800 ft.	3,800 ft.	3,800 ft.
Adjustable Oxbow Flow Control and Removable Bridge to Montgomery Island	Combined Structures	Combined Structures	Combined Structures	Combined Structures	Combined Structures
Modified River Channel	None	None	1,000 ft.	1,000 ft.	1,000 ft.
Minimum Gradient Between Upstream/ Downstream Ends of Montgomery Island[d]	0.3 ft.[d]	0.3 ft.[d]	3.0 ft	3.0 ft.	3.0 ft.
Riprap Along River Banks [e]					
River Channel	None	None	3,600 ft.	3,600 ft.	3,600 ft.
River Levee	None	None	4,400 ft.	4,400 ft.	4,400 ft.
Rock Dikes in River	None	None	1,600 sq. ft.	1,600 sq. ft.	1,600 sq. ft.

C-085411

C-085411

Table 2.4-1 - List and Approximate Size of Major Features by Alternative (Continued)

Feature	No-Project	Screen Extension	Screen Extension with Gradient Facility	Screen Extension with Gradient Facility and Internal Fish Bypass	
				Return to Oxbow	Return to River
Internal Fish Bypass System Bypass Bays	2	None	None	3	3
Bypass Pipes [c]	2[f]	None	None	3 @ 54" dia.	3 @ 54" dia.
Length of Bypass System [c]	600 ft.	None	None	1,100 ft.	4,000 ft.
Number of Staging Areas	1	1	3	3	3
Size of Staging Areas	5 acres	14 acres	10, 10 and 14 acres	10, 10 and 14 acres	10, 10 and 14 acres
Total Construction Time (Approximate)	6 mo.	25 mo.	34 mo.	34 mo.	34 mo.

[a] B. Pennock, pers. comm., 1996.
[b] Reclamation (1996d). Note that final design could change the length by 100 ft.
[c] No-project improvement assumptions based upon B. Pennock personal communication (1997).
[d] The minimum gradient differential estimated (as determined at the December 9, 1996 TAG meeting) between North Island Gage and South Island Gage.
[e] Ayres Draft Technical Memorandum (1996d). River channel riprap numbers apply to gradient control (in river) portion of facility. River levee riprap numbers apply to bank protection upstream, downstream, and on the east side of the gradient control portion of the facility.
[f] The existing bypass pipes increase in size from 24" to 60" between the screen and outfall located on the lower oxbow.

Table 2.4-2 - Estimated HCPP Operational Capacity for No-Project and Project Alternatives[a]

	No-Project	Screen Extension	Screen Extension with Gradient Facility	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River
River Flow	**Potential Pumping Capacity (cfs)**				
5,000 cfs	1,160	2,770	3,000	3,000	3,000
7,000 cfs	1,300	3,000	3,000	3,000	3,000
8,000 cfs	1,350	3,000	3,000	3,000	3,000
10,000 cfs	1,460	3,000	3,000	3,000	3,000
20,000 cfs	1,890	3,000	3,000	3,000	3,000

[a] Pumping capacity estimates are based upon wetted screen area and 0.33 ft/s approach velocity. Pumping capacity estimates do not necessarily reflect ability to meet sweeping velocity, bypass flow, or other fish protection design criteria.

Table 2.4-3 - Relative Comparison of How the No-Project and Project Alternatives Meet Project Objectives

Project Objectives[a]	No-Project	Screen Extension	Screen Extension with Gradient Facility	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River
State-of-the-Art Fish Screen Protection	Low	Medium[d]	Medium[b]	High[b]	Medium[b]
Minimizes Fish Losses	Low	Medium[d]	Medium[b]	High[b]	Medium[b]
Minimizes Other Environmental Effects	High	High[c]	Medium[c]	Medium[c]	Medium[c]
Peak Pumping Capability Within Existing HCPP Capacity	Low	Medium[d]	High	High	High
Minimizes Risk of Screen Failure Due to River Gradient Changes	Low	Low	High	High	High
Maximizes Long-Term Reliability of HCPP Operations	Low	Low	High	High	High

[a] See Section 1.4, Project Objectives.

[b] The Fish Protection Evaluation and Monitoring Program would evaluate performance of the screen and recommend necessary changes for optimal fish protection, including the possible closure, or partial closure, of the bypass system, or extension of the bypass to the river. The return to oxbow alternative would allow greater operational flexibility and adaptive management capability.

[c] Potentially significant environmental effects would be mitigated to the extent feasible. The potential for significant residual impacts would be greater than for the no-project alternative, as described in Chapter 4 (Impact Analyses) and Chapter 5 (Comparison of Alternatives).

[d] Excludes objective of long-term reliability due to the risk of loss of Sacramento River gradient.

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C-085413

Table 2.4-4 - Construction Cost Estimates for No-Project and Project Alternatives (in $1,000s and based on information available as of June 30, 1997)

	No-Project	Screen Extension[b]	Screen Extension with Gradient Facility[b]	Screen Extension with Gradient Facility and Internal Fish Bypass[b]	
				Return to Oxbow	Return to River
Replacement Water Supply Features					
Recapture Stations	$1,000[a]	NA	NA	NA	NA
Groundwater Wells	$5,000[a]	NA	NA	NA	NA
Subtotal - Replacement Water Supply	**$6,000**	**0**	**0**	**0**	**0**
Unlisted Items (10%) and Contingencies (20%)	$1,800	NA	NA	NA	NA
~~Environmental Mitigation~~	~~TBD~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~
Total - Replacement Water Supply	**$7,800**	**0**	**0**	**0**	**0**
Fish Screen And Fish Bypass Features[b]					
Mobilization	$426[a]	$520	$520	$670	$1,000
New Fish Screen Structure	NA	$3,031	$3,031	$3,773	$3,773
Modify Existing Fish Screen Structure	$871[a]	$1,152	$1,152	$1,340	$1,419
Fish Bypass Pipelines and Outlet Structure	$750[a]	$100[c]	$100[c]	$1,533[d]	$3,922[d]
Improve Bypass Channel	$637[b]	$637	$637	$637	$637
Bridge Over Bypass Channel	$383[b]	$383	$383	$383	$383
Mechanical Equipment	$556[a]	$3,338	$3,338	$3,587	$3,587
Sheet Piles and Cofferdams	$400[a]	$1,813	$1,813	$2,142	$6,660
Subtotal - Fish Screen and Bypass	**$4,023**	**$10,974**	**$10,974**	**$14,065**	**$21,381**
Unlisted Items (10%) and Contingencies (20%)	$1,206	$3,662	$3,662	$4,407	$6,138
~~Environmental Mitigation~~	~~TBD~~	~~TBD~~	~~TBD~~	~~TBD~~	~~TBD~~
Total - Fish Screen and Bypass	**$5,229**	**$14,636**	**$14,636**	**$18,472**	**$27,519**
Gradient Facility Features[E]					
Clearing and Grubbing	NA	NA	$19	$19	$19
Temporary Bridge	NA	NA	$367	$367	$367
Cofferdams and Dewatering	NA	NA	$1,277	$1,277	$1,277
Embankment Material	NA	NA	$64	$64	$64
Sheet Piling, Excavation and Replacement	NA	NA	$2,216	$2,216	$2,216
Bedding Material and Riprap	NA	NA	$5,399	$5,399	$5,399
Erosion Control Seeding	NA	NA	$86	$86	$86
Subtotal - Gradient Facility	**0**	**0**	**$9,428**	**$9,428**	**$9,428**
Unlisted Items and Contingencies (20%)	NA	NA	$1,886	$1,886	$1,886
Lands and Damages	NA	NA	$401	$401	$401
~~Environmental Mitigation~~[f]	~~TBD~~	~~TBD~~	~~TBD~~	~~TBD~~	~~TBD~~
Total - Gradient Facility	**0**	**0**	**$11,715**	**$11,715**	**$11,715**
Environmental Mitigation	*$250*	*$500*	*$1,500*	*$1,500*	*$1,500*
TOTAL COST OF ALTERNATIVES[g h]	**~~$13,000~~** **$13,300**	**~~$14,600~~** **$15,100**	**~~$26,400~~** **$27,900**	**~~$30,200~~** **$31,700**	**~~$39,200~~** **$40,700**

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C-085414

Footnotes to Table 2.4-4 - Construction Cost Estimates for No-Project and Project Alternatives

NA	Not applicable to the alternative.
TBD	To be determined.
a	B. Pennock, pers. comm., 1996. No-project alternative assumes construction of 50 additional wells and 10 new and/or expanded recapture stations at an average cost of $100,000 each.
b	Reclamation (1996d).
c	Closure of the existing bypass pipelines and outlet to reduce predator holding areas.
d	Fish bypass pipeline cost estimate (three 54-inch diameter concrete pipes).
e	Ayres (1996d). The estimate for the gradient facility features consists of the costs for the in-river and bank protection portions of the gradient facility.
f	~~Environmental mitigation costs for the no project and project alternatives could exceed $1 million. Final cost estimates will be developed for the Final EIR/EIS.~~ Environmental mitigation costs for the project alternatives could vary significantly depending upon final design, final accounting of habitat impacts, and mitigation options selected. For purposes of this EIR/EIS, the figures shown represent the currently anticipated magnitude of mitigation efforts that would be required.
g	Total costs rounded to the nearest $100,000. Excludes contractor overhead and profit and construction management ~~and environmental mitigation~~ costs. ~~Mitigation costs are expected to be proportional to the level of impact associated with each alternative.~~
h	No-project alternative features would be funded entirely by GCID. The project alternatives would involve 75 percent Federal/25 percent State and local cost-sharing.

C-085415

C-085415

Table 2.4-5 - Operation and Maintenance Activities by Alternative

	No-Project	Screen Extension	Screen Extension with Gradient Facility	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River
Oxbow Flow Control Structure Adjustments	As needed	As needed	As needed	As needed	As needed
Fish Screen Baffle Adjustments	As needed	As needed	As needed	As needed	As needed
Fish Screen Cleaning[a]	Continuous	Continuous	Continuous	Continuous	Continuous
Fish Screen Internal Bypass Bay Cleaning[a]	Periodic	NA	NA	Periodic	Periodic
Channel Dredging and Clearing					
• Oxbow[a]	Spring	Spring	Spring	Spring	Spring
• Forebay[a]	Spring	Spring	Spring	Spring	Spring
• River[b]	NA	NA	Maybe	Maybe	Maybe
Dredge Spoil Processing[c]	Maybe	Maybe	Maybe	Maybe	Maybe
Oxbow Earthen Guide Bank Contouring	Annually	Annually	Annually	Annually	Annually
Irrigation and Monitoring of Shaded Riverine Aquatic Cover (SRA Cover), Elderberry and Other Terrestrial Habitat Mitigation	Initial years	Initial years	Initial years	Initial years	Initial years
Fish Protection Evaluation and Monitoring Program	Initial years	Initial years	Initial years	Initial years	Initial years
Gradient Facility Structure Inspection	NA	NA	Annually	Annually	Annually
Navigation Hazard Sign Inspection/ Maintenance					
• Oxbow	Annually	Annually	Annually	Annually	Annually
• River	NA	NA	Annually	Annually	Annually

NA Not applicable.
[a] No substantial change from existing operation and maintenance activities.
[b] The need for and extent of dredging in the river channel is under study as part of the gradient facility design studies.
[c] Dredge spoil processing options include continued placement on Montgomery Island, and separation of aggregates either on the island or on GCID's lands at the intersection of First Avenue and Cutler Avenue across from the HCPP (Section 2.4.1.2, No-Project Operations and Maintenance).

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C-085416

For purposes of presentation and analyzing environmental impacts in this EIR/EIS, the alternatives are organized with the no-project alternative first, and project alternatives second. To reduce redundancy, project alternatives are ordered with the screen extension alternative first, and then by alternative according to the degree to which specific project objectives are met (Table 2.4-3).

2.4.1 No-Project Alternative

If the lead and participating agencies do not implement a long-term solution for the HCPP diversion, as authorized to do so, then the no-project alternative would occur, starting in 1998 (Table 2.4-1 and **Figure 2.4-1**). GCID's operations would change at HCPP and throughout its water delivery system. To augment fish protection at the existing facility, it is assumed that permit requirements for the no-project alternative would require compliance with existing California Department of Fish and Game (CDFG) (1993) and National Marine Fisheries Service (NMFS) (1997) screen criteria to the extent possible year-round (Figure 1.5-2 and **Figure 2.4-2**). It would be expected that approach velocity criteria (i.e., 0.33 ft/s) could likely be achieved, but that other criteria such as sweeping velocities (i.e., greater than 2.0 ft/s), internal bypass system velocities, and screen exposure times (i.e., less than 2.5 minutes) would not likely be achieved.

Under the no-project alternative, GCID would need to compensate for the further reductions in HCPP capacity that would result from meeting a 0.33 ft/s approach velocity criteria year-round. For purposes of analysis in this document, it is assumed that GCID would maintain its existing priority order of water supply sources described in Section 3.1 (Hydrology and Water Resources) and Appendix B (Hydrology and Water Resources Technical Report), but would need to construct and/or expand irrigation recapture and groundwater facilities and modify existing operations throughout its service area. The following is an overview of the anticipated actions that would be taken by GCID water users and GCID under the no-project alternative.

- Increasing conservation with some temporary fallowing and land use conversions due to salinity increases as occurred with the 1992 HCPP restrictions (Joint Stipulation of Parties 1992). Some long-term land use conversions would also be expected with the salinity increases.

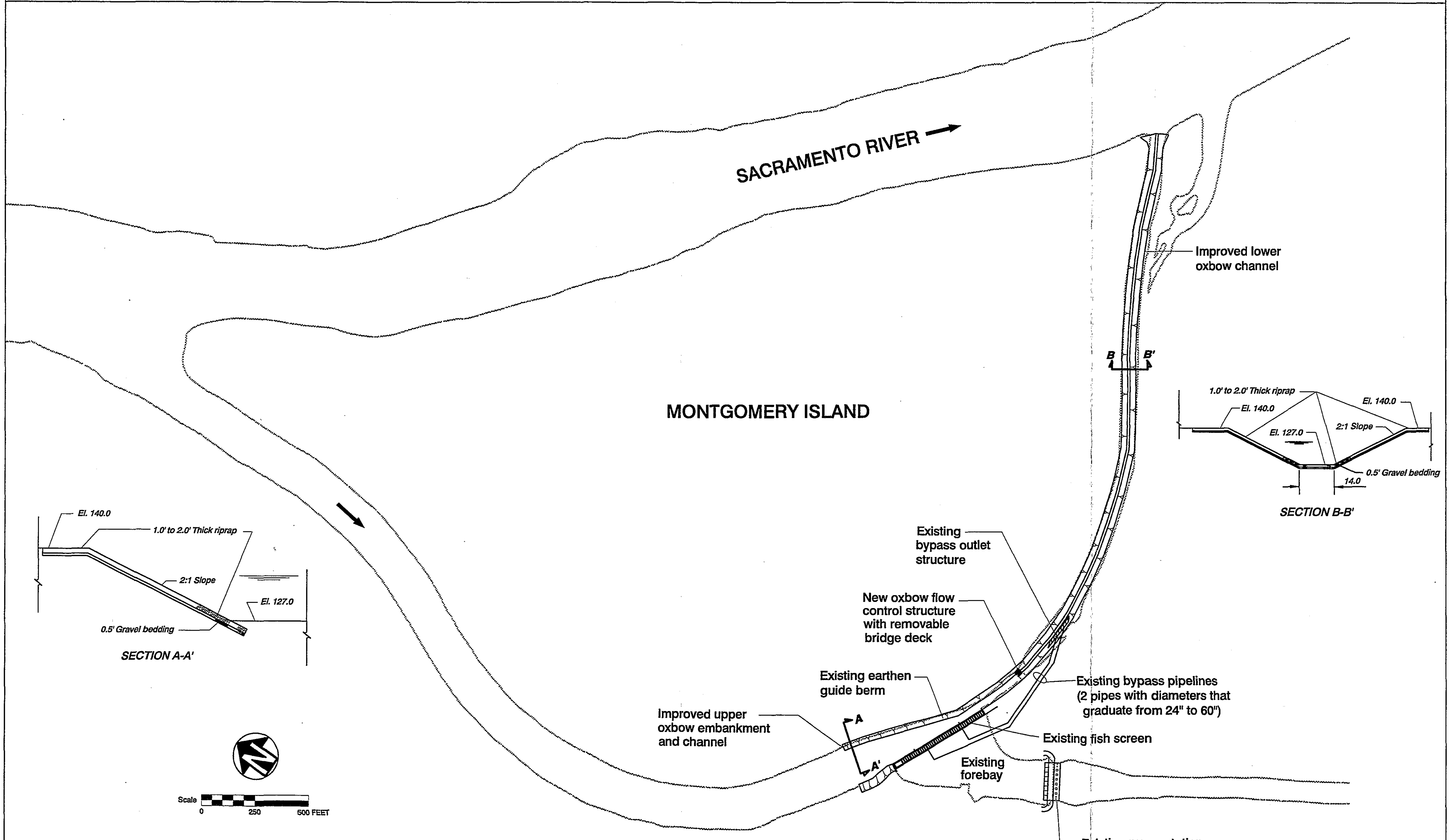
- Increasing reliance on "as-available" conveyance capacity from TCC. Existing water exchanges under agreements among GCID, Reclamation, and the TCC Authority are possible only when unused capacity is available in the TCC. TCC capacity is projected to be available only for the near-term until TCC water contractors fully utilize available capacity.

- Changing crops, including reduced planting of high water-use crops (e.g., rice) and planting of lower water-use crops (e.g., cotton). Such changes would depend upon market, regulatory, and other conditions.

C-085418

NO-PROJECT ALTERNATIVE [a]

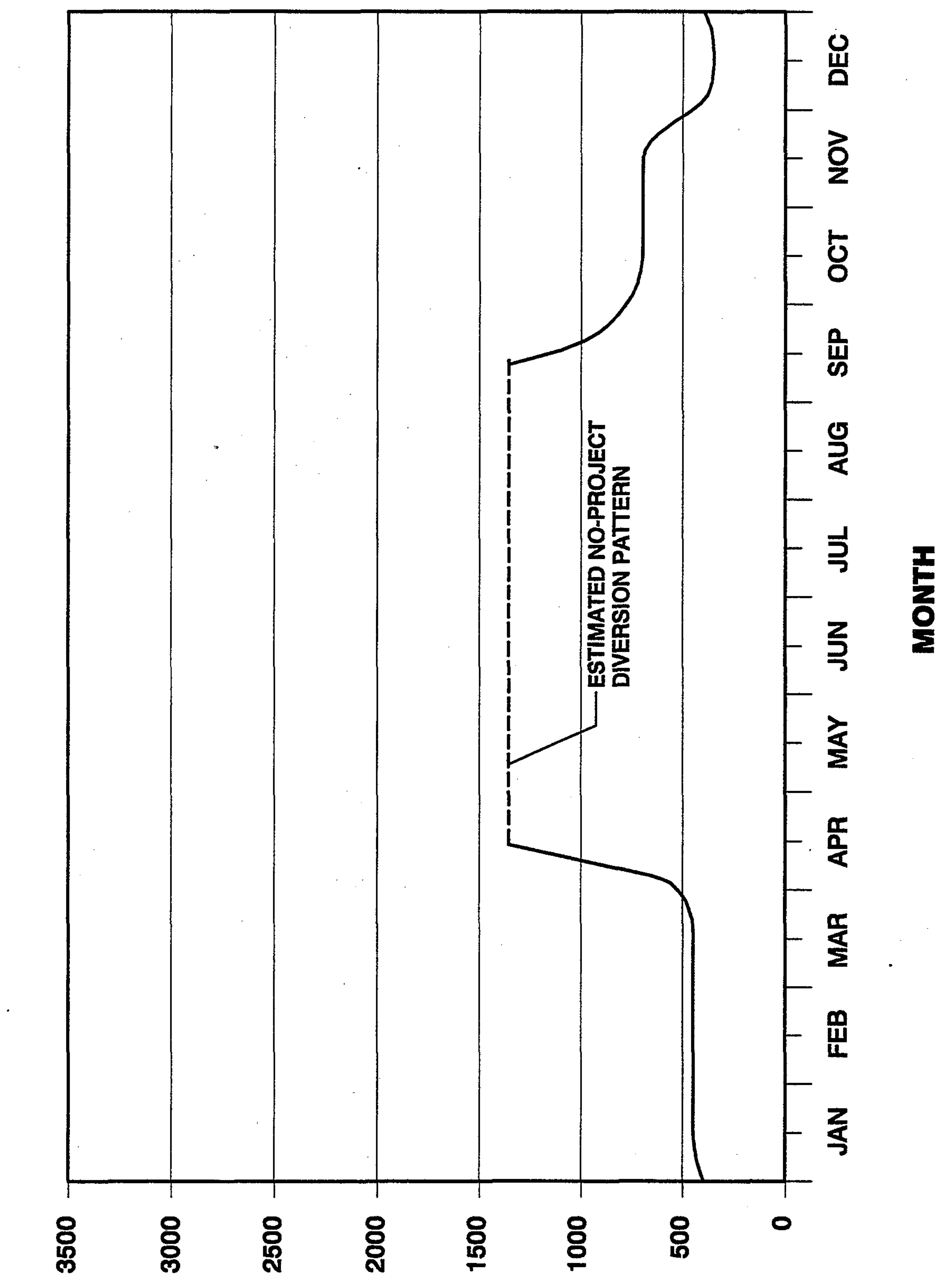
FIGURE 2.4-1



a) Fish protection improvements identified for the no-project alternative. New and modified well and recapture station locations for this alternative are unknown at this time.

C—085418

FIGURE 2.4-2. HAMILTON CITY PUMPING PLANT ESTIMATED DIVERSION PATTERN FOR THE NO-PROJECT ALTERNATIVE [a]



Sources: GCID (1995a and 1996b) and CH2M Hill (1989)

[a] *Peak diversion capability at a water surface elevation of 137 ft, assuming existing river gradient conditions.*

- Constructing new facilities to maintain peak water delivery capacities (replacement water supply sources for further reduced HCPP capacity) as follows:

  - approximately 10 new or expanded agricultural run-off recapture pump stations (late irrigation season recapture); and

  - approximately 50 new or modified groundwater wells (early irrigation season pumping).

A risk of this alternative would be the long-term viability of maintaining even the reduced HCPP diversions as illustrated by Figures 1.5-2 and 2.4-2, due to changes in the river that are not in the control of GCID. If future drops in gradient or water surface elevation occur at the screens, then corresponding reductions at HCPP would be required to maintain 0.33 ft/s approach velocities in front of the screens. Furthermore, there would be greater difficulty in meeting the other criteria that were used to design the project for protection of fisheries. The difference in water surface elevations across the screen structure have fluctuated in recent years approximately 2.5 feet due to changing hydraulic conditions in the river (Figure 2.3-1). Future changes in the river make it difficult to predict HCPP operations under this alternative, however, the significant drops in gradient in the early 1980s (Figure 2.3-1) and previously in 1970 (Section 1.5, History of HCPP Diversions and Fish Screens) demonstrate the risks associated with potential future changes in the river on GCID's ability to meet fish screen approach velocity and fish bypass conditions.

The specific construction, operation, mitigation and monitoring activities expected with the no-project alternative are described in the following sections.

2.4.1.1 No-Project Construction Activities and Schedule

Construction activities for the no-project alternative would include new wells, expansion of existing wells, new irrigation runoff recapture stations, and expansion of existing recapture stations throughout the GCID service area. Activities would also include some improvements to the oxbow and existing fish screen to improve fish bypass and predation conditions. Many of these activities may require permits or approvals from regulatory agencies. Table 2.4-1 lists the major features to be constructed for this alternative.

Well and Recapture Stations

The locations for well and irrigation recapture station construction activities are unknown at this time but would likely occur in the vicinity of existing GCID lands and water conveyance infrastructure. The locations would include areas with existing power supply for pumps, access roads for maintenance activities, and pipelines or canals for delivering water supplies to GCID's water delivery and irrigation recapture network. In most instances, it would be expected that construction would occur in areas of existing disturbance.

The new wells would require less than 0.1 acre each and could be sited adjacent to the existing GCID conveyance system of canals and laterals. The recapture stations would similarly require little land (less than 0.2 acre each) and would be sited on the existing network of drainage canals. Many of the new recapture facilities would be an expansion of the existing lift stations along the Colusa Basin Drain.

Adjustable Fish Screen Baffles

The existing fish screens would be retrofitted with baffles to increase the uniformity of approach velocities in front of the screens. The baffles would be placed either immediately behind the screen or on the downstream (west) side of the fish screen structure. Baffling on the west side would require connecting steel plates from the fish screen support piers to the screen face to reduce lateral flows along the backside of the screen. The baffles would be anchored to the existing screen support piers immediately behind the existing screen. The baffles would be mechanically operated and installed on the existing support piers so that variations in velocities along the entire screen could be controlled.

Improved Upper Oxbow Channel

The upper oxbow serves as the intake channel from the Sacramento River to the HCPP. To maximize hydraulic performance of the fish screen and to improve the uniformity of flows to decrease predation, initial pre-design engineering studies included: (1) bank-to-bank dredging and removal of hydraulic roughness elements of the entire upper oxbow; and (2) placing riprap at a 2:1 slope along both banks for a distance up to 1,200 feet upstream of the fish screen.

In response to a preliminary USFWS assessment of SRA Cover impacts and subsequent lead agency discussions, the extent of channel improvements was reduced substantially. Additionally, dredging and removal of hydraulic roughness elements upstream of areas to receive riprap would be restricted to no closer than 10 to 15 feet from each bank to protect littoral zone and SRA Cover habitat. By reducing the extent of channel improvements (riprap) and restricting dredging, up to an additional 3,900 feet of littoral zone habitat in the upper oxbow would remain undisturbed.

Dual benefits would be derived from the currently proposed design of the upper oxbow improvements. First, a significant reduction in SRA Cover impact would result. Second, a large amount of escape cover would be preserved for juvenile fish, including anadromous salmonids, as they pass through the upper oxbow prior to encountering the fish screen.

Under the no-project alternative, 150 feet of bank on each side of the channel would be modified, which would result in a total of 300 feet of bank improvements upstream of the screen.

C-085421

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Improved Lower Oxbow Channel

The lower oxbow serves as a bypass corridor that returns downstream migrating fish to the river after passing the screen. In this area, the concentration of juvenile fish and potential disorientation resulting from passage of the fish screen facilities renders juvenile fish more susceptible to predation. Under the no-project alternative, the lower oxbow channel would be modified to increase velocities, which would minimize predator holding habitat and expedite the return of the juvenile fish to the main river channel.

Numerical two-dimensional simulations conducted by Ayres (Ayres 1991, 1995, 1996a, 1996b, 1996c, 1996d, 1997a, 1997b) have been used to develop a design for the no-project and project alternatives that would provide a minimum 2.0 ft/s velocity flow in the lower oxbow to reduce the availability of holding habitat for predators. The lower oxbow channel would be narrowed by adding to the embankment of the access road on Montgomery Island. Fill and riprap would be placed on the opposite bank either from the road or from a barge. Modification of the channel would require the construction of temporary earthen cofferdams.

Thus, the lower oxbow has been designed as a return channel to the main river. The lower oxbow would specifically not be utilized as rearing habitat for juvenile salmonids. Therefore, SRA Cover in the lower oxbow is not intended or expected to provide either rearing habitat or escape cover for juvenile fish.

Oxbow Flow Control Structure with Removable Bridge Deck

Oxbow flows are a function of river flows, river gradient between the upstream and downstream ends of Montgomery Island, pumping rates, oxbow channel configuration, and, when installed, a seasonal earthen berm across the oxbow downstream of the screen. The existing seasonal earthen berm serves two purposes. The first is to maintain a minimum water surface elevation on the screen face. The second purpose is to regulate flows into the lower oxbow. Unrelated to flow control, the earthen berm also provides access to Montgomery Island. The berm is currently removed in mid-July of each year to reduce predation potential for winter-run chinook salmon juveniles migrating downstream.

A permanent oxbow flow control structure would be installed with the no-project alternative. The new structure would be designed with adjustable height control so that lower oxbow flows could be maintained at optimum rates for fish protection over a range of river flow conditions. The basic design of the structure could involve a narrower fixed channel cross section with stop logs placed and removed to raise and lower water levels; or an inflatable rubber dam design that would be adjusted as needed for wetted screen area and lower oxbow flow control purposes. The final design would include abutments on the sides to support a bridge deck that could be removed during high river flows. Design of the in-water portion would minimize the potential for predator holding areas.

Internal Fish Bypass

The existing internal fish bypass system includes two functioning bypass bays, a pipe collection system, and an outfall downstream of the screen immediately below the seasonal earthen weir. Structural improvements would be made to the existing bays, pipelines, and outfall to improve juvenile fish collection and return to the lower oxbow to reduce predation. During construction, the bypass bays would be blocked off to prevent fish from entering the bypass system or forebay.

Staging Area

A staging area of approximately five acres would be needed to stockpile rock, store equipment, and serve as a construction management area for the construction contractor and inspectors. The staging area would likely be located across from the HCPP service yard on a GCID parcel at the intersection of First Avenue and Cutler Avenue. Small staging areas would be needed for the groundwater well and recapture work station work.

Construction Schedule and Management

GCID would be solely responsible for managing final design, construction, and inspection activities for construction of the no-project alternative. The work would occur over about a six-month period as shown in Table 2.4-1. Final design, construction scheduling, State and Federal permitting, and implementation of this alternative would be subject to California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) review requirements subsequent to this EIR/EIS process.

2.4.1.2 No-Project Operations and Maintenance

No-project operation and maintenance activities would be similar to current activities except for potential minor changes associated with the oxbow flow control structure, fish screen baffles, and the Fish Protection Evaluation and Monitoring Program (FPEMP) (Section 2.4.1.4, No-Project Monitoring Activities). The FPEMP would be developed through consultation with resource agencies having public trust responsibilities (e.g., CDFG, NMFS and U.S. Fish and Wildlife Service (USFWS)) for protection and management of special-status species or other public trust resources. Operating activities would also be directed by operating conditions of future Corps Section 10 and 404 permit conditions. An overview of annual maintenance activities is presented in Table 2.4-5.

Dredging Operations

Possible changes for managing dredge spoils from the oxbow and forebay in the future have been identified. The possible changes involve where and how the materials would be treated.

GCID now surveys the upper oxbow each spring to determine the quantity of dredge material that needs to be removed. Dredging follows high flow subsidence and is completed before July 1 of each year. Dredging takes place for 12 hours per day, and can last up to two months, depending on the water year (B. Pennock, pers. comm., 1996).

Dredge material is currently stockpiled on the northern portion of Montgomery Island using a suction dredge on a barge. The dredge has a pipeline attached that is moved as the dredge moves through the oxbow and pumping plant forebay. Material dredged near the northern tip of the island is deposited on the tip of the island. This material is mostly gravel and sand that deposits in the oxbow near the river.

Dredge volumes vary widely from year to year depending on several factors, including the previous winter river flows, pumping plant operations, and river gradient conditions that largely determine oxbow water levels and velocities. Historically, gravel and sand have accumulated from heights of a few feet up to approximately 25 feet on the tip of Montgomery Island. Sediment accumulation farther downstream in the oxbow is finer material, mostly sand and silt, that is dredged and pumped over the Montgomery Island embankment to the island interior where runoff percolates in porous soils. Material pumped to the interior of the island has gradually raised the pipe discharge area from a few inches to a few feet each year, except in those years when dredging has not been required.

The possible changes in the location and treatment of dredge spoils involve two options to existing conditions. The first option is to segregate coarse aggregates from fines on the tip of the island and transfer marketable materials to GCID's triangular 14-acre parcel at the intersection of First Avenue and Cutler Avenue across from the HCPP. Gravel equal to or larger than 3/4 of an inch would be separated from smaller particles and placed on the northern tip of Montgomery Island. High river flows in winter and spring would wash the gravel placed on Montgomery Island downstream, perpetuating natural river sediment transport and deposition on downstream gravel bars and shoreline. Leftover dredge spoils would be stockpiled on GCID's lands across from the pump station and sold. Marketable material would likely be sold to local aggregate or landscaping companies. The second option is to pump all dredge materials to GCID's 14-acre parcel across from the pump station where all materials would be sorted and marketed.

Left Bank Oxbow Earthen Guide Berm

To improve sweeping flows in front of the fish screen structure, GCID would continue to annually maintain an earthen guide berm across the channel from the screens. The guide berm would be maintained with previously deposited gravel materials from Montgomery Island.

2.4.1.3 No-Project Mitigation

Mitigation measures for the no-project alternative are neither identified nor addressed in this EIR/EIS, except that potential mitigation options as discussed in Section 2.4.2 (Screen Extension Alternative) could be used to ensure significant impacts to the lower oxbow bypass would not occur due to the no-project alternative. Mitigation requirements for the no-project alternative would depend upon the final siting and design of the well, irrigation runoff recapture, and on-site

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C-085424

fish screen activities. If a project alternative is not selected, then the no-project alternative would be planned and undergo separate CEQA, California Endangered Species Act (CESA), NEPA, and Endangered Species Act of 1973, as amended (ESA) review. However, it is anticipated that most of the no-project alternative activities could be sited, designed, constructed, and operated in a manner not likely to have potentially significant environmental effects.

2.4.1.4 No-Project Monitoring Activities

Monitoring activities for the no-project alternative could include measures required for mitigating potentially significant effects. As noted above, such measures would be the subject of a subsequent environmental review process if a project alternative is not implemented. Regardless of the alternative selected (no-project or project) GCID would, in consultation with appropriate resource agencies, develop and implement a FPEMP as identified in Table 2.4-5 and discussed in Chapter 6, Environmental Commitments and Mitigation and Monitoring, to assess the effects of fish screen and HCPP operation changes on fish protection at the HCPP.

2.4.1.5 No-Project Costs

The estimated costs for the no-project facilities (Table 2.4-4) would be as follows:

- new/expanded agricultural runoff recapture lift stations (approximately $1.0 million for 10 stations at $100,000/station construction).
- new or modified groundwater wells (approximately $5.0 million for 50 wells at $100,000/well construction).
- improvements to existing fish screen improvements (approximately $5.2 million).

GCID would fund the total cost of this alternative. The estimated total construction cost for this alternative is approximately ~~$13.0~~13.3 million, including contingencies and excluding contractor overhead and profit and construction management. ~~and environmental mitigation. Environmental mitigation costs could exceed $1 million. Final cost estimates for environmental mitigation will be developed for the Final EIR/EIS.~~

2.4.2 Screen Extension Alternative

The screen extension alternative consists of an approximately 600-foot extension of the existing fish screen, upper oxbow channel improvements, an improved and extended guide berm across from the fish screens, an oxbow flow control structure with removable bridge deck, and lower channel improvements. The screen extension alternative is shown on **Figure 2.4-3**.

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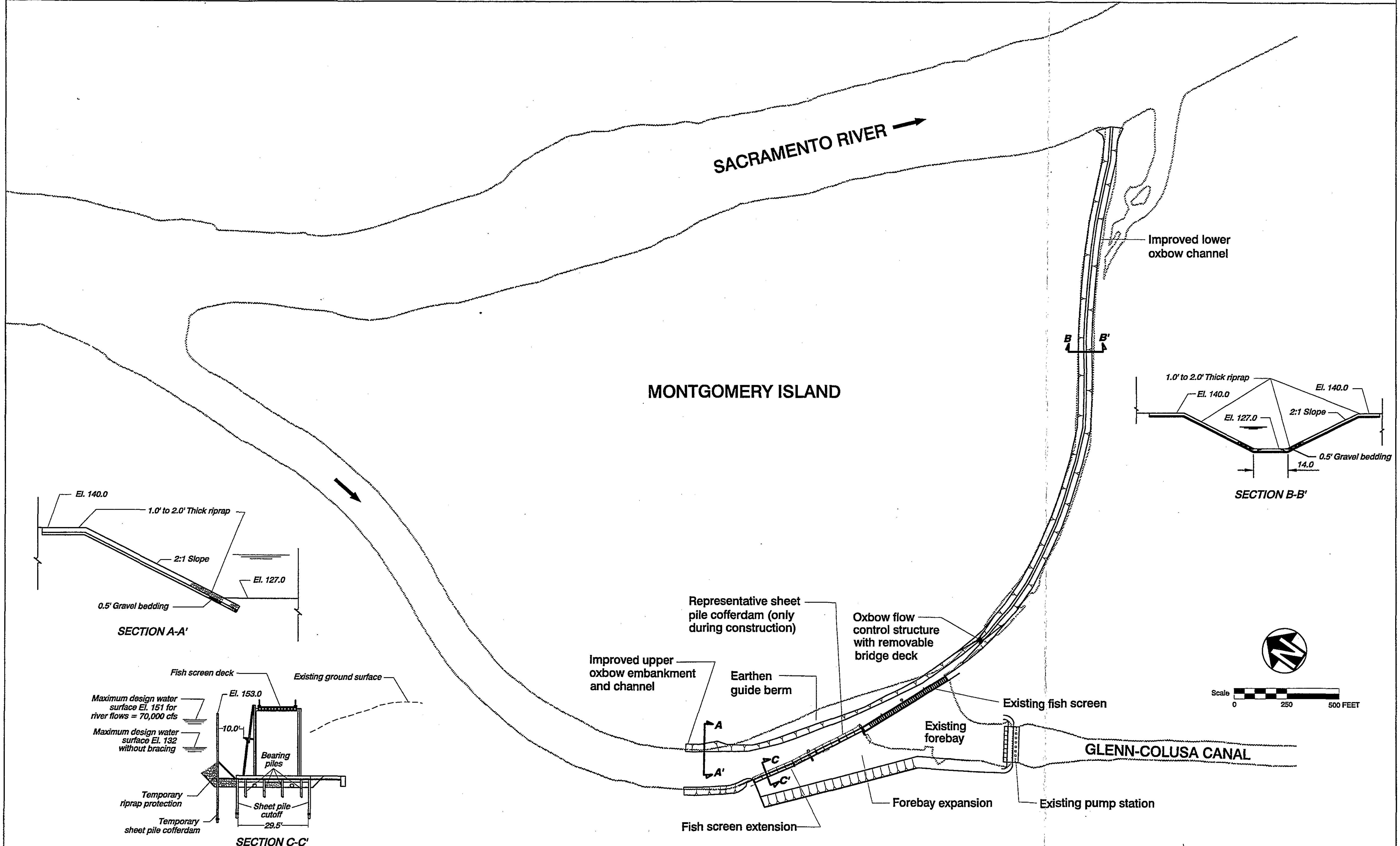
SCREEN EXTENSION ALTERNATIVE

FIGURE 2.4-3



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The 600-foot extension of the existing fish screen would enable GCID to meet screen approach velocity criteria while meeting peak demands, increasing its ability to meet its water supply obligations through the HCPP under most river flows (Table 2.4-2). With increased supplies through HCPP, water supplies from other sources would be substantially reduced.

As with the no-project alternative, however, the screen extension alternative would not include measures to minimize the potential for future river gradient changes that could significantly reduce the flow rates and water levels in the oxbow (Section 2.4.1, No-Project Alternative). Annual variations (Figure 2.3-1) could reduce the river gradient, even without considering major flood or other river events that could modify the gradient.

The probable occurrence of these gradient changes combined with analyses (Ayres 1996d) that address current conditions indicate that the screen extension alternative would not be reliable in meeting other key fish protection considerations (e.g., sweeping flows in front of the screen, fish exposure time to the screen, and lower oxbow flows to the river). Therefore, unlike the no-project alternative, the screen extension alternative would nearly restore existing HCPP capacity (3,000 cfs) for most river flows (Table 2.4-2), but similar to the no-project alternative, it would not meet key fish protection criteria and pose long-term risks that HCPP operations would not be viable due to future river gradient changes.

The specific construction, operation, mitigation, and monitoring activities expected with the screen extension alternative are described in the following sections.

2.4.2.1 Screen Extension Construction Activities and Schedule

Construction activities for the screen extension alternative would include more than doubling the length of the existing screen, improving the upper oxbow channel, and blocking the existing internal fish bypass system on the existing fish screen. Some of the activities described for the no-project alternative would also be constructed with the screen extension alternative. These similar activities include improving the upper and lower oxbow, constructing a new oxbow flow control structure with removable bridge deck, and installing adjustable baffles behind the fish screen. Table 2.4-1 lists and Figure 2.4-3 shows the location of the major construction features of the screen extension alternative.

Extended Fish Screen Structure

The screen extension would be placed upstream of the existing screen so that it would increase the existing screen length from about 450 feet to 1,050 feet. Final design could change the length of the screen by approximately 100 feet.

The screen design would be similar to the existing screen. The flat-plate screen mesh would consist of strips of steel spaced at 3/32-inch intervals and supported by steel members anchored to concrete piers. The piers would be placed on a concrete foundation at approximately the same elevation as the existing screen foundation.

C-085427

C-085427

The screen would extend up from the foundation approximately 12 feet, where steel plates would extend approximately 15 more feet to a 16-foot wide deck where equipment and vehicles could access the screen for maintenance activities. The screen would be constructed so that river flows less than approximately 100,000 cfs would not overtop the fish screen deck. Overtopping would normally occur only during winter flood flows when HCPP diversions are minimal or non-existent. An automated cleaning system similar to that used on the existing screen would be installed on the new screen to prevent debris from accumulating and to maintain optimum screen performance.

A sheet pile retaining wall would extend immediately upstream of the screen to transition oxbow flows from the upper oxbow bank improvements (see ***Improved Upper Oxbow Channel***) to the new screen. These transition walls would be designed to minimize eddies that could create predator holding areas. A replacement dredge dock facility would be located in the pumping plant forebay.

Construction of the new screen would require temporary cofferdamming, unwatering, and dewatering in the oxbow. These cofferdams would be created by using vibrating pile drivers operated from shore or from barges. Impact pile drivers would be used to seat the sheet piles at the final depth. Based on geotechnical information and anticipated construction activities for the fish screen area, it would be expected that the vibratory pile drivers could be used to drive the piles a majority of the necessary depth. Sheet piles could be set several sheets at a time with a vibratory driver to the extent feasible. Then, impact pile drivers would be used to complete that set of sheet piles before continuing with the next set; or, this could also be accomplished by setting all sheet piles in that segment with the vibratory pile driver and then returning to complete sheet pile driving with the impact driver for all of the sheet piles at once. In the first instance, impact pile driving could be required two to three hours per day, or about one day per week for several weeks. In the latter case, impact pile driving could be required for one full week, interspersed with weeks of vibratory hammer use. The sheet pile walls of the cofferdams would need to be approximately 650 feet long and 20 feet high for normal flows, 30 feet high if flood flows are expected. Figure 2.4-3 illustrates the general design of the temporary cofferdams.

During this construction phase, approximately 400 feet of old sheet pile wall along the northern edge of the forebay would need to be removed before the new screen structure's afterbay could be excavated. Old sheet piles would be removed and the forebay expansion excavated using heavy equipment, such as self-loading scrapers, crawler tractors, graders, and self-propelled compactors.

The bulkhead on the existing fish screen would be removed and the existing internal fish bypass system and outfall would be closed. Several workshops and underground utilities would need to be relocated early in construction. Workshops would be moved to an area adjacent to the heliport near the CDFG building. New utilities would be constructed underground and routed around the area proposed for the expanded forebay. All new utilities for the workshops and new fish screen would be placed underground.

C—085428

C-085428

Adjustable Fish Screen Baffles

Adjustable baffles would be retrofitted to the existing screen and included with construction of the fish screen extension. For the screen extension, the design of the baffles would be similar to the baffles described for the no-project alternative in Section 2.4.1.1 (No-Project Alternative Construction Activities and Schedule).

Extended Left Bank Oxbow Earthen Guide Berm

The existing earthen guide berm (also called an embankment) across the oxbow from the existing fish screen would be extended farther upstream to a distance equal to the length of the screen extension. As shown on Figure 2.4-2, the berm would gradually narrow the channel in front of the screen to provide uniform hydraulic conditions along the face of the screen.

Improved Upper Oxbow Channel

Similar to the no-project alternative described in Section 2.4.1.1 (No-Project Construction Activities and Schedule), the screen extension alternative also would include improvements to the upper oxbow. The improvements in the oxbow for the screen extension, however, would be greater than the improvements for the no-project alternative. Modifications would include clearing of vegetation, recontouring the channel and sideslopes, and placing riprap on the channel banks. The 600 feet of riprap would be placed on the oxbow slideslopes, 300 feet on the right bank, and 300 feet on the left bank.

Improved Lower Oxbow Channel

Improvements to the lower oxbow channel would be the same as described for the no-project alternative in Section 2.4.1.1 (No-Project Construction Activities and Schedule).

Oxbow Flow Control Structure with Removable Bridge Deck

The new oxbow flow control structure and bridge to Montgomery Island would be the same as described for the no-project alternative in Section 2.4.1.1 (No-Project Alternative Construction Activities and Schedule).

Internal Fish Bypass System

No internal fish bypass system would be constructed with the fish screen extension and the internal bypass on the existing system would be closed.

Staging Area

A staging area of approximately 14 acres would be used to stockpile rock, store equipment and construction materials for the screen extension, provide employee parking, and serve as a construction management area for the construction contractors, inspectors, and lead agency

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construction managers. The staging area would likely be located on GCID's land across from the HCPP service yard at the intersection of First Avenue and Cutler Avenue.

Construction Schedule and Management

Construction management of the screen extension alternative would be shared by GCID and Reclamation. GCID would be responsible for improvements to the existing screen and lower oxbow, and Reclamation would be responsible for the screen extension and improvements to the upper oxbow. The work would occur over an approximately two-year period as shown on **Figure 2.4-4.**

2.4.2.2 Screen Extension Operations and Maintenance

Screen extension operations and maintenance activities would be similar to current activities except for potential changes associated with dredging operations, the oxbow flow control structure, fish screen baffles, and the FPEMP. The general timing of fish screen and oxbow maintenance activities is shown in Table 2.4-5.

Operations would be expanded to include the increased forebay area behind the fish screen extension and the annual contouring of the extended left bank earthen guide berm. Guide berm maintenance, dredging, and dredge spoil management would be similar to activities described for the no-project alternative in Section 2.4.1.2 (No-Project Operations and Maintenance), except that additional forebay dredging would require the disposal of more dredge material.

2.4.2.3 Screen Extension Mitigation

The lead agencies (GCID, CDFG, Corps, and Reclamation) have identified several measures that would minimize the potential for adverse impacts from the project. These include design, construction management, and project operating measures described below. Many of the design measures have already been incorporated into screen extension and other project alternatives. Construction management measures include construction worker education and construction contract specifications to minimize impacts to biological resources, local landowners, and worker health and safety.

~~Additional measures have been recommended and are presented in Chapter 4. These measures include the specific types and amount of terrestrial (e.g., riparian) and aquatic (SRA Cover) habitat mitigation needed to compensate for project impacts.~~

If the screen extension or other project alternative is selected and approved by the lead agencies, then proposed project mitigation could be supplemented with measures adopted by the lead agencies to address potentially adverse effects. Supplemental measures could include those presented in Chapter 4 (Impact Analyses). Lastly, mitigation requirements could be specified after this EIR/EIS process by agencies with permitting authority for the project. However, because permitting agencies have participated in the planning and design of the project

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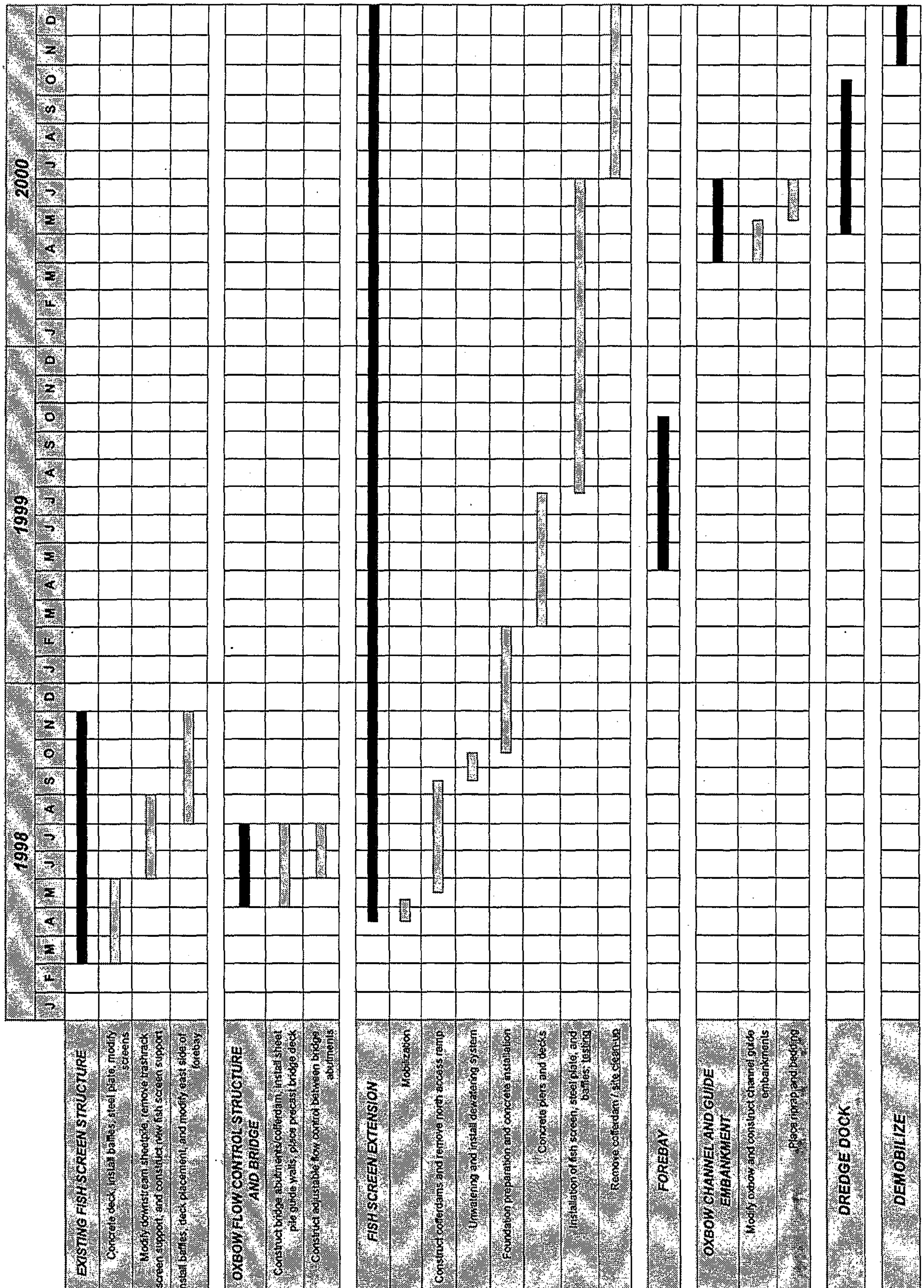
FIGURE 2.4-4. CONSTRUCTION SCHEDULE: SCREEN EXTENSION ALTERNATIVE



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(Section 1.7, Public Agency Consultation and Coordination), the lead agencies anticipate that mitigation adopted through decisions on this EIR/EIS should adequately address most, if not all, potentially significant environmental effects.

Presented below are general descriptions of the overall mitigation monitoring program and mitigation measures that have either been adopted or identified as potentially feasible measures available to mitigate adverse effects of the project. Chapter 6 (Environmental Commitments and Mitigation and Monitoring) provides further details on the proposed environmental mitigation monitoring for the project.

Construction Contract Specifications

Construction of the fish screen improvements and associated facilities would be completed in accordance with Reclamation construction contract specifications paragraphs. These specifications stipulate general policies for the construction program; access to work and haul routes; use of land for construction purposes, existing fences, utility lines, maintaining public traffic; protection of existing installations; electric power for construction use, water use for construction purposes, safety, environmental quality protection, landscape preservation; repair and replacement of existing vegetation; prevention of water pollution; abatement of air pollution; dust, light and noise control; pesticide use; and water removal.

Final construction designs and plans for all project features, including the embankments, would comply with existing building standards that take into consideration the potential for liquefaction, settlement, and other geologic hazards.

During unwatering of the cofferdams required for construction of the proposed gradient facility and the fish screen extension, water drawn from near the river bed would be discharged into a desilting basin prior to discharge into the river. This would reduce the chance for any potential increases in turbidity. Desilting basins could be located within one or more of the staging areas.

Reclamation, GCID, and the Corps would each be responsible for contracting for certain portions of project construction. Construction contracts will require compliance with mitigation provisions and permit conditions of agency decisions. To help minimize the potential for redundancy and improve the success of mitigation implementation, the lead agencies would designate a representative of the lead agencies that would coordinate mitigation requirements and monitoring among the construction contracts.

Access Management Plan

To promote efficient, safe access to construction areas, an Access Management Plan would be prepared and implemented prior to the initiation of construction activities. The following items would be considered in this plan.

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- The ability of access routes to accommodate high levels of construction vehicle and truck traffic. Factors would include road width, surface conditions, and vertical clearance.

- Securing necessary easements from the landowner(s), including consideration of improvement and maintenance costs, restoration activities, and damage provisions.

- Ensuring the safety of all people potentially affected by construction traffic. Affected people would be informed about the expected changes in traffic levels, and reasonable accommodations to help ensure safety (e.g., temporary fencing and slower construction speed limits) would be considered.

- Ensuring vehicle access would not disturb adjacent riparian vegetation during placement of permanent features in the project area.

Environmental Compliance and Mitigation Monitoring Program (ECMMP)

Chapter 6 (Environmental Commitments and Mitigation and Monitoring) presents a summary description of the proposed ECMMP that would be used by the lead agencies as the master program to implement, track, and assess the success of mitigation included as part of project approvals. As an umbrella program for managing mitigation, the ECMMP would organizes, identifyies responsibilities, and shows the timing of individual and resource-specific plans.

Local Potential Riparian and SRA Cover Habitat Mitigation Options

The lLocal riparian and SRA Cover mitigation options under review for the screen extension and other project alternatives are include those shown on **Figure 2.4-5**. Since completion of the Draft EIR/EIS, on-site and off-site mitigation options have been refined and a specific proposal (Parcel No. 037-100-002) for habitat mitigation has been developed by the lead agencies. This parcel is one of several options that the lead agencies could acquire for mitigation purposes. Acquisition of Parcel No. 037-100-002 assumes landowner willingness to sell the land. If the landowner is unwilling to sell the property, then the lead agencies would seek to acquire another mitigation site option from a willing seller.

The final amount and location of on-site and off-site mitigation would be based on final design, consultations with resource agencies, coordination with requirements of the Bbiological Oopinions to be issued by of the NMFS and USFWS, and availability and suitability of site-specific conditions. Parcel No. 037-100-002 would provide only limited SRA Cover value. The lead agencies may also consider other sites in combination with Parcel No. 037-100-002 to compensate for habitat impacts. Parcel No. 037-100-002 would exceed compensation needed for project impacts to riparian habitat (including habitat of the valley elderberry longhorn beetle) and wetlands. Chapter 6 (Environmental Commitments and Mitigation and Monitoring) describes the habitat evaluation and mitigation process for identifying, implementing, and monitoring on- and off-site measures. The areas and activities shown on Figure 2.4-5 represent measures identified by the lead agencies, resource agencies, and lead agency consultants as potentially viable options.

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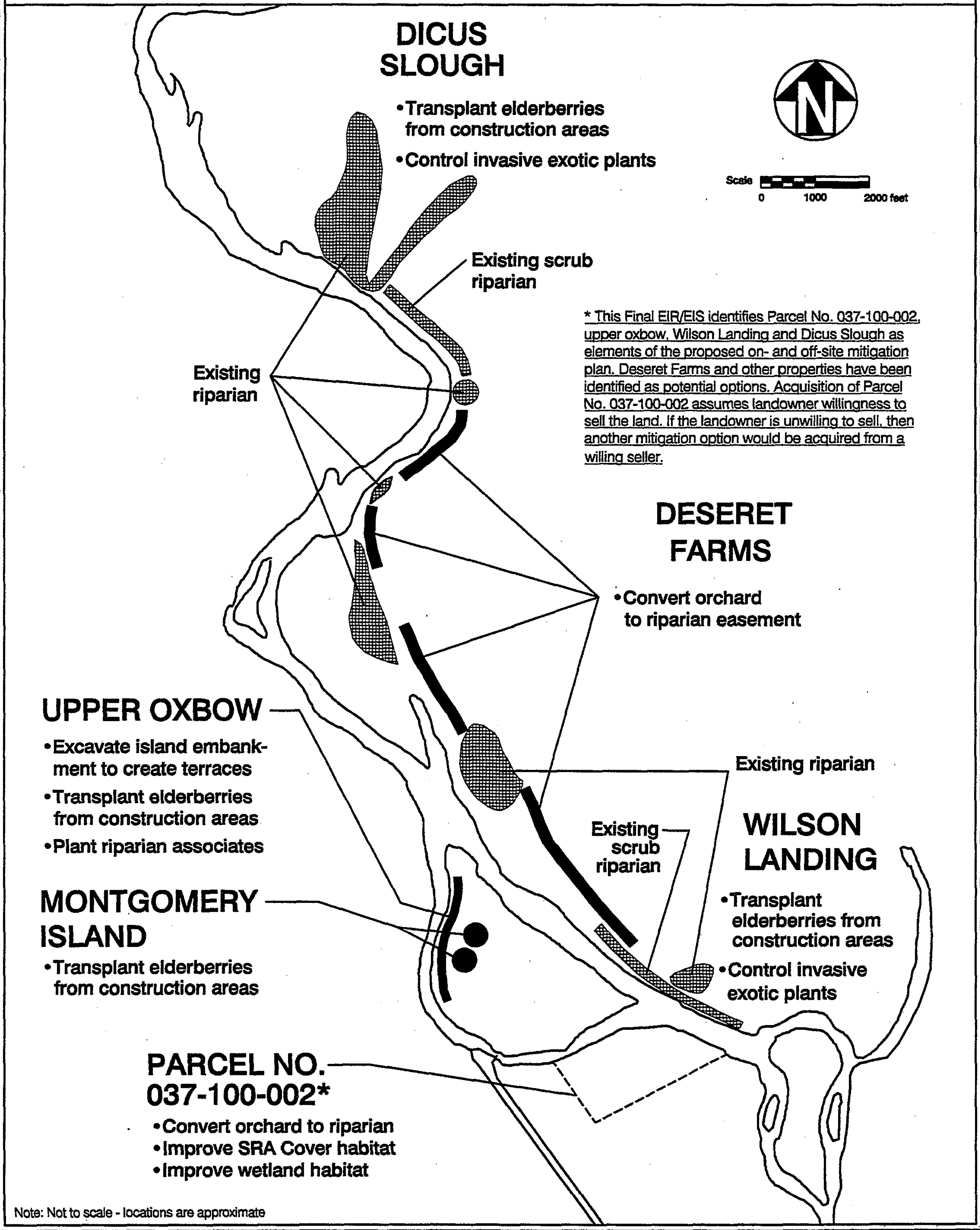
FIGURE 2.4-5. LOCAL POTENTIAL RIPARIAN AND SRA COVER HABITAT MITIGATION OPTIONS*



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Initial elderberry transplants would occur from the screen extension area to Wilson Landing, lands owned by CDFG and identified as a suitable transplant site by USFWS and CDFG. Wilson Landing is shown on Figure 2.4-5.

~~Two types of~~ L~~l~~ocal biological resources mitigation activities ~~c~~would occur ~~with the project. The first type involves activities associated~~ with standard construction practices and ~~c~~would include avoidance, revegetation of disturbed areas, and remedial actions (e.g., spill containment) for unplanned events. These standard measures are considered in the impact analyses in Chapter 4 and are not addressed further in this section. ~~The second type involves the quantification and designation of areas for compensating net project impacts. At the time this EIR/EIS was prepared, options for mitigating net effects had been identified, but decisions had not been made on specific amounts or locations needed to offset project effects.~~

Off-Site Potential Riparian and SRA Cover Habitat Mitigation Options

Initially, more than 27 off-site locations were identified and evaluated as potential off-site mitigation locations for project impacts (Section 6.2, Mitigation Measures Recommended for Project Features). These and other potential sites were narrowed to six options. All six options provide opportunities for riparian (including impacts to the valley elderberry longhorn beetle), SRA Cover, and other habitat.

As described above, this Final EIR/EIS describes the proposed acquisition of land south of the lower oxbow (Parcel No. 037-100-002) for riparian, SRA Cover, and other habitat mitigation. This parcel is one of several options that the lead agencies could acquire for mitigation purposes. Acquisition of Parcel No. 037-100-002 assumes landowner willingness to sell the land. Parcel No. 037-100-002 would provide only limited SRA Cover value. The lead agencies may also consider other sites as options to compensate for habitat impacts. Parcel No. 037-100-002 would exceed compensation needed for project impacts to riparian habitat (including habitat of the valley elderberry longhorn beetle) and wetlands.

Parcel No. 037-100-002 provides opportunities for the restoration, improvement, and/or creation of riparian habitat, SRA Cover, and seasonal and emergent wetlands. To mitigate for riparian habitat impacts resulting from the project, up to 70 acres of the existing walnut orchard adjacent to the riverbank could be converted into riparian habitat. The walnut trees would be removed and native riparian species would be planted. Species under consideration include: elderberry, Fremont cottonwood, box elder, Northern California black walnut, valley oak, California sycamore, willows, button bush, and Oregon ash. Mitigation for elderberry shrub impacts would be performed simultaneously with riparian mitigation.

Parcel No. 037-100-002 currently supports significant SRA Cover along the river as a result of natural colonization of vegetation along revetted portions of the river bank. Existing SRA Cover values are already relatively high and are anticipated to improve with time as additional colonization occurs and vegetation matures.

Wetlands could be created in the northeastern corner of Parcel No. 037-100-002 as an extension of the channel between the parcel and South Island. This channel would no longer be connected with the lower oxbow following construction of the lower oxbow improvements. Modifications could be designed to create various stages of seasonal and emergent wetland through its interconnection with the river. Sanford's arrowhead and/or rose mallow, if found at the wetland impacted at the gradient facility site and if deemed appropriate by USFWS biologists, could be transplanted, or their seeds collected and scattered, within the created wetlands.

A detailed plan for terrestrial/aquatic habitat improvement on Parcel No. 037-100-002 is being developed by the lead agencies through consultation with the USFWS and NMFS. Final habitat development plans for this or other mitigation options would be made a part of project approvals and be completed as part of final project design.

~~The off-site riparian and SRA Cover mitigation options~~ If none of the six off-site mitigation options has landowners willing to sell their property, or if all six sites are otherwise determined not to be viable options, then numerous other sites are potentially available. ~~under review for the screen extension and other project alternatives~~ The locations of these other options include those ~~are~~ shown on **Figure 2.4-6**, and described in Section 6.2 (Mitigation Measures Recommended for Project Features). As noted above, ~~T~~the final amount and location of off-site mitigation would be based on final design, consultations with resource agencies, coordination with requirements of the ESA and associated ~~B~~biological ~~O~~opinions to be issued by NMFS and USFWS, and availability and suitability of site-specific conditions.

~~Appendix D describes the habitat evaluation and mitigation process for identifying, implementing, and monitoring on- and off-site measures. The areas on Figure 2.4-6 were identified by the lead agencies, resource agencies, and lead agency consultants as potentially viable options.~~

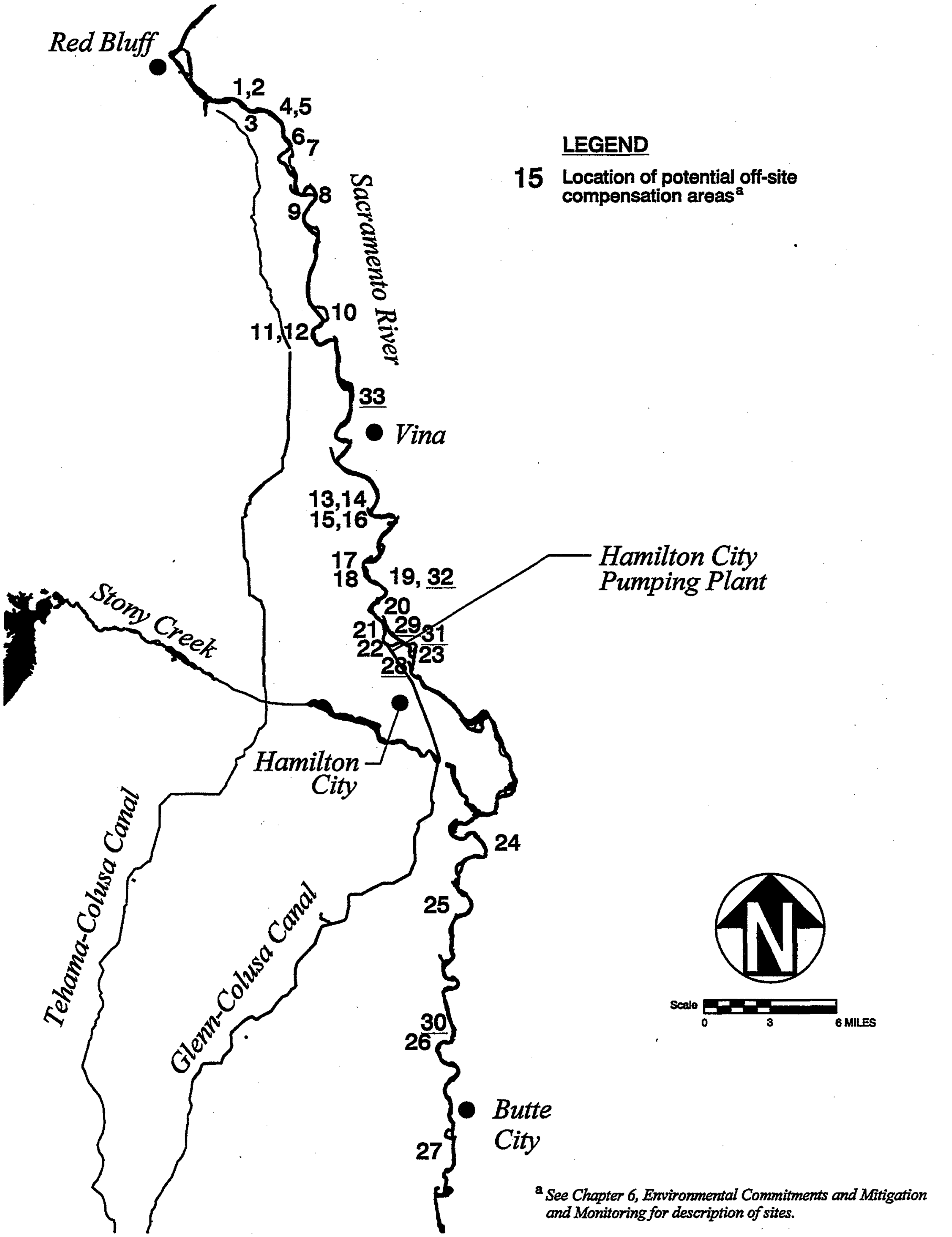
2.4.2.4 Screen Extension Monitoring

Monitoring for the screen extension alternative would include construction and post-construction monitoring activities. Chapter 6, Environmental Commitments and Mitigation and Monitoring, identifies the proposed scope, timing, and responsible parties for monitoring activities. Regardless of the alternative selected (no-project or project) GCID would, in consultation with appropriate resource agencies, develop and implement an FPEMP as identified in Table 2.4-5 and discussed in Chapter 6, to assess the effects of fish screen and HCPP operation changes on fish protection at the HCPP.

2.4.2.5 Screen Extension Costs

The estimated costs for construction of the screen extension alternative are identified in Table 2.3-4. State and Federal cost-sharing responsibilities would be divided 25 percent/75 percent, respectively, with GCID funding 12.5 percent, the State of California funding 12.5 percent, and Federal appropriations funding 75 percent. The total estimated construction cost for this alternative

FIGURE 2.4-6. OFF-SITE POTENTIAL RIPARIAN AND SRA COVER HABITAT MITIGATION OPTIONS



[a] *See Chapter 6, Environmental Commitments and Mitigation and Monitoring for description of sites.*

is approximately ~~$14.6~~15.1 million, excluding contractor overhead and profit and construction management. ~~and environmental mitigation. Environmental mitigation costs could exceed $1 million. Final cost estimates for environmental mitigation will be developed for the final EIR/EIS.~~

2.4.3 Screen Extension with Gradient Facility Alternative

The screen extension with gradient facility alternative would include the features described for the screen extension alternative (Section 2.4.2) plus a gradient facility on the mainstem Sacramento River adjacent to Montgomery Island. Modifications to the existing fish screen and oxbow included with the screen extension alternative would also be included with this alternative. This alternative would enable GCID to meet additional fish protection and screen performance criteria, including sweeping velocities past the screen and oxbow flows for returning bypassed fish to the river. Also different from the screen extension alternative, the screen extension with gradient facility alternative would enable GCID to meet its water supply obligations through the HCPP for river flows as low as 5,000 cfs (Table 2.4-2).

A key difference of this alternative from both the no-project and screen extension alternatives is that it would minimize the risk of screen performance failure and maximize the long-term reliability of HCPP operations. Historically, major changes in river gradient have caused the failure of past screen designs (Section 1.5, History of HCPP Diversions and Screens). Minor gradient changes (Figure 2.3-1) also affect screen performance, GCID's ability to meet fish protection criteria, and HCPP pumping capacity. The gradient changes are largely due to local river channel erosion and sedimentation adjacent to and downstream of the HCPP that are associated with natural river meander processes and the transport of sediments as a result of dredge spoil movement during high flows (Section 3.1, Hydrology and Water Resources).

The gradient facility would be designed with the characteristics of a natural riffle (Ayres 1996d), providing a "hard point" in the river that would ~~slightly increase and~~ stabilize the Sacramento River in the project reach and restore the minimum water surface elevation at the fish screen to provide adequate hydraulic gradient for ~~water surface elevation at the fish screen and provide the hydraulic gradient necessary for~~ efficient screen and bypass performance. The gradient facility design would provide for hydraulic conditions that would not hinder upstream or downstream fish passage and would provide adequate depths to facilitate navigation by recreational boats. Ayres (1991) proposed the "design riffle" concept based on the rationale that if fish species and recreational boaters can accommodate natural riffle hydraulic conditions within the Sacramento River, then those hydraulic conditions would provide an acceptable basis for the design of the gradient facility. Additional information on the "design riffle" concept can be found in Ayres (1996d) and RCE (1994a).

The in-river portion of the gradient facility would involve placement of sheet piles at specified elevations and intervals in the river bed. The buried sheet piles would be ~~capped with concrete and~~ surrounded and covered by large riprap. Placement of riprap upstream and downstream along both the river channel and river levee banks would maintain river channel alignment through the in-river portion of the facility.

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The gradient facility feature of this alternative would establish a minimum gradient between the upstream and downstream points of Montgomery Island and, therefore, enable HCPP operations to comply with nearly all fish protection criteria over the life of the project. However, as with the screen extension alternative (Section 2.4.2), lack of an internal bypass system would increase fish exposure time to the screen relative to the existing screen. Therefore, a key fish protection criterion that would not be met with this alternative is the exposure time of downstream emigrating juvenile salmonids to the screen face.

The specific construction, operation, mitigation, and monitoring activities expected with the screen extension with gradient facility alternative are described in the following sections.

2.4.3.1 Screen Extension with Gradient Facility Construction Activities and Schedule

Construction activities in the oxbow (screen improvements, oxbow channel improvements, and oxbow flow control) for the screen extension with gradient facility alternative would be the same as those described for the screen extension alternative in Section 2.4.2.1. The primary difference of the screen extension with gradient facility alternative is the addition of the gradient facility and associated river channel reinforcements. Table 2.4-1 lists and **Figure 2.4-7** shows the location of the major construction features of the screen extension with gradient facility alternative.

Extended Fish Screen Structure

The construction of the fish screen extension would be the same as described for the screen extension alternative in Section 2.4.2.1 (Screen Extension Construction Activities and Schedule).

Adjustable Fish Screen Baffles

Adjustable baffles would be retrofitted to the existing screen and included with the new screen as described in Section 2.4.1.1 (No-Project Construction Activities and Schedule) and Section 2.4.2.1 (Screen Extension Construction Activities and Schedule).

Extended Left Bank Oxbow Earthen Guide Berm

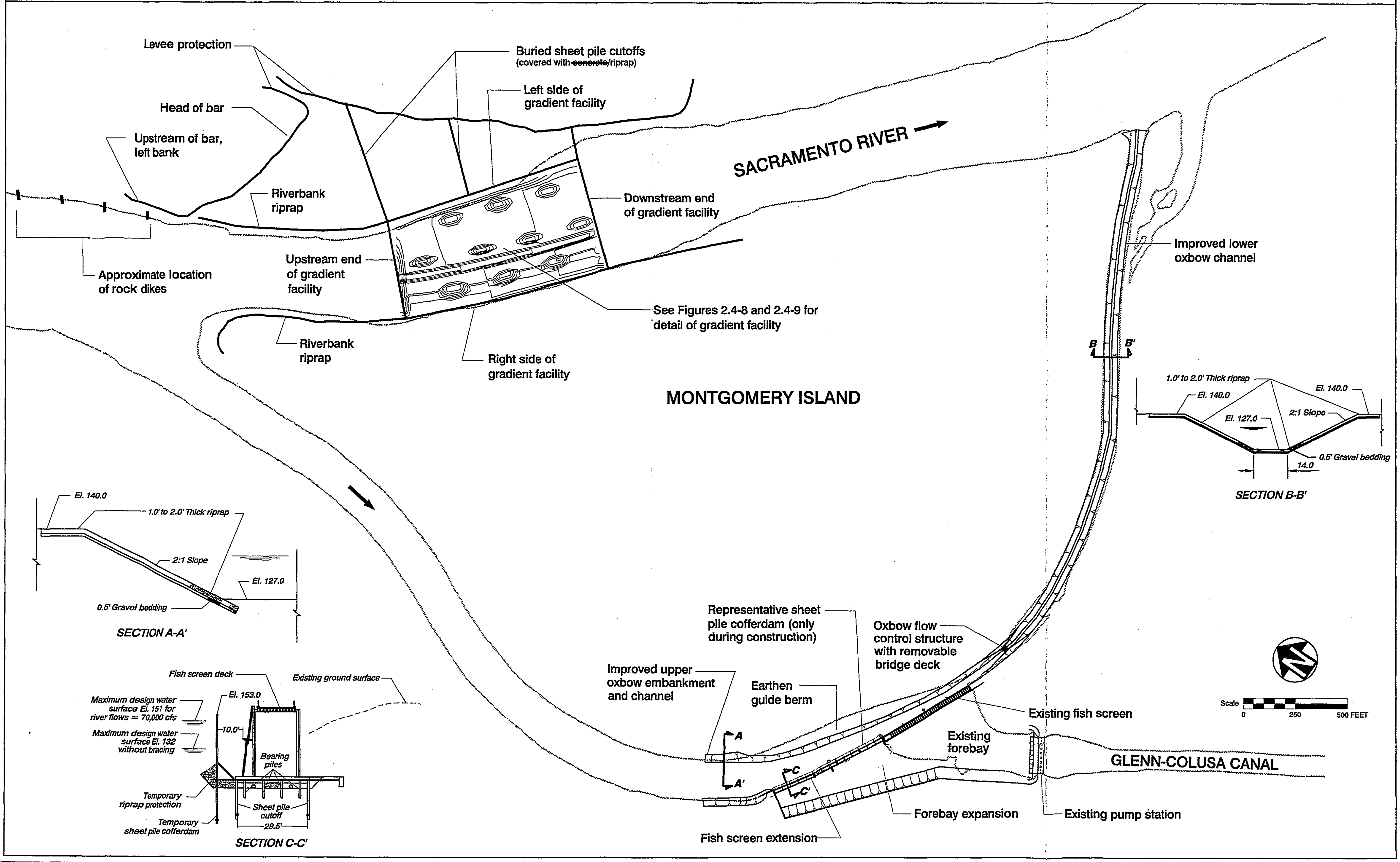
The existing earthen guide berm across the oxbow from the existing fish screen would be modified as described in Section 2.4.2.1 (Screen Extension Construction Activities and Schedule).

Improved Upper Oxbow Channel

The upper oxbow channel and bank construction activities would be as described in Section 2.4.2.1 (Screen Extension Construction Activities and Schedule).

SCREEN EXTENSION WITH GRADIENT FACILITY ALTERNATIVE

FIGURE 2.4-7



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Improved Lower Oxbow Channel

The lower oxbow channel and bank construction activities would be as described in Section 2.4.1.1 (No-Project Construction Activities and Schedule).

Oxbow Flow Control Structure with Removable Bridge Deck

The new oxbow flow control structure and bridge to Montgomery Island would be the same as described in Section 2.4.1.1 (No-Project Construction Activities and Schedule).

Improved River Gradient

The construction activities for the river gradient portion of the screen extension with gradient facility alternative would be initiated following completion of the existing fish screen improvements and the fish screen extension. The activities would include staged sequencing of access road construction (existing access roads on both sides of the river would be widened from existing widths of 10 to 20 feet up to a maximum of 50 feet), staging area clearing, cofferdam installation in the river, unwatering and dewatering of the cofferdam enclosures, sheet pile installation with vibratory and impact sheet pile driving equipment, placement of riprap ~~and concrete~~ around and over the sheet piles, and removal of cofferdams.

Sheet-pile driving could vary depending upon the contractor and would involve both vibratory and impact sheet pile driving. It would be expected that the vibratory pile drivers could be used to drive the piles a majority of the necessary depth. Sheet piles could be set several sheets at a time with a vibratory driver to the extent feasible. Then, impact pile drivers would be used to complete that set of sheet piles before continuing with the next set; or, this could also be accomplished by setting all sheet piles in that segment with the vibratory pile driver and then returning to complete sheet pile driving with the impact driver for all of the sheet piles at once.

The construction of the gradient facility would occur in four phases during one year with one-half of the river channel blocked by cofferdams in each of the four phases. By constructing in four phases, there would be increased assurance that any given phase could be completed during periods when impacts to fish could be minimized. The areas of construction and associated disturbance within the riverbed at any one time would be minimized in comparison to the one- or two-phase construction options (see ***Alternative Gradient Facility Construction Methods*** below). However, this approach reduces some of the efficiencies that come with larger scale operations. In particular, the cofferdam installation and associated expenses would be increased by the more extensive compartmentalization of the construction activities.

The downstream portion of the gradient facility would be installed first, starting with the west (Montgomery Island) side of the river channel. The downstream east side of the channel would be constructed second. The west and east sides of the upper portion of the gradient facility would then be constructed third and fourth, respectively. Placement of riprap between the buried sheet piles would be completed within dewatered areas prior to moving upstream. Using this approach, segments of the structure would tend to be functionally complete and would be likely

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to withstand interim conditions if construction activities had to be suspended during high flows. Further, by working from downstream to upstream, the impact of construction on local river hydraulics would be minimized in the event that work had to be suspended and delayed until the following year.

To ensure successful dewatering, the sheet pile cofferdams would be driven approximately 40 feet into the river bed for dewatering (RCE 1993; 1994b). Earthwork and ground preparation would be accomplished with heavy equipment such as tractors, graders, and compactors. Front-end loaders and hydraulic excavators would be used to install riprap to stabilize the banks before the permanent sheet pile is driven for the gradient facility. A desilting basin and a temporary barge launch area would also be constructed early in the construction sequence.

The in-river construction activities would also include the use of pipeline dredges and hydraulic excavators for contouring and placing riprap on the river channel, as shown in a representative cross-section of the facility on **Figure 2.4-8**. The entire bed of the 1,000-foot river channel portion of the gradient facility **(Figure 2.4-9)** would be covered with riprap in a configuration that simulates natural riffles in the vicinity of the project (RCE 1994a; Ayres 1996d). This configuration would include the construction of depressions in the riverbed to establish slower velocity pool areas for upstream migrating adult fish, a longitudinal berm to maintain channel alignment, and a thalweg channel where the primary energy path of the river would be directed. Figure 2.4-7 shows the proposed layout of the in-river portion of the gradient facility. Detailed descriptions of the facility are presented in Ayres (1996d) and 1997e).

Channel and levee work would include clearing vegetation and placing riprap along both sides of the river, on east side river levees, and at the proposed locations for the rock dikes immediately upstream of the gradient facility. Riprap would be placed along ~~both sides of~~ the river channel, ~~bank,~~ including the in-river gradient facility portion of the channel, for a total river channel ~~bank~~ distance of ~~4,400~~ 3,600 feet (sum of both sides of the river). High-water levee sections would also be cleared and riprapped to help ensure the river is maintained within its current high water channel. Additional riprap would be placed on east side levees upstream and downstream of the in-river portion of the gradient facility (Figure 2.4-7). River levee riprap would be placed over a total distance of approximately ~~3,600~~ 4,400 feet (sum of both sides of the river). The in-river portion of the gradient facility would be relatively less erosive than the earthen levees in the vicinity and flood events could compromise the stability of the levees and river banks surrounding the facility. The east side levee riprap would prevent the river from "out-flanking" the gradient facility.

During preparation of this Final EIR/EIS, project engineers were evaluating the possibility of eliminating the revetment proposed for the "Head of Bar" shown on Figure 2.4-7 and replacing the east river levee revetment with entrenchment of a revetment bank within the orchard. For purposes of analysis, this EIR/EIS assumes construction of the features shown in Figure 2.4-7. However, if feasible, these alternative construction methods could substantially reduce riparian habitat impacts.

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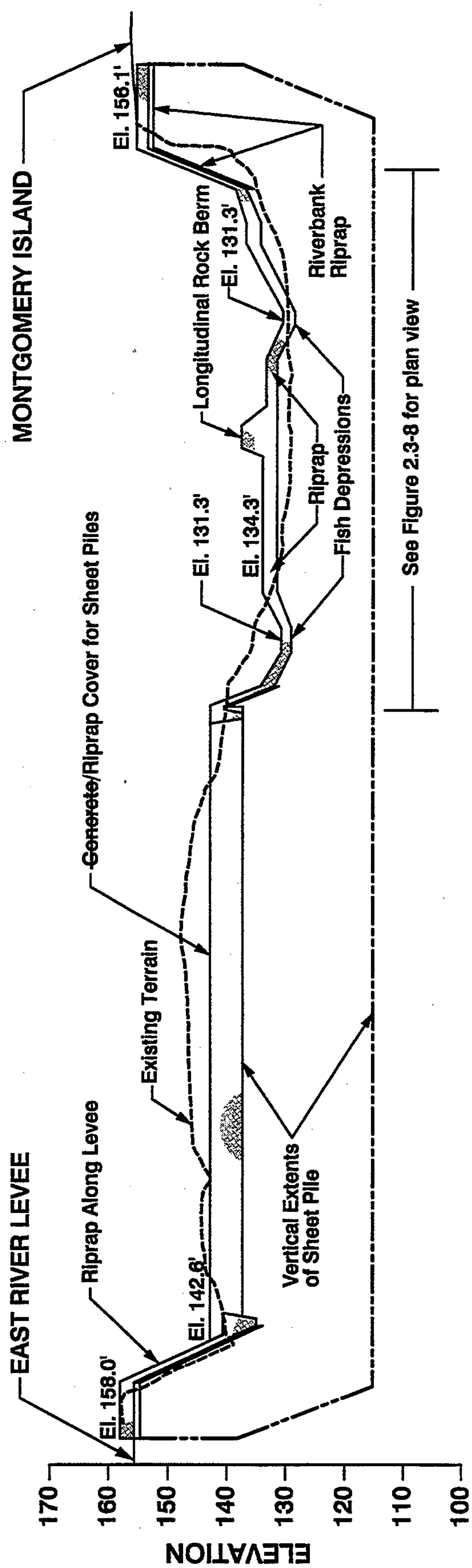
FIGURE 2.4-8. REPRESENTATIVE CROSS SECTION OF GRADIENT FACILITY



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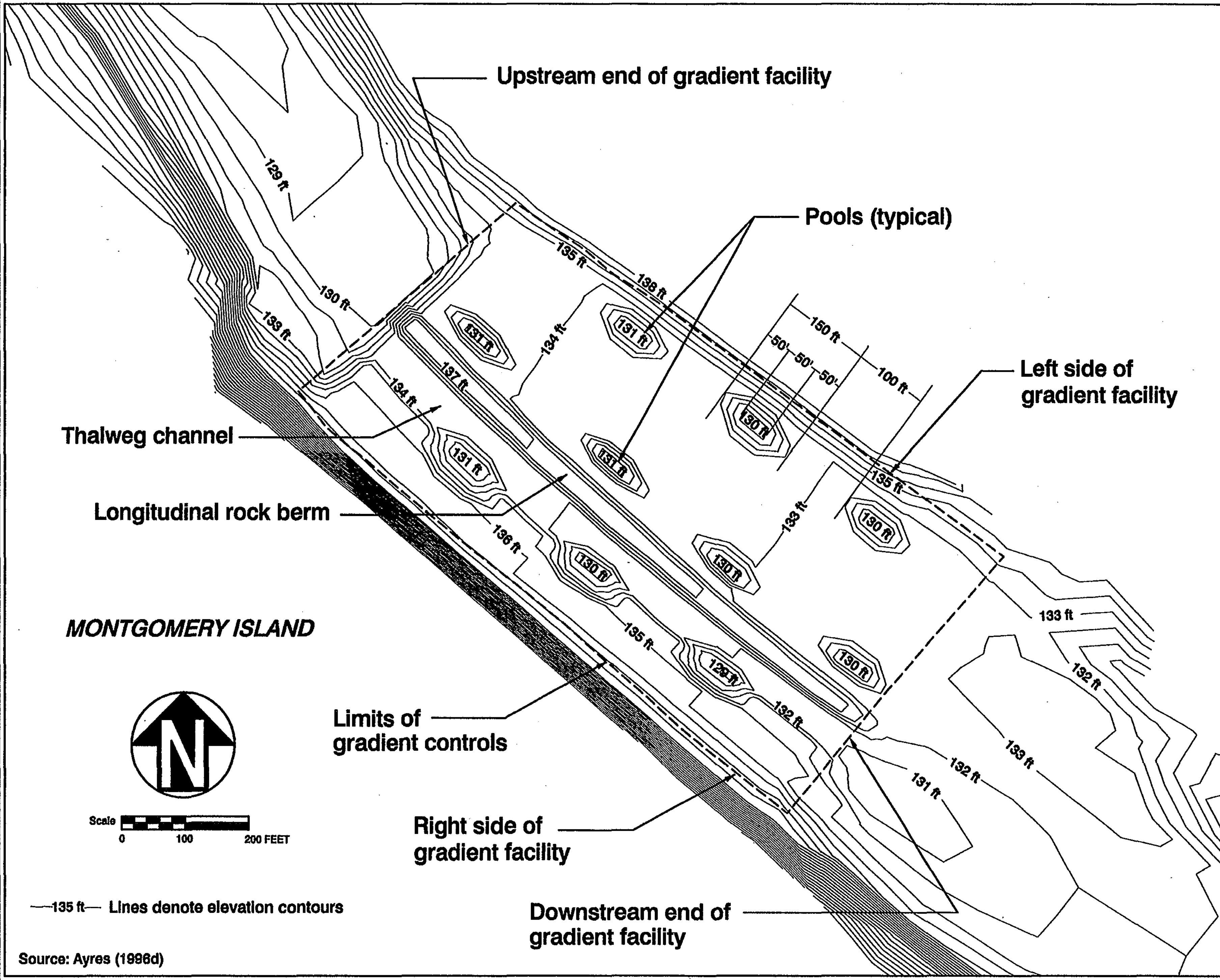

FIGURE 2.4-9. GRADIENT FACILITY IN-RIVER DESIGN DETAIL

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Rock Dikes in River

The river channel and levee riprap described above for the gradient facility would be supplemented by the placement of four rock dikes immediately upstream of the facility on the east side of the river (Figure 2.4-7). The purpose of the dikes would be to prevent the river from flanking the gradient facility (Mussetter 1997). Historic variations in river course (Section 3.1, Hydrology and Water Resources) show some minor shifting of the river in this area. The dikes would help ensure the river's natural meander forces do not create a channel that bypasses the gradient facility. The dikes would be approximately 40 feet long and extend perpendicular from the river bank toward the main channel. The dikes would be separated at distances of about 150 feet. The top of the dikes would tie into the existing bankline (Ayres 1997c).

Internal Fish Bypass System

No internal fish bypass system would be constructed with the fish screen extension, and the internal bypass system on the existing fish screen would be closed as described in Section 2.4.2.1 (Screen Extension Construction Activities and Schedule).

Staging Area

Three temporary staging areas would be constructed to stockpile rock, store equipment and construction materials, provide employee parking, provide a desilting basin, and serve as a construction management area for the construction contractors, inspectors, and lead agency construction managers. One staging area would be located on GCID's land across from the HCPP service yard at the intersection of First Avenue and Cutler Avenue. It would be up to 14 acres in size. A second staging area would be located on the southeast portion of Montgomery Island and cover an area up to 10 acres. The third staging area would be on the east side of the river directly across from Montgomery Island.

Construction Schedule and Management

Construction management of the screen extension with gradient facility alternative would be shared by GCID, Reclamation, and the Corps. GCID would be responsible for improvements to the existing screen and lower oxbow. Reclamation would be responsible for the screen extension and improvements to the upper oxbow. The Corps would be responsible for the gradient facility. The work would occur over an approximately three-year period as shown on **Figure 2.4-10.**

Alternative Gradient Facility Construction Methods

The lead agencies are currently in the final design phase of the project. ~~Detailed~~ Final plans have not been developed on ~~the approach and~~ methods for construction of the gradient facility. ~~For purposes of this EIR/EIS, the one-year, four-phase construction method has been assumed as the proposed construction method for impact analyses later in this document. Several alternative construction methods are under consideration and have been analyzed, but information is~~

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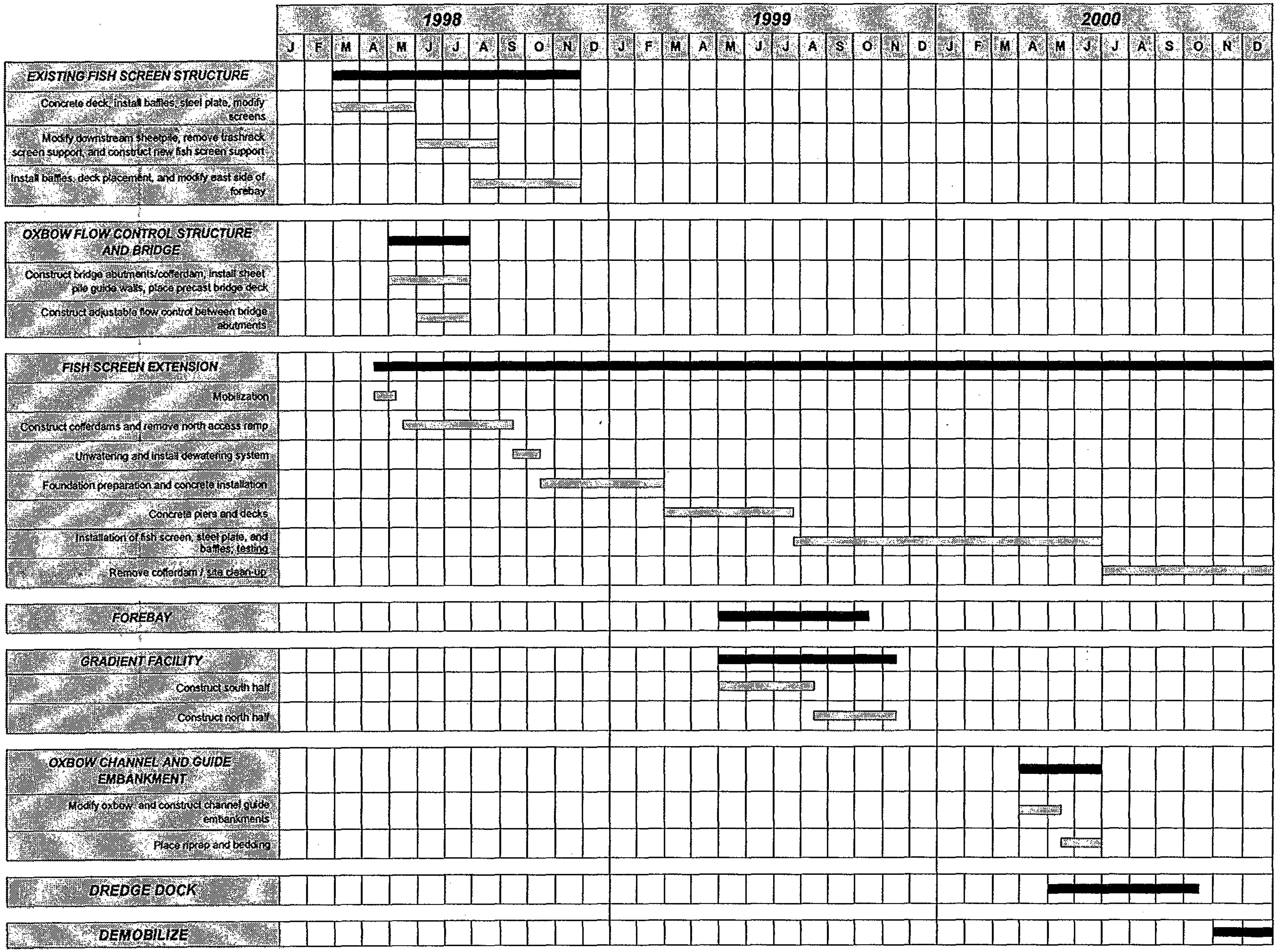
FIGURE 2.4-10. CONSTRUCTION SCHEDULE: SCREEN EXTENSION WITH GRADIENT FACILITY ALTERNATIVE



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currently limited on their scope. Several methods would be available for construction of the gradient facility. These include variations on two basic methods: dry construction involving the use of cofferdams to exclude water from construction areas and wet construction involving the in-water placement of materials. The method proposed in this EIR/EIS for construction of the gradient facility is dry construction. However, this EIR/EIS analyzes both methods with the anticipation that either method or a combination of methods could be selected and implemented. The information presented below represents the best available information for analyzing impacts later in this document.

Wet Construction

Wet construction would utilize portable barges, cranes, compactors, front-end loaders, hydraulic excavators, and large draglines to construct the gradient facility. Unlike the dry construction method, cCofferdams and water removal would not be required. Temporary rock berms extending from Montgomery Island or the eastern river bank could be used to facilitate construction. The berms would be composed of clean rock, would be up to approximately 150 feet long, and would be in the river for up to a month at a time.

No desilting ponds would be required for the wet construction method. Also, substantial reductions in sheet pile driving would result (over the dry method) because no cofferdams or dewatering of the riverbed would be required.

Staging of the in-water (wet) construction method would include stockpiling of materials and supplies (as with the dry method), use of multiple barges for riverbed excavation, installation of sheet piles, placement of rock over and between the sheet piles, and river channel and riverbank revetment. Up to 100 feet of river channel would be blocked during sheet pile installation. The actual amount would depend on the final operation sequence selected by the contractor.

Excavation of the riverbed to design grade and for shaping of the channel (e.g., fish pools) could involve up to a 300-by-300-foot area in a days operation. Placement of riprap in the gradient facility would progress more slowly, covering an area roughly 100 feet by 100 feet at a time. The rate of sheet pile driving is less predictable and would be affected by site-specific conditions. Sheet-pile driving could vary depending upon the contractor and would involve both vibratory and impact sheet pile driving. It would be expected that the vibratory pile drivers could be used to drive the piles a majority of the necessary depth. Sheet piles could be set several sheets at a time with a vibratory driver to the extent feasible. Then, impact pile drivers would be used to complete that set of sheet piles before continuing with the next set; or, this could also be accomplished by setting all sheet piles in that segment with the vibratory pile driver and then returning to complete sheet pile driving with the impact driver for all of the sheet piles at once.

The following sections briefly describe some of the potential advantages and disadvantages of this the wet construction methodology. For the purpose of comparison, disadvantages and advantages relative to dry construction are discussed below. It is important to note that the

C—085447

C-085447

~~water based construction scenario has not been fully evaluated and this tabulation of advantages and disadvantages is by no means comprehensive.~~

Advantages

- Capable of starting and/or stopping construction quickly in the event of high water conditions or for responding to potential schedule restrictions (e.g., avoidance period for special status species).
- Provides a means of construction in the event that it would be impractical to adequately dewater the site (as would be required with dry construction).
- Limits sheet pile driving activities in the main river to the installation of the buried cutoff elements that would actually be part of the gradient facility structure.
- Eliminates the sheet pile cofferdam and dewatering costs and time to install the cofferdams, although reduced production rates would be likely to offset some of these cost reductions.
- If construction activities were delayed and could not be completed in one year, then the project could readily be winterized and reinitiated the following year.
- Reduces fish stranding by eliminating cofferdam installation.

Disadvantages

- It could be difficult to accurately produce the design lines and grades as well as inspect and provide quality control checks on the work. It could also be difficult to adjust placement of rock below water to achieve the desired configuration.
- A much higher level of survey (probably hydrographic measurements) of the rock placement would be needed during construction.
- It would be more difficult to determine and map the constructed condition, which would in turn make follow-up monitoring and evaluation of any changes more difficult to quantify.
- Aquatic resources would not be isolated from equipment and materials during construction of the gradient facility.
- Temporary increases in predation potential could result downstream of the temporary rock berms.
- There would be somewhat of an increased potential for contaminant spills from construction equipment.

- Any turbidity generated by ~~the~~ construction would occur in the main river, and it would be difficult to contain a turbidity plume if one were to be generated by manipulation of the bed materials.

- As the buried sheet pile cutoffs were constructed and riffle hydraulic conditions began to develop, shallower water depths and somewhat increased velocities would develop through the gradient facility. As a result, it could become difficult to operate barges in the vicinity of the gradient facility. As construction proceeds upstream, loaded barges and water-based equipment would only be able to work from the upstream side of the structure. The structure would become an impediment to movement of loaded barges. Equipment might not have the reach required to work just from the banks or from barges located either up or downstream of the gradient facility. Temporary rock berms may need to be extended out into the river at several locations to provide a working platform for equipment.

Dry (Cofferdam) Construction

Dry construction from within cofferdams could follow a number of construction alternatives: one-phase construction, two-phase construction, four-phase construction (analyzed in this EIR/EIS), and two-year construction. One-phase construction of the gradient facility would consist of installation of cofferdams across the main channel, consequently, all Sacramento River flow would be diverted through the oxbow. Two-phase construction of the gradient facility would consist of installation of two sets of cofferdams, one set damming off the west side of the Sacramento River channel, the other damming off the east side of the Sacramento River channel. These cofferdams would be constructed in sequence; the second would be constructed following completion of construction of the gradient facility within the first cofferdam. Two-year construction would follow the four-phase construction currently proposed; however, the two downstream quarters of the gradient facility would be constructed in year one, and the two upstream quarters would be constructed in year two rather than all four quarters in one year.

The advantages and disadvantages of each of these dry construction alternatives are discussed following a general review of the advantages and disadvantages of dry construction methods.

<u>Advantages</u>

- Once the cofferdams were in place, the construction activities would be isolated from the river. Therefore, direct impacts on aquatic species (e.g., turbidity) during construction would be minimized.

- A high degree of control could be maintained over the construction process and appropriate measurements and visual observation could occur to ensure that the gradient facility would be constructed as designed. The constructed condition could be thoroughly documented, providing an accurate baseline for monitoring and assessment of future performance.

- Production rates should be considerably higher for rock and sheet pile emplacement within the cofferdam as compared to water-based construction operations.

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C-085449

Disadvantages

- Installation of cofferdams and dewatering of the site would be a relatively costly and time-consuming process.
- Vibrating and impact pile driving for cofferdams would be an ongoing process continuing through much of the construction process. Pile driving activities would be required to install the buried sheet pile cutoff elements regardless of the method of construction.
- Local velocities would increase during the period when the cofferdams would be in place. Local hydraulic effects would include increased velocities and alteration of the flow distribution between the main river and oxbow channel. Similar impacts could occur if temporary rock dikes would be necessary as a component of water-based construction activities. This impact could be reduced somewhat by diversion of additional flows through the oxbow channel.
- The ability to cofferdam and dewater the site would depend on successfully embedding the piles into the underlying geologic units, which could include relatively resistant Riverbank Formation.
- Eddies could be created by in-river work, including cofferdams, that could create predatory fish habitat. Cofferdam designs that minimize angles would reduce predation opportunities.
- Closure of the cofferdam cells could strand and probably kill fish trapped within the cells.

One-Phase (Dry) Construction of the Gradient Facility

Under this gradient facility construction scenario, the entire Sacramento River channel would be dammed upstream of the gradient facility location, and all Sacramento River flow would be routed through the oxbow throughout the period required to construct the gradient facility. Because construction crews would have complete access to the entire construction site throughout the construction period, and because relatively time-consuming installation of multiple cofferdams would not be required, the period of time needed to complete the gradient facility under this construction scenario is anticipated to be approximately three months, possibly up to six months. However, an accurate estimate of the construction window required for this approach has not been identified to date.

Advantages

- Construction crews would have complete access to the entire construction site throughout the construction period.
- Phased cofferdam installation to facilitate construction on sections of the gradient facility would not be required, which would save time and potentially shorten the overall construction window.

C—085450

C-085450

Disadvantages

- Successful dewatering of such a large area could be difficult to accomplish.
- High levels of bank erosion and turbidity would occur within the oxbow, which would increase turbidity and sedimentation in the Sacramento River downstream of its confluence with the lower oxbow.
- All juvenile fish emigrating past the HCPP during the construction window would be routed past the fish screen, likely resulting in substantially increased numbers of fish being exposed to the screen. However, construction schedules show that screen improvements would be in place prior to gradient facility construction.
- The upstream dam used to divert river flows through the oxbow would also raise water levels for an undetermined distance upstream of the dam. The reduced current velocities and increased depth that would be expected to occur upstream of the dam would substantially change river habitat, and could result in increased predation losses within this portion of the river.
- This method would substantially affect fish migration, riverbed invertebrate habitat, and riparian vegetation habitat resources. This method would increase costs associated with mitigation.

Two-Phase (Dry) Construction of the Gradient Facility

During phase one, half of the area of the gradient facility (west side) would be cofferdammed to facilitate installing the sheet piling and riprap. During phase two, cofferdams for the second half of the area (east side) of the gradient facility would be installed to facilitate construction of this side of the gradient facility. Constructing half the gradient facility would require approximately three months (this estimate assumes working 10-hour days, five days per week). Hence, completing the entire gradient facility in one season would, at a minimum, require a six-month construction window, which is approximately equivalent to that required for the four-phase approach. Advantages and disadvantages of this construction scenario are provided below.

Advantages

- Less cofferdamming would be required compared to the four-phase approach.
- Reduced cofferdamming requirements should result in a shorter overall construction window required to complete the gradient facility.
- Construction crews would have access to a larger portion of the gradient facility at any given time during construction.

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C-085451

Disadvantages

- If construction could not be completed in one season, high winter and spring river flows could damage the partially completed gradient facility, because the completed half of the gradient facility would not be secured to both banks of the Sacramento River.

- Sacramento River flow would pass through the constricted portion of the channel for the entire length of the gradient facility (i.e., about 1,000 feet) rather than half its length, as would occur under the four-phased approach. Therefore, higher velocities in the Sacramento River channel at the gradient facility would occur for a greater distance than with the four-phase method. These higher velocities would damage unprotected sections of the river and banks.

- This approach would dictate water removal from half the area required to construct the gradient facility. Fish losses associated with water removal from larger areas under the two-phase scenario could increase relative to the four-phase scenario due to expected higher numbers of fish that would become stranded when enclosing a larger area. However, other factors also must be considered, including timing of cofferdam enclosure, particularly relative to the outmigration period for winter-run chinook salmon.

Two-Year (Dry) Construction Schedule

The current gradient facility construction schedule assumes work on the gradient facility would be initiated in mid-May and completed in mid-November of the same year. However, because potentially significant impacts to Sacramento River aquatic resources could occur if the gradient facility were constructed in four phases during one year as currently proposed, it could be advantageous to implement the four-phase, two-phase, one-phase, or wet construction scenarios over a two-year rather than one-year period. The south (downstream) half of the gradient facility could be constructed during the first year, with the north (upstream) half constructed during the second year.

Because a two-year schedule, by definition, would impact project area environmental resources in two consecutive years rather than just one (e.g., impact two-year classes of salmon rather than one), it would only be advantageous to implement if: (1) completing the gradient facility in one construction season (i.e., between April and November) was not possible; (2) attempting to complete the gradient facility in one season poses a high risk of having a partially completed gradient facility damaged or even destroyed from high winter and spring river flows; and/or (3) the construction window required to complete the gradient facility in one season would potentially result in unacceptable impacts to special status resources.

C-085452

C-085452

Advantages

- Cofferdam installation and removal of water from the enclosed areas for dry construction methods could be limited to periods of the year when winter-run chinook salmon are not emigrating past the HCPP.

- Spreading gradient facility construction over two seasons would provide additional flexibility for the contractor, thereby minimizing the possibility that construction would extend into the fall and the possibility that high winter and spring flows would damage the gradient facility.

Disadvantages

- Project impacts would extend to two seasons.
- Costs for certain construction activities, such as mobilization, could increase.

2.4.3.2 Screen Extension with Gradient Facility Operations and Maintenance

Screen extension with gradient facility operations and maintenance would be the same as described for the screen extension alternative (Section 2.4.2.2), plus annual inspection and maintenance of the gradient facility, rock dikes, and associated river channel and levee riprap. Maintenance could also include the possible need to dredge the depression pools of the gradient facility and the river channel immediately upstream of the gradient facility. If required, dredging methods would be the same as used for the oxbow. Current physical model development and testing for the gradient facility will provide further information on the possible need for river dredging and other maintenance activities. Further possible operation and maintenance requirements for the gradient facility are unknown at this time.

2.4.3.3 Screen Extension with Gradient Facility Mitigation

Mitigation plans, construction specification provisions, access management, and local and off-site potential riparian and SRA Cover habitat mitigation options for the screen extension alternative (Section 2.4.2.3, Screen Extension Mitigation) would also apply to the screen extension with gradient facility alternative. In general, the extent of mitigation required for this alternative would be greater and would involve additional specific environmental issues as described in Chapter 4 (Impacts Analyses).

2.4.3.4 Screen Extension with Gradient Facility Monitoring

Monitoring for the screen extension with gradient facility alternative would include construction and post-construction monitoring activities similar to the screen extension alternative (Section 2.4.2.4, Screen Extension Monitoring). Monitoring would be expected to be more complex and require greater coordination during construction due to the substantial increase in construction activities associated with the gradient facility.

2.4.3.5 Screen Extension with Gradient Facility Costs

The estimated costs for construction of the screen extension with gradient facility are identified in Table 2.4-5. State and Federal cost-sharing responsibilities would be divided 25 percent/75 percent, respectively, with GCID funding 12.5 percent, the State of California funding 12.5 percent, and Federal appropriations funding 75 percent. The total estimated construction cost for this alternative would be approximately $~~26.4~~27.9 million, excluding contractor overhead and profit and construction management.~~ and environmental mitigation. Environmental mitigation costs could exceed $1 million. Final cost estimates for environmental mitigation will be developed for the Final EIR/EIS.~~

2.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass Alternative

The screen extension with gradient facility and internal fish bypass alternative would include the features described for the screen extension with gradient facility alternative (Section 2.4.3) plus an internal fish bypass system. An internal bypass system would convey juvenile fish moving along the screen face into one of three bell-shaped entrance bays that transition to an approximately four- to five-foot diameter pipeline. The gradient facility would provide the hydraulic head to operate the internal bypasses. The fish would then be returned either to the oxbow immediately downstream of the screen or to the middle of the river near the confluence of the oxbow with the river.

This alternative would enable GCID to meet all fish protection and screen performance criteria established for this project, including exposure time (2.5 minutes or less) of downstream migrating juvenile fish passing the screen face. GCID would be able to meet its water supply obligations through the HCPP for river flows as low as 5,000 cfs (Table 2.4-2). Minor differences in approach velocities and bypass flows would occur because this alternative would route approximately 150 cfs more oxbow flow (50 cfs for each of the three internal bypasses) toward the fish screen face and into the internal fish bypass system (Reclamation 1997a). There are some potentially significant differences in lower oxbow flow rates between the two intermediate bypass pipeline alternatives during low flow conditions.

As with the screen extension with gradient facility alternative, this alternative would minimize the risk of screen performance failure due to local river gradient changes and maximize the long-term reliability of HCPP operations. Design and construction of the gradient facility would also be the same as the screen extension with gradient facility alternative (Section 2.4.3).

The two internal fish bypass options would involve the same internal bypass entrance bay and pipe collection design on the fish screens, but would differ in the location of fish returned to open waters. The first option (return to oxbow) involves returning the bypassed fish into the oxbow immediately downstream of the existing screen (**Figure 2.4-11**). The second option (return to river) involves returning the bypassed fish into the middle of the river near its confluence with the lower oxbow (**Figure 2.4-12**).

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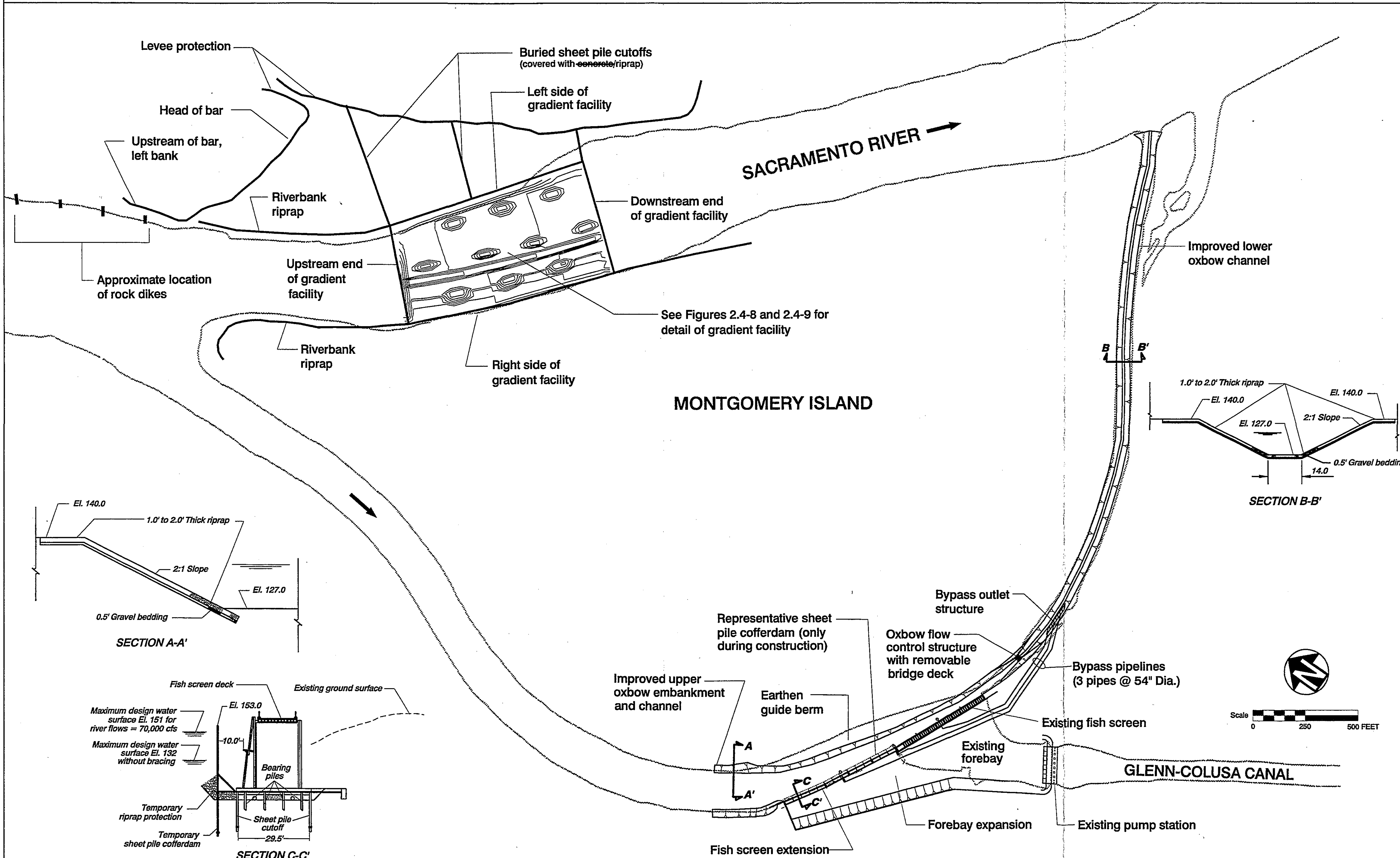
SCREEN EXTENSION WITH GRADIENT FACILITY AND INTERNAL FISH BYPASS WITH RETURN TO OXBOW ALTERNATIVE **FIGURE 2.4-11**



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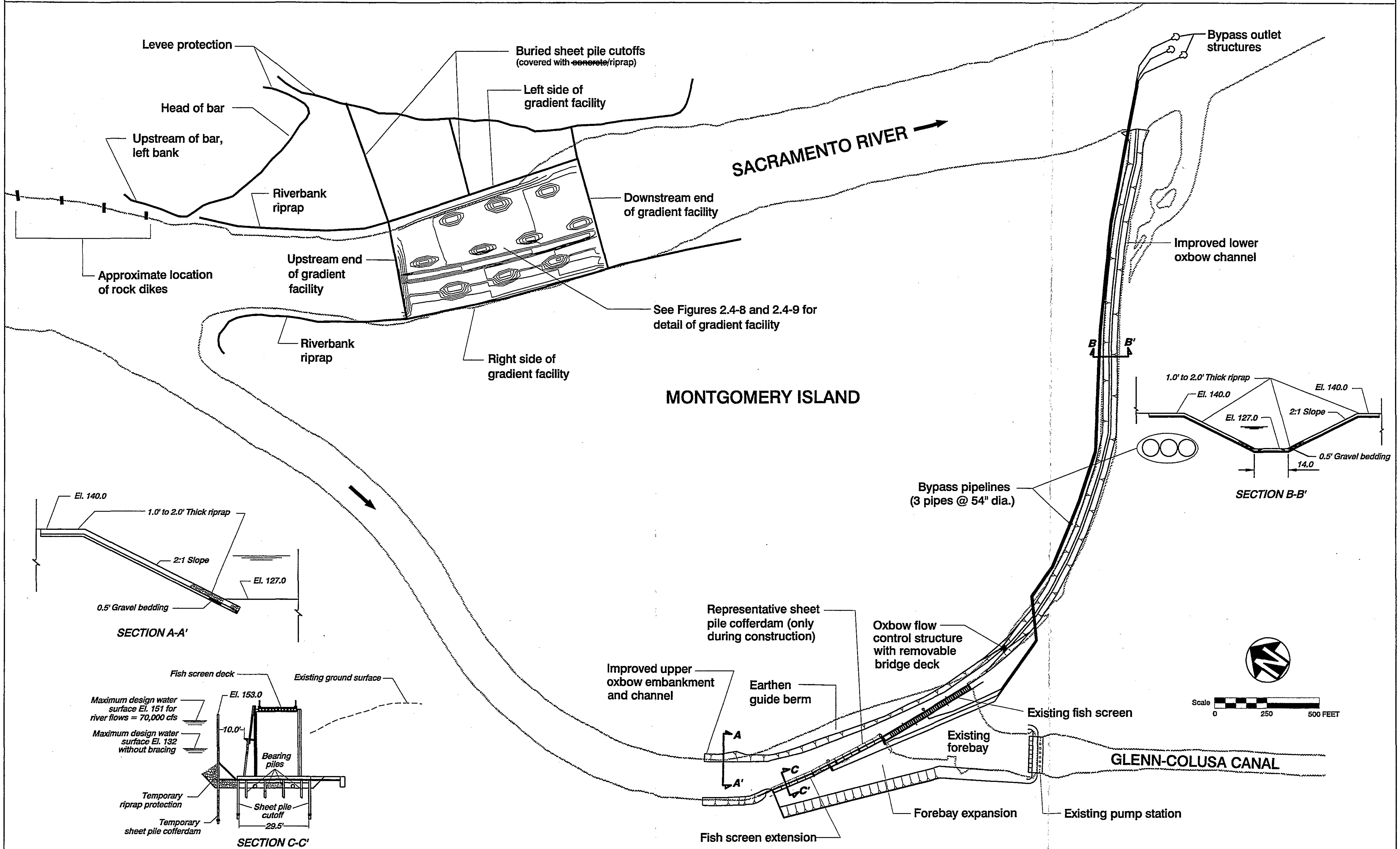
SCREEN EXTENSION WITH GRADIENT FACILITY AND INTERNAL FISH BYPASS WITH RETURN TO RIVER ALTERNATIVE

FIGURE 2.4-12



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The specific construction, operation, mitigation, and monitoring activities expected with the screen extension with gradient facility and internal fish bypass alternative (including the two options for outfall locations) are described in the following sections.

2.4.4.1 Screen Extension with Gradient Facility and Internal Fish Bypass Construction Activities and Schedule

Construction activities in the oxbow and river (screen improvements, oxbow channel improvements, oxbow flow control, gradient facility and rock dikes) for the screen extension with gradient facility and internal fish bypass alternative would be the same as those described for the screen extension with gradient facility alternative in Section 2.4.3.1. The primary difference with this alternative is the addition of the internal fish bypass system that would have two options (oxbow and river) for returning collected fish to open water. Table 2.4-1 lists and Figures 2.4-11 and 2.4-12 show the location of the major construction features of the screen extension with gradient facility and internal fish bypass system alternative.

Extended Fish Screen Structure

The construction of the fish screen extension would be the same as described for the screen extension alternative in Section 2.4.2.1 (Screen Extension Alternative Construction Activities and Schedule) except for the addition of fish bypass openings (bays) on the screen face and bypass pipes as described below under ***Internal Fish Bypass System.***

Adjustable Fish Screen Baffles

Adjustable baffles would be retrofitted to the existing screen and included with the new screen as described in Section 2.4.1.1 (No-Project Construction Activities and Schedule) and Section 2.4.2.1 (Screen Extension Construction Activities and Schedule).

Extended Left Bank Oxbow Earthen Guide Berm

The existing earthen guide berm across the oxbow from the existing fish screen would be modified as described in Section 2.4.2.1 (Screen Extension Construction Activities and Schedule).

Improved Upper Oxbow Channel

The upper oxbow channel and bank construction activities would be the same as described in Section 2.4.2.1 (Screen Extension Construction Activities and Schedule).

Improved Lower Oxbow Channel

The lower oxbow channel and bank construction activities would be the same as described in Section 2.4.1.1 (No-Project Construction Activities and Schedule).

Oxbow Flow Control Structure with Removable Bridge Deck

The new oxbow flow control structure and bridge to Montgomery Island would be the same as described in Section 2.4.1.1 (No-Project Construction Activities and Schedule).

Improved River Gradient

The improved river gradient features would be the same as described in Section 2.4.3.1 (Screen Extension with Gradient Facility Construction Activities and Schedule).

Rock Dikes in River

The rock dikes in the Sacramento River would be the same as described in Section 2.4.3.1 (Screen Extension with Gradient Facility Construction Activities and Schedule).

Internal Fish Bypass System

Three bypass bays and pipelines would be constructed with the fish screen improvements. One bypass bay and pipeline would be retrofitted to the midpoint of the existing fish screen, one would be constructed at the interface between the existing screen and screen extension, and one would be placed at the midpoint of the screen extension. Screen exposure distances for fish would range from about 240 feet to 300 feet.

The bypass bays (**Figure 2.4-13**) would have bell-shaped entrances leading to a 2-foot wide chamber that would extend from the bottom to the top of the fish screen. Stop log guides at the interface between the bay and screen would enable complete closure of individual bays for operational testing and monitoring associated with the FPEMP (Section 2.4.2.4, Screen Extension Monitoring), maintenance purposes, low flow conditions, or future closure if it is later determined through monitoring that the bypass system is not performing to design specifications.

The base of the 3 bypass bays would have a concrete ramp that would shorten the internal height of the bay from about 22 feet to 18 feet. After the concrete ramp, an adjustable weir (with hoist) would be placed to further shorten the internal height of the bay by up to 5 feet (from about 18 feet to 13 feet).

The bays would transition from the adjustable weir into 4- to 5-foot diameter concrete pipes that would carry the bypassed fish in approximately 50 cfs flows at a minimum design rate of about 3.5 ft/s. The bypass bay design with adjustable weir (Figure 2.4-13) would enable HCPP operators to maintain minimum velocities into the pipelines to prevent fish from returning upstream for the range of expected oxbow water levels. A physical model of the bypass bays has been constructed and is being tested to determine the optimum design of the internal bypass and adjustable ramp (Reclamation 1997a).

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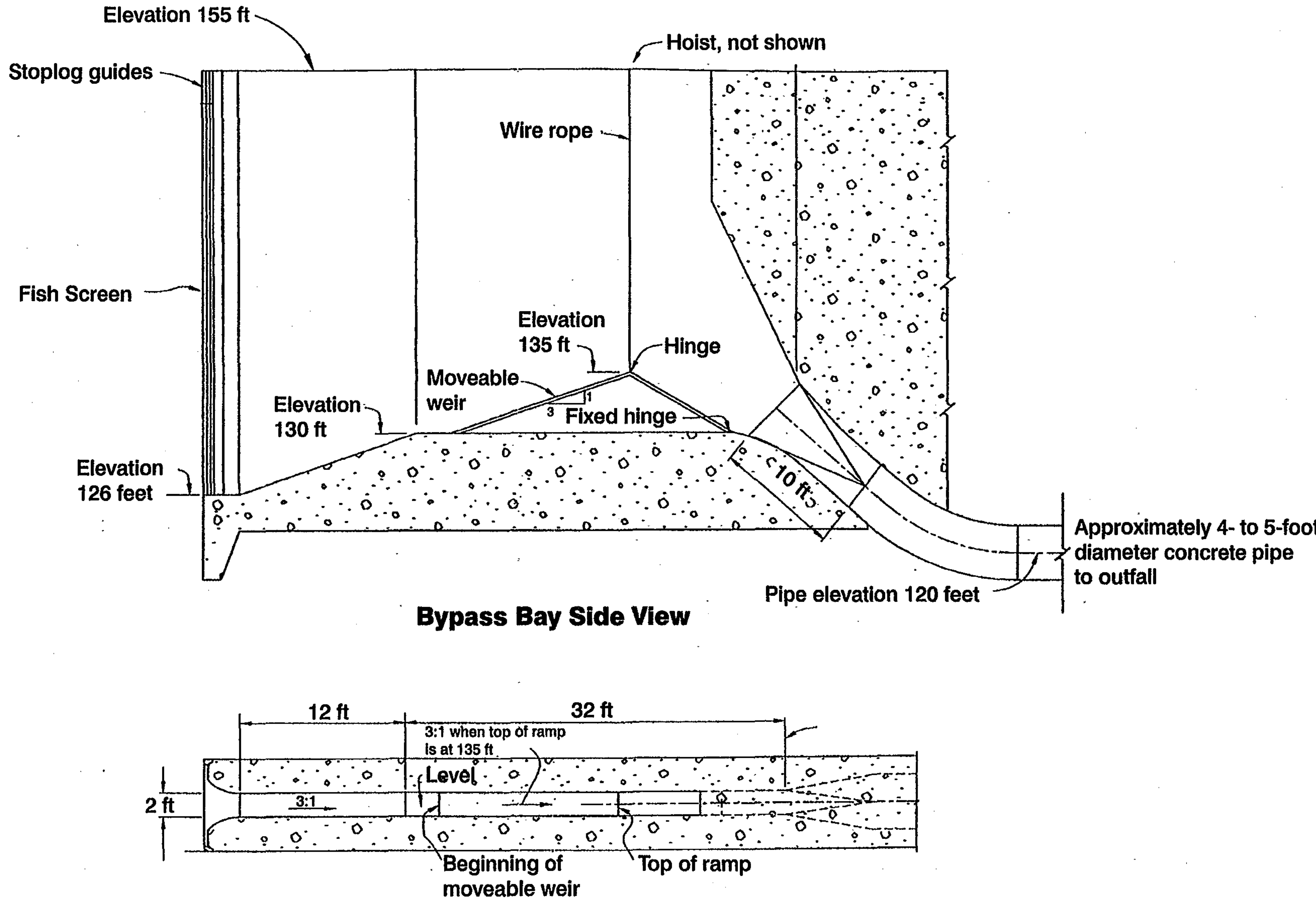
FIGURE 2.4-13. PRELIMINARY INTERNAL FISH BYPASS BAY DESIGN



NOT TO SCALE

All elevations are approximate

Source: Reclamation (1997a)

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The three concrete pipelines would separately convey bypassed fish from each of the bays to one of the two optional outfall locations. One location is in the immediate vicinity of the existing oxbow bypass outfall. This location would be just downstream of the oxbow flow control structure/removable bridge. This option would involve slightly greater distances for the bypass pipelines relative to the existing bypass system, but would result in greater velocities and shorter overall travel time for bypassed fish. The total length of the pipelines for this option could range from approximately 800 feet to 1,400 feet, depending on final siting of the outfall structure. The locations of the pipelines for the return to oxbow option are shown on Figure 2.4-11. The pipelines would terminate at an outfall structure that would mix the total internal fish bypass flows of about 150 cfs with a minimum lower oxbow flow of 350 cfs.

The second option for internal fish bypass outfall would be near the center of the Sacramento River near its point of confluence with the lower oxbow. Three separate concrete outfall structures (one for each pipeline) would be placed on the river channel bottom. The concrete pipelines would follow the same general alignment as the return to oxbow option, cross under the oxbow, and then parallel the island side of the lower oxbow to the river. The total length of the three parallel pipelines could range from approximately 3,700 feet to 4,300 feet, depending on final siting of the outfall structures. The locations of the pipelines for the return to river option are shown on Figure 2.4-12. The outfall structures would be placed in the main portion of the river channel at separate locations to reduce the potential for predation. The total pipeline flows would be approximately the same (i.e., 150 cfs) for the return to river option as the return to oxbow option.

Construction activities for the internal fish bypass system would not differ substantially from the fish screen extension with gradient facility alternative with the exceptions of construction of the new internal bypass pipelines through the forebay for both options and along the lower oxbow for the return to river option. Both options would require sheet pile installation, unwatering, dewatering, and removal in the forebay and in the oxbow along the shoreline of Montgomery Island. In the lower oxbow, there could be construction periods when placement of the pipelines would require blocking portions of the lower oxbow flows for short periods of time. Installation of the pipelines and outfall structures in the Sacramento River would result in construction activities similar to those described for the gradient facility in Section 2.4.3.1 (Screen Extension with Gradient Facility Construction Activities and Schedule).

During construction of the bypass improvements, the existing bypass bays would be blocked to prevent fish from entering the bypass system or the pumping plant forebay. The bypass system would be closed up to approximately 16 months while the existing bypass system is modified and the new bypasses and bypass pipelines are interconnected. Testing and monitoring of the bypass system would then be performed as described in Section 6.4 (Fish Protection Evaluation and Monitoring Program).

Initial operation of the new bypass system would likely be phased starting with the opening of the downstream bypass bay in November 1999. The upstream two bypasses would be operable and available for testing and monitoring under the FPEMP beginning November 2000.

Reclamation's (1997a) Concept Design Study Executive Summary identifies the return to oxbow design as the lead agencies' preferred option. Additional discussion of the design of the fish screen with gradient facility and internal fish bypass (return to oxbow) alternative can also be found in Reclamation (1996d).

Staging Area

The staging areas for the fish screen extension with gradient facility and internal fish bypass alternative would be the same for both the return to oxbow and return to river options. The areas would be the same as those described in Section 2.4.3.1 (Screen Extension With Gradient Facility Construction Activities and Schedule).

Construction Schedule and Management

Construction management of the screen extension with gradient facility and internal fish bypass alternative would be essentially the same as described for the screen extension with gradient facility alternative (Section 2.4.3.1). GCID and Reclamation would share design and construction management activities for the internal fish bypass system. The work would occur over an approximately three-year period as shown on **Figure 2.4-14**.

Alternative Gradient Facility Construction Methods

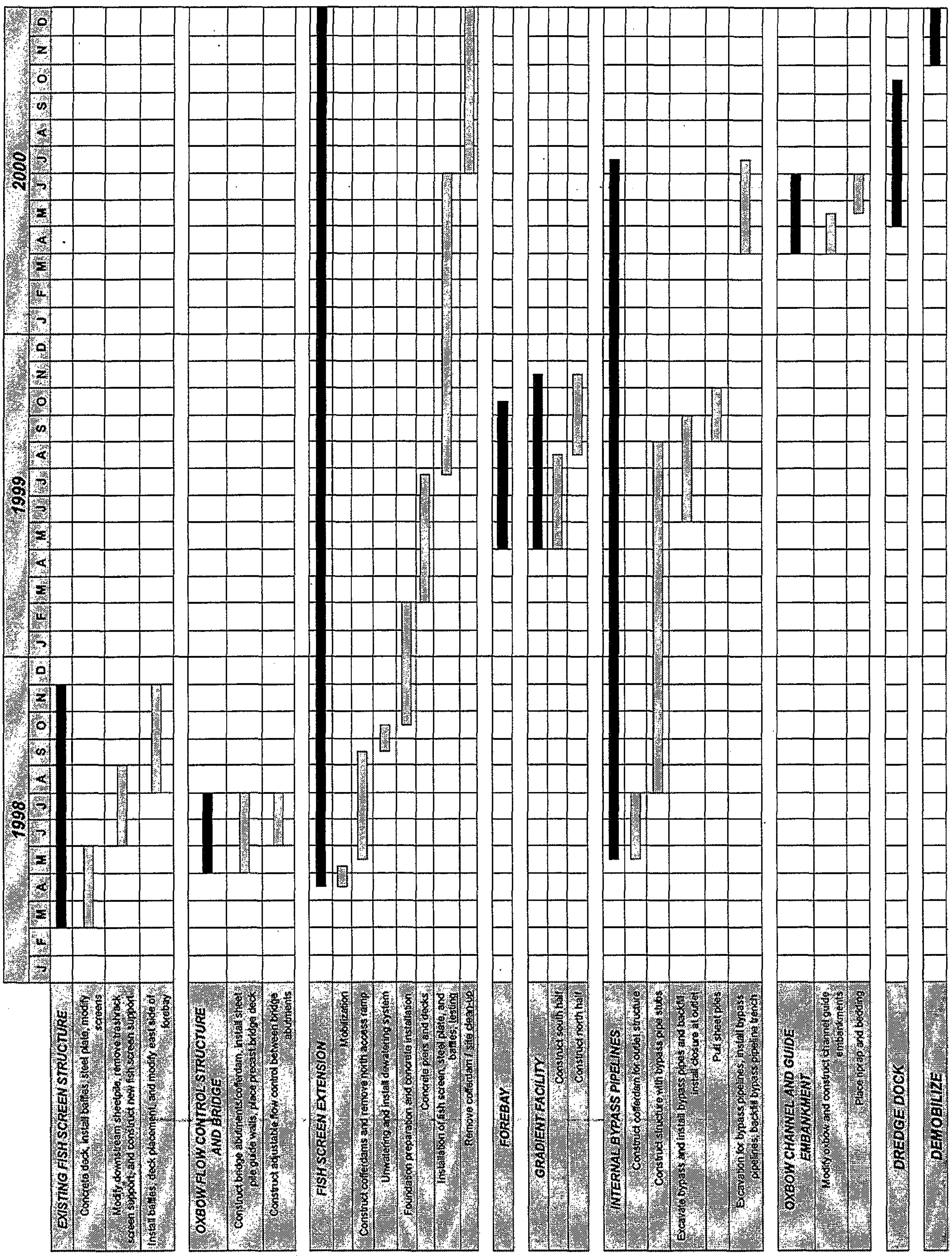
The alternative construction methods for gradient facility construction would be the same as those described for the screen extension with gradient facility alternative (Section 2.4.3.1).

2.4.4.2 Screen Extension with Gradient Facility and Internal Fish Bypass Operations and Maintenance

The operations and maintenance activities for this alternative would be essentially the same as described for the screen extension with gradient facility alternative in Section 2.4.3.2 except for the addition of activities related to the internal fish bypass system.

The internal fish bypass system would add a relatively limited amount of operations and maintenance activities to what would otherwise be required for the fish screen extension and gradient facility. Operation of the bypass system would be coordinated with fish screen operations, HCPP pumping, and water level information to maximize fish protection and bypass performance of the overall system. Refinements in the coordination of system features would be expected in the early years of the project as data is gathered and evaluated through the FPEMP. The general timing and extent of fish screen and oxbow maintenance activities is presented in Table 2.4-7.

FIGURE 2.4-14. CONSTRUCTION SCHEDULE: SCREEN EXTENSION WITH GRADIENT FACILITY AND INTERNAL FISH BYPASS ALTERNATIVE - RIVER AND OXBOW OPTIONS



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2.4.4.3 Fish Screen Extension with Gradient Facility and Internal Fish Bypass Mitigation

Mitigation plans, construction specification provisions, access management, and local and off-site potential riparian and SRA Cover habitat mitigation options that would occur with the screen extension with gradient facility alternative (Section 2.4.3.3) would also apply to this alternative. In general, the internal fish bypass system with return to oxbow option would not substantially add mitigation beyond that required for the fish screen extension with gradient facility alternative because the areas of construction activity would essentially be the same. For the return to river option, new areas of construction activity would be required for the river portion of the bypass pipelines and outfall structures. Chapter 4 (Impact Analyses) describes the differences.

2.4.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass Monitoring

Monitoring for the screen extension with gradient facility and internal fish bypass alternative would include construction and post-construction monitoring activities similar to the screen extension with gradient facility alternative (Section 2.4.3.4). Additional monitoring activities would be associated with the performance of the bypass bays and outfalls under FPEMP as described previously.

2.4.4.5 Screen Extension with Gradient Facility and Internal Fish Bypass Costs

The estimated costs for construction of this alternative, including the two bypass return options, are presented in Table 2.4-5. State and Federal cost-sharing responsibilities would be divided 25 percent/75 percent, respectively, with GCID funding 12.5 percent, the State of California funding 12.5 percent, and Federal appropriations funding 75 percent. The total estimated construction costs for this alternative is approximately ~~$30.2~~31.7 million for the return to oxbow option and ~~$39.2~~ 40.7 million for the return to river option, excluding contractor overhead and profit and construction management.~~, and environmental mitigation.~~ The substantial difference in costs is due to the substantial increase in bypass pipeline length for the return to river option (Table 2.4-1). ~~Environmental mitigation costs could exceed $1 million. Final mitigation cost estimates for environmental mitigation will be developed for the Final EIR/EIS.~~

2.5 Alternatives Considered and Eliminated From Further Analysis

Table 2.5-1 summarizes the alternatives considered and eliminated from further analysis. Alternatives were eliminated either because they were determined to be infeasible (due to technical, economic, or environmental reasons) or because they offered no substantial environmental advantages over alternatives carried forward for detailed analysis.

Alternatives considered and eliminated are organized by topic: fish screen, gradient restoration, and water supply. CH2M Hill (1989), HDR (1994), Reclamation (1996d), and Reclamation (1997a) provide additional information on alternatives considered and eliminated.

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Table 2.5-1 - Alternatives Considered and Eliminated From Further Analysis[a]

Types of Fish Screens Considered	*Reason for Elimination*
Rotary Drum Screens Cylindrical screens that rotate about the horizontal axis, generally made of steel members with the outer shell covered with wire mesh, punch plate, or wedgewire material. Rotary drum screens are designed to operate with the water depth equal to approximately 70% of the drum diameter.	In the HCPP setting, water surface fluctuations would not allow the screens to operate consistently.
Multiple V Vertical Flat-Plate Screens Similar to linear flat-plate screens except that panels are arranged in a V configuration with a fish bypass collection pipe located at the apex of the V. Multiple units can be constructed adjacent to each other.	
• Near mouth of oxbow	Sedimentation would make screen operations infeasible.
• At existing structure	Requires berm or concrete wall that would close oxbow, affect upstream migration, trap trash, and block sediment movement downstream. Studies show this alternative would be technically difficult to obtain acceptable screen hydraulics.
• West of existing screen structure	This alternative would require a pumped bypass system that is not considered technically feasible at the scale required to meet project objectives and design considerations.
• Located on Montgomery Island	Eliminated because additional length of screen structure and fish bypass system would make this economically infeasible.
Modular Inclined Screens Flat-plate wedgewire screens are inclined at an angle of approximately 20 to 30 degrees to the horizontal and have relatively high velocities to sweep fish past the screens into a bypass channel.	Eliminated because this screen type is still experimental.
Screen Pods Rectangular screen pods that lay on the channel bottom and are capable of being removed when not needed. Require a large pipe to carry screened water to the pump station.	Eliminated because this screen type is still experimental.
Fish Screen Bypass Pumps Pumps used to lift fish entering the internal fish bypass to an elevation where gravity flows could return fish to the oxbow or river channel.	
• Eductor pumps	Eliminated because this type of pump would create unacceptable shear stresses on fish when additional head is required for the bypass return conveyance system.
• Archimedes screw pumps	Still experimental and reliability as yet undetermined.

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Table 2.5-1 - Alternatives Considered and Eliminated From Further Analysis[a] (Continued)

Types of Fish Screens Considered	*Reason for Elimination*
Bypass Pumps (Continued) • Hidrostal (centrifugal) pumps	Used successfully in hatcheries and in the fish processing industry, but the sizes needed are still considered experimental and reliability as yet undetermined.
Existing Internal Fish Bypass Features Existing two bypasses with a discharge to the lower oxbow channel.	Bay width did not meet fish protection considerations, and the existing piping system would be inadequate.
Secondary Screens Additional screens added at various points in the bypass system to reduce volume of flow that must be returned to the oxbow or river.	Eliminated because potential cost savings would not offset the additional stress to fish.
Screen Locations--Alternative Sites for Screens • Relocation upstream of the oxbow at RM 207.6	Eliminated on the basis of risk, reliability, and environmental impact. Concern that periodic shifts in river channel at this location could leave the screen inoperable. High banks at the site would make construction difficult. Would result in the loss of extensive riparian habitat.
• Additional fish screen at RM 201	A new pump station and screen with a capacity of 1,800 cfs to supplement the existing pump station. RM 201 was eliminated after consideration of geotechnical information. The area around the site has a high rate of erosion, except for an outcrop of the resistant Modesto Formation. Thus, the banks to either side of the intake site, which would be located approximately 200 feet upstream of the Modesto Formation, would be vulnerable to retreat. As a result, the intake site could project into the channel from the rest of the bank, potentially resulting in complex hydraulics, unless significant bank protection is undertaken. Further, the use of the riprap along the banks in the area would significantly impact a large colony of bank swallows. Therefore, geotechnical considerations, combined with the added costs for bank protection, new gradient and screen facilities, and new pumping plant and conveyance facilities, resulted in the elimination of this alternative. ~~would be substantially greater than the cost of other alternatives, and would be technically questionable because of the need to construct new features in the river channel at RM 201.~~

C-085465

C-085465

Table 2.5-1 - Alternatives Considered and Eliminated From Further Analysis[a] (Continued)

• Additional fish screen at RM 200.5	This would also involve a new screen and new pump station similar to RM 201. At RM 200.5, an extensive outcrop of the resistant Modesto Formation creates a straight channel pattern in the Sacramento River that could result in favorable hydraulics for an intake structure. However, the cost of building a new pumping station, with fish screens, conveyance facilities and a gradient control structure in the river to divert trash and guide water to the screens would be high relative to the other alternatives. Furthermore, operations and maintenance costs would be from approximately two to three times the annual costs of the other alternatives. At this location, the river is further from the Glenn-Colusa Canal and, because of the natural fall of the river, more pumping would be required. The range of costs for pumping under this alternative was roughly $4.5 to $8.0 million annually (1994 dollars), whereas the pumping costs under the other alternatives were approximately $2.8 million (1994 dollars).
• Relocation to mouth of oxbow channel	Site eliminated due to shallow depths; hydraulically the site would be infeasible because screen could not meet uniformity criteria, and undesirable due to potential for extreme sedimentation problems.
Open Channel Internal Fish Bypass Systems Open internal bypass systems such as concrete channel, large diameter pipe cut in half, and sheet piles.	Would not provide cost, operational, or environmental advantages over oxbow channel and closed pipe systems carried forward for further analysis.
Internal Bypass Pipeline Through Adjacent Orchard A more direct route for fish return to the river through the orchard south of the lower oxbow channel.	Eliminated for cost of excavation, uncertainty of willing seller, and no major environmental advantages.
Reduce or Eliminate Night Pumping Studies showing large percentages of downstream migrating fish moving at night.	Would require the construction of large off-channel storage facilities for storing water when HCPP pumps during the day. Would also require higher rates of pumping during daytime hours which would not be feasible during the irrigation season.
Behavioral Devices Devices (light, electrical currents, sound) for excluding fish from intakes, pumps, and turbines.	Would not be a primary means of screening, and devices have been shown to not be consistently effective.
Large Gradient Restoration Facility A larger size facility than proposed in this EIR/EIS to increase gradient for improved fish screen performance and HCPP operations.	Eliminated because it would provide no substantial benefits over facilities addressed in this EIR/EIS and would result in greater environmental impacts.
Small Gradient Restoration Facility A smaller size facility than proposed in this EIR/EIS to increase gradient for improved fish screen performance and HCPP operations.	Eliminated because it would provide insufficient gradient for meeting fish screen protection criteria and would result in comparable environmental impacts.
Gradient Restoration without Fish Screen Extension Would reestablish 1970 hydraulic gradient and stabilize water levels for existing flat-plate screen.	A gradient facility without fish screen extension would improve fish bypass conditions, but not HCPP pumping capacity due to insufficient area on existing screen to reach 0.33 ft/s approach velocity.

C-085466
C-085466

Table 2.5-1 - Alternatives Considered and Eliminated From Further Analysis[a] (Continued)

Type of Fish Screens Considered	*Reason for Elimination*
Divert Main Channel of River Through Oxbow or Reestablish River Through Wilson Landing Pre-1970 Channel Would reroute one- to two-mile sections of existing river channel.	Eliminated on the basis of extreme risk due to the difficulty of installing a structure large enough to redirect the full range of flows.
Downstream Location of the Gradient Facility, Approximately near the Middle of Montgomery Island Would shift proposed facility downstream about .5 mile.	Eliminated because a larger structure would be needed to achieve minimum gradient, and the upstream location would result in lesser environmental impacts.
Water Supply	*Reason for Elimination*
Alternative Water Sources Would provide water to GCID service area through other means besides HCPP.	
• Additional recapture and reuse of drain water currently leaving the District as return flows	Further reuse of captured drain water alone would only provide a small increment of supply to meet demands. In addition, water quality impacts including salt build-up would limit the use of such water for irrigation.
• Additional groundwater pumping (pumping by GCID and water users throughout the service area)	Additional groundwater pumping alone would not be economically feasible and no information is available to show that sufficient groundwater resources would be available.
• Additional diversions from the Tehama-Colusa Canal	TCC alone could not supply what would be needed by GCID due to existing contractual commitments of TCC capacity. In addition, the TCC deliveries during the period from September 15 to May 15 are unreliable because of winter-run restrictions that require RBDD gates to remain up. No gravity diversions are possible when the restrictions are in place. Existing TCC deliveries to GCID are temporary and "as-available."
• Diversions from or increased capacity of Black Butte Reservoir	Surplus water from Black Butte Reservoir alone would be insufficient to meet GCID's demands. Water losses along Stony Creek (method of conveyance) would represent 10 to 40 percent of releases.
Additional Water Conservation Increase existing water conservation programs to increase the amount of water available to GCID.	Further conservation would be limited to less than an additional 10 percent, and thus would not meet project water supply objectives. Further salinity build-up could have adverse environmental effects.
Off-Stream Storage New reservoir construction as opportunity to store winter/spring HCPP diversions for GCID irrigation season releases.	Economically infeasible due to costs of new reservoir and conveyance facilities plus continued risk of river gradient loss at HCPP.

[a] This table summarizes alternatives found to be infeasible or that do not meet most project objectives as described in CH2M Hill (1989), HDR (1994), Reclamation (1996d), and Reclamation (1997a).

2.6 Issues Identified and Considered in EIR/EIS Process

Through the scoping process and EIR/EIS preparation, environmental and other issues have been raised concerning potential environmental impacts of the project and no-project alternatives. Analysis of these issues indicates the potential for significant environmental effects in some instances, and less than significant effects in other instances. In some cases, analysis results remain uncertain. In other cases, certain issues are considered to be of possible concern or importance to interest groups, landowners, or resource managers.

This section of the EIR/EIS separates issues into two groups. One group includes issues considered (in some cases analyzed in detail) and then eliminated from further analysis because it was concluded that no potential existed for significant environmental effects. The second group includes issues determined to either have a potential for significant effect or be of sufficient public or agency interest to warrant public review as part of the EIR/EIS process.

Table 2.6-1 presents issues considered and eliminated from further analysis, including the reason for elimination. **Table 2.6-2** presents issues carried forward into this EIR/EIS for additional analysis. The issues addressed in later chapters of this EIR/EIS are presented in the same order as they appear in Table 2.6-2.

Table 2.6-1 - Issues Considered and Eliminated From Further Analysis

Topic	Issue (In Bold)
Hydrology and Water Resources	
GCID Deliveries	**Effects on the Availability and Reliability of Water Deliveries to National Wildlife Refuges** National Wildlife Refuges will receive Level 4 allocation of CVP water by 2002 as stipulated in the CVPIA, regardless of HCPP operations.
Water Quality	**Potential Increase in Sacramento River Turbidity Due To Construction Activities** Use of desilting basins, and compliance with Corps and Reclamation standard water quality construction specifications paragraphs are included in project design to minimize turbidity during construction. As part of the permit approval process, the Central Valley Regional Water Quality Control Board would issue a permit and construction activities would comply with such terms and conditions.
	Introduction of Contaminated Sediment into the Sacramento River Due to Construction Activities Environmental laboratory analyses were performed on soil samples taken from various sites within the proposed location of the gradient facility. Preliminary results (Reclamation 1996a) of the analyses indicate: • no detectable amount of TCL Organochlorine Pesticides/PCBs; • no detectable amounts of Hexavalent Chromium; and • detectable amounts of various heavy metals at concentrations far below toxic levels.
River Channel Stability	**Impacts During Construction of the Gradient Facility on River Meander** River meander processes are generally long-term, whereas construction of the gradient facility would be short-term and not of sufficient time to cause changes in river alignment. Cofferdam structures would be removed during seasonal high flow periods.
Sedimentation	**Increase in Sedimentation in the Oxbow Due to the Gradient Facility** The average annual amount of sedimentation, and associated dredging, that would occur with the gradient facility in place would not be substantially greater than the amount under current conditions (approximately 1-2% greater). Modeling conducted by Reclamation (1997c) indicates the average annual dredge volume would be 47,078 cubic yards under the base conditions (without gradient facility), and 47,794 cubic yards with the gradient facility.
Flooding	**Increase in Flooding Potential During Operation of Improvements** The increase in upstream river stage as a result of channel improvements (including gradient restoration) would be minimal at low flows and diminishes to negligible levels as river flows increase (Ayres 1996d).
Aquatic Resources	
Fish Screen Performance	**Entrainment of Fish Larger Than 30 Millimeters (mm)** The screen mesh would exclude fish larger than 30 mm.
	Potential Indirect Effects of Diverting Food Sources Away From the River Into the Oxbow The percentage of particulate matter diverted into the oxbow and HCPP as compared to the percentage of total particulate matter in the Sacramento River would be negligible.
	Algal Growth and Debris Accumulation on the Screen Face Potential reductions in screen performance would be counteracted by continuous cleaning mechanisms.

Table 2.6-1 - Issues Considered and Eliminated From Further Analysis (Continued)

Topic	Issue (In Bold)
Aquatic Resources (Continued)	
Aquatic Habitat	**Effects of Changes in Diversions in Stony Creek on Aquatic Resources in Stony Creek** No net change in diversions, and therefore no impacts to aquatic resources, would be expected in Stony Creek.
	Effects of Maintenance Dredging of the Oxbow and Areas Adjacent to the Fish Screen on Riverine Habitat Numerical modeling (Reclamation 1997c) indicates that sedimentation and associated dredging would not be substantially greater (1-2%) than currently occurs, therefore, impacts to riverine habitat would not be considered significant.
Geology and Soils	
Changes in Topography and Geomorphology	**Creation of Gravel and Sediment Piles** The placement of gravel and sediment piles on the north end of Montgomery Island and on GCID's land across from the HCPP yard on Cutler Avenue would not result in significant changes to topography and geomorphology. Substantial unstable earth conditions or changes in geologic substructures that could affect human safety would not be expected.
Seismic Impacts on Proposed Project Features	**Lateral Deformation of Slopes and Settlement of Soils During a Seismic Event** Final construction designs and plans for all project features would comply with building standards that take into consideration the potential for seismic-induced liquefaction, settlement, and other geologic hazards; therefore, no seismic-related safety hazards would be expected.
	Land Subsidence From Groundwater Pumping Under the No-Project Alternative Further reducing the diversion rate at HCPP would require the use of more groundwater, which could result in land subsidence. However, these impacts would not be expected to result in substantial unstable earth conditions or changes in geologic substructures that could affect human safety, nor would they result in the exposure of people or property to major geologic hazards.
Recreation and Navigation	
Interference with Recreational Boating	**During Operation, Interference of the Gradient Facility with Recreational Boating** The gradient facility would be designed to allow sufficient passage for normal recreation activities. Potential subsurface hazards at low river levels would be marked.
Terrestrial Biology	
Species of Concern and Their Habitat	**Construction Impacts to Riparian Habitat for the State Species of Concern Yellow-Breasted Chat and Yellow Warbler** There is a low probability of encountering a substantial number of nesting pairs within the area impacted.
	Effect of the Proposed Project on Pacific Flyway Waterfowl and the Water Quality and Quantity Delivered to the Sacramento, Colusa, and Delevan National Wildlife Refuges National Wildlife Refuges would receive their Level 4 allocation of CVP water by 2002 as stipulated in the CVPIA regardless of HCPP operations.

C-085470

C-085470

Table 2.6-1 - Issues Considered and Eliminated From Further Analysis (Continued)

Topic	Issue (In Bold)
Terrestrial Biology (Continued)	
Species of Concern and Their Habitat (Continued)	**Potential Impact to the Habitat of Giant Garter Snakes with the No-Project Alternative** Any construction activities at recapture stations along canals associated with the no-project alternative would be subject to the appropriate environmental documentation, including analysis under CESA and ESA. The potential locations of drainage recapture facilities are not known or proposed at this time, therefore, it would be speculative to assess potential effects to this species.
	Potential Impact to Buildings Providing Roosting Habitat and/or Hiberniculae for Species of Bat Surveys were conducted by biologists in April 1997 of all buildings potentially impacted by project construction. No bats were observed during these surveys. Additionally, no evidence of prior use was observed. These buildings, therefore, are not considered as habitat used by bat species for roosting or hibernation.
	Potential to Inundate Elderberry Shrubs Upstream of the Gradient Facility and Associated Destruction of Valley Elderberry Longhorn Beetle (VELB) Habitat Water elevations would slightly increase upstream of the gradient facility during the low water period of the year during both construction and operation and maintenance. Elderberry shrubs upstream of the gradient facility and close to the river are currently inundated during high flow periods (e.g., winter and early spring). Inundation patterns would not change during this period. During the low flow period (e.g., summer and fall), shrubs are at a sufficient elevation that inundation would not occur under normal operating conditions. Exceptions to normal operations (including the construction period) would occur infrequently and would not permanently disturb elderberry shrubs or VELB. **Effect of the Gradient Facility on Natural Riparian Successional Processes due to Changes to Dynamic River Processes** The impacts of the gradient facility would be on the gradient and river channel alignment in the immediate project vicinity. Natural river dynamic processes and riparian successional development would continue both upstream and downstream of the gradient facility. **Impacts Which Disrupt the Community Structure of VELB, Including the Impedance of Genetic Flow Between Populations** Surveys of elderberry shrubs (JSA 1996b) indicate numerous shrubs throughout the project area that would not be affected. Additionally, proposed transplanting of shrubs to appropriate sites within the local project area would make this impact less than significant.
Loss and Disturbance of Habitat	**Loss and Disturbance to Grassland Habitat** Grassland is abundant in the project area. All grassland habitat impacted by the project would be revegetated.

C—085471

C-085471

Table 2.6-1 - Issues Considered and Eliminated From Further Analysis (Continued)

Topic	Issue (In Bold)
Terrestrial Biology (Continued)	
Loss and Disturbance of Habitat (Continued)	**Inundation and Loss of Riparian Vegetation Upstream of the Gradient Facility** Inundation due to increased water levels would occur upstream of the gradient facility. This effect would be undetectable at flood flows. During low flow periods (e.g., 7,000 cfs), water levels would increase upstream to the natural riffle at RM 207 (Figure 3.1-3), at approximately elevation 140.0 ft (Ayres 1996d). This water would persist during the summer growing season and could affect riparian vegetation, particularly vegetation established after the change in river gradient in 1970. Based on 1992 aerial photographs, the area affected is not likely to exceed approximately 5 acres. Changes could include an increase in wetland and riverine habitat, particularly in Snaden Slough, and a corresponding shift of riparian vegetation types. Accurate estimates of the increase in backwater wetland habitat and long-term changes in riparian habitat are not possible. Regardless, the extent of potential change and associated impact would not be considered significant.
	Ruderal Habitat Under the no-project alternative, 0.4 acre of ruderal habitat would be affected in the lower oxbow. Additionally, a 5-acre storage area would be located on a 13.7-acre parcel at First Avenue and Cutler Avenue across the street from the HCPP in an area of moderate human use. This parcel was recently in agricultural production and is presently in a ruderal, fallow state. These impacts are also common to all project alternatives. The screen extension alternative would impact an additional 0.9 acre of ruderal habitat beyond that impacted in the no-project alternative. The screen extension with gradient facility, and screen extension with gradient facility and internal fish bypass (to the oxbow or river) would impact an additional 1.7 acres above that impacted by the no-project alternative.
	Agricultural Habitat Agricultural areas, primarily orchards, would be impacted by construction of those project alternatives containing the gradient facility. Access roads for construction of the gradient facility would impact 6.4 acres while the structure itself would impact 1.2 acres. Orchards provide habitat for species that are generally adaptable to human encroachment. They can also provide marginal habitat to some riparian species when space is limited in the adjacent riparian system. Removal of orchard property from production would not create a substantial impact on terrestrial biological resources.
	Loss and Disturbance to Gravel Shoreline Gravel shoreline is an ephemeral and common shoreline type along the upper Sacramento River. All gravel shoreline impacted by the project would be recontoured to resemble pre-project topography.
Visual Resources	
Changes to Visual Setting and Views of Sensitive Visual Receptors	**Soil and Vegetation Disturbance within the Vicinity of the Fish Screen During Construction** Disturbance would occur within close proximity of the existing fish screen and related facilities; therefore, it would not substantially change the visual character of the area.
	Soil and Vegetation Disturbance in the Vicinity of the Internal Fish Bypass Pipeline During Construction The relatively small size of the additional temporary disturbance would not be visible from key viewpoints, and would not substantially change the visual character of the area.

C-085472

C-085472

Table 2.6-1 - Issues Considered and Eliminated From Further Analysis (Continued)

Topic	Issue (In Bold)
Visual Resources (Continued)	
Changes to Visual Setting and Views of Sensitive Visual Receptors (Continued)	**Presence of a Larger Fish Screen During Operation** The fish screen extension would not be visible from key viewpoints, nor would its presence substantially change the visual character of the area, because it would be located adjacent to the existing fish screen.
	Presence of an Oxbow Flow Control Structure With Bridge During Operation The oxbow flow control structure and bridge would not be visible from key viewpoints, nor would its presence substantially change the visual character of the area.
	Presence of Dredging Equipment During Construction The presence of dredging equipment during construction would not be expected to substantially change the visual character of the area, because similar equipment is currently in use.
	Disturbance to the Sacramento River During Construction of the Gradient Facility Disturbance would be visible from key viewpoints, however, it would be short-term and would not result in substantial changes to the visual character of the project area.
	Permanent Presence of Gradient Facility Anchorages on Montgomery Island and the Eastern Bank of the Sacramento River During Operation The edges of the tie-ins to the riverbanks would be visible, however, the existing visual quality of the area is not expected to be substantially changed.
	Covering of the Eastern River Bank Gravel Bar During Operation of the Gradient Facility The increased frequency of water flows on this gravel bar would not represent a substantial change to the existing visual condition or quality of the area.
	Changes to the Area's Visual Character Resulting From the No-Project Alternative New facilities that would be required under this alternative include additional pump recapture stations and groundwater wells. The construction and operation of these facilities would not be expected to significantly impact the visual character of the area, due to the relatively small size and number of additional facilities required and because such facilities are common within the area.
	Changes to the Visual Character of Potential Mitigation Lands The possible conversion of optional mitigation lands from farmland to riparian would result in a beneficial visual resources impact (i.e., an increase in native riparian vegetation) for river recreationists and would not differ substantially from existing visual conditions.
Land Use	
Changes to Agricultural Lands	**Potential Conversion of Currently Unfarmed Parcels to Agricultural Production** Limited amounts of currently unfarmed agricultural land (estimated to be a total of approximately 650 acres within the GCID service area) could be converted due to the project. The feasibility of conversion of individual parcels is unknown, and the amount represents less than 0.5 percent of total irrigated land in the GCID service area. In addition to conversion of agricultural land due to project facilities, farmland could also be converted as a result of local potential and off-site potential mitigation areas. About two acres of orchard located on Butte County parcels 047-400-002 and 047-400-003 and 29 are local potential riparian mitigation sites. This would not result in a significant loss of farmland resources given the extent of agricultural land in the local and regional area. The acquisition and use of off-site potential mitigation areas may result in the conversion of additional farmlands. Given the extent of agricultural land in the local and regional area, the potential conversion of farmland associated with these off-site potential mitigation areas is not considered to be a significant impact.

Table 2.6-1 - Issues Considered and Eliminated From Further Analysis (Continued)

Topic	Issue (In Bold)
Land Use (Continued)	
Changes to Agricultural Lands (Continued)	**Potential Conversion of Farmland to Public Facility or Mitigation Use** Permanent conversion of farmlands to public facility use due to project features is not expected to exceed 1 acre, and would occur on Glenn County parcel 037-043-003 and Butte County parcel 047-400-003. Given the extent of agricultural land in the local and regional area, this is not considered to be a significant effect. Road improvements for construction access is estimated to temporarily convert about three acres of orchard use. Impacts associated with road use (e.g., soil compaction) are not expected to permanently alter the productivity of this land; however, non-conversion of roads back to orchard use by the landowner would make the conversion permanent. In addition to conversion of agricultural land due to project facilities, farmland could also be converted as a result of local potential and off-site potential mitigation areas. About 2 acres of orchard located on Butte County parcels 047-400-002 and 047-400-003 are local potential riparian mitigation sites. This would not result in a significant loss of farmland resources given the extent of agricultural land in the local and regional area. The acquisition and use of off-site potential mitigation areas may result in the conversion of additional farmlands. Given the extent of agricultural land in the local and regional area, the potential conversion of farmland associated with these off-site potential mitigation areas is not considered to be a significant impact.
Use of Private Property	**Use of Private Property for Project Facilities and Mitigation** Under the no-project alternative, new facilities would be expected, however, specific locations of new facilities cannot be predicted. It would be highly unlikely that substantial disruptions in local land uses would occur due to the locations at which the facilities would be sited (along existing canals and adjacent to existing GCID water delivery facilities). Under the project alternatives, the amount of private land required for permanent use due to the project facilities (less than 1 acre on Glenn County parcel 037-043-003 and Butte County parcel 047-400-003) would be small relative to the sizes of affected parcels. In addition, temporary conversion of private land would be required for construction access and staging areas. The total amount of private land (all on Butte County parcel 047-400-003) required for temporary construction facilities is estimated to be less than 20 acres. Potential mitigation sites for project alternatives would involve acquisition and use for terrestrial resource mitigation, including about two acres currently in orchard use, as well as an undefined amount of private riparian lands. Local potential mitigation areas are located on parcels 047-400-002 and 047-400-003 on the east bank of the river; the mitigation sites are small relative to the total size of these parcels (1,525 acres). In addition, off-site potential mitigation areas are currently being considered for terrestrial resource mitigation purposes. Acquisition and use of off-site potential mitigation areas would be subject to agreements with affected landowners.

Table 2.6-1 - Issues Considered and Eliminated From Further Analysis (Continued)

Topic	Issue (In Bold)
Transportation and Traffic Safety	
Electrical Service	**Change in Power Usage at HCPP and Other GCID Facilities** Each alternative would affect the use of electricity at HCPP and other GCID facilities used to supply water to the service area; changes in the amount are unlikely to have a substantial affect on power suppliers (Western Area Power Administration and Pacific Gas and Electric Company).
Air Quality	
Effects of Water Availability for Alternative Rice Straw Decomposition Methods	**Less Water Availability for Rice Straw Decomposition Under the No-Project Alternative** Under the no-project alternative, the capacity of the HCPP would be limited to approximately 1,400 cfs year-around, assuming no major future changes in river gradient. This could have indirect impacts on water being available for use in rice straw decomposition in the early fall. However, other methods of rice straw decomposition are currently being employed, and irrigation water demands are typically low during the fall.
Indian Trust Assets	
	Potential Effects to Indian Trust Assets No Indian Trust Assets would be adversely affected.
Environmental Justice	
Impacts on Minority or Low Income Populations	**Disproportionate Impacts on Minority or Low Income Populations** No disproportionate impacts would be expected; impacts of alternatives would affect the farming community and those economically linked to farming, equally.
International Impacts	
	Significant Effects Upon the Environment Outside the Jurisdiction of the U.S. No potential international impacts have been identified.

Table 2.6-2 - Issues Carried Forward for Further Analysis

Topic	Issue (In Bold)
Hydrology and Water Resources [a]	
GCID Deliveries	**Regional Water Delivery Operation Changes** Water supply sources, diversion amounts (e.g., at RBDD), and HCPP operations would vary depending upon the alternative and flow in the Sacramento River.
River Flows	**Potential Sacramento River Flow Changes** Shifts in diversions between RBDD and HCPP would result in changes in Sacramento River flows.
Water Quality	**Potential Temperature Increase** Changes in diversions at RBDD would lead to changes in temperature between RBDD and the HCPP. The Water Quality Control Plan identifies river temperature objectives for the project area; temperature increases could adversely affect aquatic resources.
	Increases in Electrical Conductivity Increases in electrical conductivity levels of GCID outflow, Colusa Basin Drain diversions, and Colusa Basin Drain due to increased reliance on recaptured water could adversely affect crop production.
	Pesticide Concentrations Increased reliance on recaptured water could lead to reduced outflow and dilution, and pesticide levels could exceed standards and affect some beneficial uses of surface water.
River Channel Stability	**Changes in River Alignment and Gradient** The gradient facility would create a "hard point" in the river. The Sacramento River alignment is dynamic, and the potential could exist for this hard point to contribute to future changes in river alignment and grade or be out-flanked.
	Bank Erosion Upstream of Gradient Facility A landowner on the west bank of the river at approximately RM 206 has expressed concern regarding potential increases in erosion of the bank with the project.
Sedimentation and Dredging in River	**Sacramento River Sedimentation** The gradient facility could increase sedimentation in the river, requiring GCID to dredge in the river.
Flooding	**Flooding Potential During Construction** Cofferdams placed in the river during construction would restrict flow and could increase flooding potential or channel erosion.
Aquatic Resources	
Impingement and Entrainment	**Impingement of Juvenile Fish on the Screen, Entrainment of Fish at Early Life Stages at the Screen, Potential Impacts of Varying Sweeping and Bypass Flow** Fish mortality at the screen could be affected by the uniformity of approach and sweeping velocities, compliance with design criteria, change in the number of fish exposed to the screen, change in the time of screen exposure, or change in the ratio of sweeping/approach velocities.
Internal Fish Bypass System Performance	**Direct Mortality, Latent Mortality, Disorientation** Fish losses associated with the internal fish bypass system could result from direct mortality due to stress or injury within the bypass system, latent mortality after transport in the bypass system due to disease and/or predation, and disorientation and subsequent predation.

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C-085476

Table 2.6-2 - Issues Carried Forward for Further Analysis (Continued)

Topic	Issue (In Bold)
Aquatic Resources (Continued)	
Fish Predation	**Predation at Upper Oxbow, at Screen Face, at Oxbow Flow Control Structure, at Hydraulic Hot Spots Within Internal Bypass System, at the Bypass Outfall in Lower Oxbow, and Within the Gradient Facility** Change in the potential for predation at new or modified facilities could have a significant effect on juvenile fish populations.
Fish Migration	**Immigration (Upstream Migration) of Adult Fish Through the Oxbow and Gradient Facility; Emigration (Downstream Migration) of Juvenile Fish Through the Oxbow and Gradient Facility** Changes in water current velocities, ~~and/or the~~ placement of cofferdams, and/or equipment noise (e.g., sheet pile drivers) during construction could have a significant effect on fish species migrating through the project area.
Alteration of Aquatic Habitat	**Changes in Habitat** Aquatic habitat could be affected by the loss of fish spawning and/or rearing habitat, including SRA Cover, as well as invertebrate aquatic habitat, within the oxbow or gradient facility site.
Water Quality	**Changes in Water Quality** Changes in water quality could have a significant effect on aquatic resources through changes in temperature, turbidity, and/or sedimentation (i.e., direct effects or reduction in screen performance).
Geology and Soils	
Seismic Events	**Lateral Deformation or Settlement of Soils** Seismic events up to magnitude 5.0 on the Richter Scale could induce lateral deformation of constructed slopes or soil settlement.
Recreation and Navigation	
Recreational Boating	**Construction Activity Effects on Recreational Boating and Potential Boating Hazards** During construction, potentially significant impacts to recreational boating could occur due to increased velocities, channel blockages, and turbulence in the vicinity of cofferdams.
	Boating Hazards, Operation Effects on Potential Recreational Boating Hazards The gradient facility could increase hazards to recreational boaters at low river flows due to the presence of submerged riprap. ~~and concrete caps.~~
Terrestrial Biology	
Habitat	**Loss and Disturbance of Riparian, Wetland, Orchard and Cropland Habitats** Impacts to riparian and wetland habitats could further diminish these increasingly rare habitats in the Central Valley. This also includes impacts to orchards used as marginal habitat or as a buffer between riparian and more urbanized areas. Loss of cropland could decrease forage areas available to wintering and migrant species of birds.
Special-Status Species	**Potential Impacts to Special-Status Species** Impacts to special-status species could occur due to disruption or elimination of habitat or from noise or other disturbance during construction.

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C-085477

Table 2.6-2 - Issues Carried Forward for Further Analysis (Continued)

Topic	Issue (In Bold)
Visual Resources	
Visual Setting and Views of Sensitive Visual Receptors	**Soil and Vegetation Disturbance on the Banks of the Sacramento River and Montgomery Island During Construction of the Gradient Facility** Relatively large areas of riparian vegetation would be removed from the banks of the Sacramento River and Montgomery Island, which would result in a potentially significant impact to visual resources.
	Permanent Presence of Riprap During Operation Riprap would be visible within a one-quarter mile radius and would be visible from key viewpoints, which could result in a significant impact to visual resources.
	Increased Dredging and the Creation of a New Dredge Spoil Stockpiling Area During Operation Potentially larger stockpiles and the use of a new stockpiling area could represent a significant impact to visual resources.
Land Use	
Local Land Use Regulations	**Project Consistency with Applicable Regulations** Because the project would involve Federal action, local government authority could be limited. However, the lead agencies would coordinate with local governments to help ensure consistency with local land use regulations.
Cropping Patterns	**Change in Pattern or Types of Crops (Due to Future River Gradient Change)** Under the no-project alternative, and potentially under the screen extension alternative, shifts in cropping patterns would be likely responses of growers to decreases in water availability and the possibility of increased salinity in water supplies within the GCID service area and lower Colusa Basin.
Noise	
Construction-Related Noise Impacts	**Vibratory and Impact Pile Drivers, Riprap Placement, Materials Delivery/Truck Traffic, Dredging** Construction noise could adversely impact local residents.
Cultural Resources	
Unidentified Cultural Resources	**Potential Occurrence of Unidentified Subsurface Cultural Resources** **Potential Disturbance of Unidentified Cultural Resources** Testing has been conducted for subsurface cultural resources in the vicinity of the fish screen extension and no evidence was found of potential new sites. The potential exists for project construction activities in other areas to impact unidentified cultural resources.
Socioeconomics	
	Increases in Water Delivery Costs to GCID Customers Increases in water delivery costs would likely occur with the no-project alternative due to GCID funding 100 percent of costs of new groundwater wells, recapture station construction, and existing facility improvements. Relatively smaller increases would be expected with the proposed project due to cost-sharing by Reclamation and the State of California. No substantial environmental consequences are anticipated to occur from changes to water rates.
Transportation and Traffic Safety	
Road Maintenance and Traffic Safety	**Short-Term Changes in Road Maintenance and Traffic Safety During Construction of the Gradient Facility** Some local roads may not support significant increases in traffic, and local residents could be affected by changes in traffic patterns during construction.

C-085478

C-085478

Table 2.6-2 - Issues Carried Forward for Further Analysis (Continued)

Topic	Issue (In Bold)
Air Quality	
Air Pollution	**Increases in Pollutant Emissions During Construction** Construction equipment emissions and increased dust and particulate matter could result in significant impacts to air quality.
Indian Trust Assets	
	No potentially significant effects were identified.
Environmental Justice	
	No potentially significant effects were identified.
International Impacts	
	No potentially significant effects were identified.

[a] Resource and topic headings correspond to the outline of resources and topics presented in Chapter 3 (Affected Environment) and Chapter 4 (Impact Analyses).

C-085479

C-085479

CHAPTER 3
AFFECTED ENVIRONMENT

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C-085480

3.0 AFFECTED ENVIRONMENT

This chapter describes the affected environment of the resources that would be potentially impacted by the no-project and project alternatives. A description of the potential impacts on the resources is included in Chapter 4 (Impact Analyses) of this Environmental Impact Report/Environmental Impact Statement (EIR/EIS).

The Bureau of Reclamation (Reclamation) has developed a Project Simulation Model (PROSIM) that describes hydrology and water supply conditions. This and two other models were used to characterize historical, existing, and future hydrology and water resource changes for purposes of describing the affected environment here in Chapter 3 and evaluating impacts in Chapter 4 (Impact Analyses). Output from PROSIM was used in a Reclamation temperature model to simulate variations in Sacramento River temperatures. PROSIM output was also used in a Glenn-Colusa Irrigation District (GCID) water supply operations model to characterize how much water is supplied from the Hamilton City Pumping Plant (HCPP) and other water supply sources. Appendix B (Hydrology and Water Resources Technical Report) provides a complete description of the models and model output.

For other resources addressed in this EIR/EIS, the best available information was used to describe historical, existing, and future conditions. This information included literature review, agency consultations, and field data collection. As with hydrology and water resources, existing conditions and, where appropriate, future conditions of the resources are described to characterize the affected environment and to establish a baseline to evaluate potential impacts of the alternatives in Chapter 4, Impact Analyses.

Each section of this chapter starts with an introduction of the affected environment for the resource category under consideration. The scope of the introduction varies depending on the issues identified (Section 2.6, Issues Identified and Considered in EIR/EIS Process) and context and nature of the resource in the broader setting of the project study area. A description of the regulatory, regional, and local settings for each resource is then provided.

C-085481

C-085481

3.1 Hydrology and Water Resources

3.1.1 Introduction

This section describes the regulatory, regional, and local setting of the project with respect to Sacramento River hydrology, Hamilton City Pumping Plant (HCPP) and Glenn-Colusa Canal operations, related water conveyance systems, lower Colusa Basin groundwater and water quality, and river channel stability and alignment. For purposes of this Environmental Impact Report/Environmental Impact Statement (EIR/EIS), existing Sacramento River hydrology is defined as river management practices in effect in 1995. Existing conditions for HCPP operations are defined by the U.S. Army Corps of Engineers (Corps) dredge permit (Corps 1996) and Joint Stipulation of Parties (1993). A future condition is also described for 2020 Central Valley Project (CVP) operating conditions. Because of the inter-dependence between hydrology and the other resource categories analyzed in this EIR/EIS (e.g, aquatics), information critical to the impact analyses for those resources in Chapter 4 is also provided in this section.

3.1.2 Regulatory Setting

This section describes regulatory provisions that affect the Sacramento River and the HCPP. Regulatory requirements that influence hydraulic and hydrologic conditions in the Sacramento River and on Glenn-Colusa Irrigation District (GCID) operations include the National Marine Fisheries Service (NMFS) Biological Opinion for Winter-Run Chinook Salmon (1993), the Corps permits (1988 through 1996) for GCID dredging operations, Joint Stipulation of Parties (1993) (Section 1.5.2, History of Fish Screens), and the Central Valley Project Improvement Act (CVPIA) Draft Anadromous Fish Restoration Program (AFRP) (USFWS 1995b). Regulatory requirements relevant to water quality include objectives identified in the Central Valley Regional Water Quality Control Plan (WQCP), and a Memorandum of Understanding between the California Department of Pesticide Regulation (CDPR) and the State Water Resources Control Board (SWRCB).

This section also describes Senate Bill 1086 (SB 1086) Upper Sacramento River Fisheries and Riparian Habitat Plan (SB 1086 Plan). The description includes goals and policies of the plan, and the incorporation of fish screen improvements at the HCPP.

The regulatory history leading to current operation of the HCPP and fish screens is contained in Section 1.5, History of HCPP Diversions and Fish Screens. Section 1.7, Public and Agency Consultation and Coordination, presents regulations and other requirements that would apply to constructing and operating the new fish screen at the pumping plant.

3.1.2.1 National Marine Fisheries Service Biological Opinion

Sacramento River flow requirements are specified in the Winter-Run Chinook Salmon Biological Opinion (NMFS 1993). The requirements apply to operations of CVP facilities on the Sacramento River. It specifies that end-of-September water storage in Shasta Reservoir shall be maintained at no less than 1.9 million acre-feet (maf) in all normal water years. In addition, the Biological Opinion states that a minimum fishery flow of 3,250 cubic feet per second (cfs) shall be maintained in the Sacramento River below Keswick Dam from October 1 through March 31 of all years. Between July 1 and March 31, reductions in flows must adhere to the following schedules:

- for a reduction down to a level of 6,000 cfs, flows must not be decreased more than 15 percent each night and 2.5 percent in a one-hour period;
- for a reduction at levels between 5,999 and 4,000 cfs, flows must not be decreased by more than 200 cfs each night and 100 cfs in a one-hour period; and
- for a reduction at levels between 3,999 and 3,250 cfs, flows must not be decreased by more than 100 cfs each night.

The Bureau of Reclamation (Reclamation) has agreed to operate in compliance with the Biological Opinion.

3.1.2.2 U.S. Army Corps of Engineers Permits

Conditions for current operation, maintenance, and dredging activities related to the HCPP fish screens are specified in the Corps permit (Corps 1996) issued to GCID. Activities specified in the permit include:

- maintenance dredging of the oxbow channel upstream and downstream of the pumping facility; and
- placement of fill material to maintain the seasonal low-water crossing/weir below the existing fish screens and to maintain the guide bank opposite the fish screens.

A three-year permit was issued by the Corps in 1996. The permit incorporates the NMFS March 27, 1996 Biological Opinion on the Corps 1996 permit and specifies criteria for screen approach velocities and bypass flows during the period of December 1 through July 31. The Corps permit conditions, shown in **Table 3.1-1,** are in effect until 1998.

3.1.2.3 Draft Anadromous Fish Restoration Program

Congress directed the Secretary of the Interior (Secretary) to develop and implement a program that makes all reasonable efforts, including increased river flows, to restore and enhance anadromous fish habitat in the rivers and streams of California's Central Valley (excluding the San Joaquin River upstream of Mendota Pool). The program has an overall target of doubling the natural production of anadromous fish relative to the average levels attained during the period 1967-1991 (Section 3046(b)(1) of the CVPIA; Public Law 102-575). Section 3046(b)(1) is referred to as the Anadromous Fish Restoration Program. The Secretary directed the U.S. Fish and Wildlife Service (USFWS) and Reclamation to jointly implement the CVPIA; implementation of the AFRP is required by the year 2002 (USFWS 1995b).

C—085483

C-085483

Table 3.1-1 - Hamilton City Pumping Plant Operating Criteria Per Corps Dredge Permit

December 1 through July 31			August 1 through November 30	
River and Bypass			**River and Bypass**	
	$Q_R \geq 9{,}500$ cfs	$Q_B \geq 500$ cfs	$Q_R \geq 4{,}000$ cfs	$Q_B \geq 500$ cfs
7,000 cfs<	$Q_R < 9{,}500$ cfs	$Q_B \geq 400$ cfs	$Q_R < 4{,}000$ cfs	$Q_B \geq 200$ cfs
	$Q_R < 7{,}000$ cfs	$Q_B \geq 300$ cfs		
	Coleman Release[a]	$Q_B \geq 500$ cfs		
Approach Velocity			**Approach Velocity**	
	$Q_R \geq 7{,}000$ cfs	$V_a \leq 0.60$ ft/s	All river flows	$V_a \leq 0.33$ ft/s
	$Q_R < 7{,}000$ cfs	$V_a \leq 0.50$ ft/s		
	Coleman Release	$V_a \leq 0.40$ ft/s		

[a] Coleman Fish Hatchery juvenile chinook salmon release period. See Figure 1.5-2.
ft/s feet per second
Q_R Sacramento River flow at North End of Montgomery Island
Q_B Lower oxbow bypass flow
V_a Approach velocity at fish screens

The Sacramento River Draft AFRP recommendations call for Reclamation to maintain a storage pool in Shasta Reservoir that will enable the release of cool water to the river through spring and summer. This pattern includes an attempt to optimize fall- and late fall-run salmon spawning flows and to reduce river flow fluctuations that could affect spawning and rearing success during winter. For the upper Sacramento River, the Draft AFRP recommends developing and implementing an integrated river regulation plan that balances carryover storage needs with instream flow needs based on runoff and storage conditions as shown in **Table 3.1-2.**

Table 3.1-2 - Draft AFRP Minimum Recommended Sacramento River Flows at Keswick Dam October 1 to April 30[a]

Carryover Storage (maf)	Keswick Dam Release (cfs)	Carryover Storage (maf)	Keswick Dam Release (cfs)
1.9	3,250	2.5	4,250
2.0	3,250	2.6	4,500
2.1	3,250	2.7	4,750
2.2	3,500	2.8	5,000
2.3	3,750	2.9	5,250
2.4	4,000	3.0	5,500

[a] Based on September 30 carryover storage in Shasta Reservoir and critically dry runoff conditions (driest decile runoff of 2.5 maf) to produce a target April 30 Shasta Reservoir storage of 3.0 to 3.2 maf for Sacramento River summer flow temperature control.

C-085484

C-085484

3.1.2.4 Water Quality Regulations

State law requires that this project provide water quality protection and enhancement for both existing and potential beneficial uses of water resources. Specific water quality objectives relevant to the issues of this project are identified in Section 4.1.2, Impact Significance Criteria in Chapter 4, Impact Analyses. Water quality objectives consistent with the beneficial uses of the Sacramento River in the project vicinity are specified in the WQCP (CVRWQCB 1994).

3.1.2.5 SB 1086 Upper Sacramento River Fisheries and Riparian Habitat Plan

SB 1086 established the Upper Sacramento River Fisheries and Riparian Habitat Advisory Council and called for an advisory management plan to protect, restore, and enhance the fish and riparian habitat and associated wildlife of the upper Sacramento River. The resulting advisory management plan is the SB 1086 Plan. The SB 1086 Plan presents a program for protecting and restoring fish and riparian habitat and identifies a series of priority actions with specified timeframes, estimated costs and benefits, and proposed funding sources. This plan establishes goals for the participating agencies to incorporate in their planning activities.

The plan identifies the establishment of an "inner river" zone that would accomplish the goals of the plan. SB 1086 Plan riparian habitat protection goals include protecting and maintaining existing riparian habitat from further loss or deterioration, re-establishing a continuous riparian ecosystem along the river between Chico and Redding, and re-establishing riparian vegetation along the river from Verona to Chico, consistent with the Sacramento River Flood Control Project. Two actions are proposed for restoring riparian vegetation or reducing losses of native vegetation, and comprise a Riparian Habitat Restoration Plan component (Resources Agency 1989).

Twenty actions are proposed solutions to fisheries problems on the mainstem Sacramento River and its tributaries, and collectively are called the Fisheries Restoration Plan component. The intent of the Fisheries Restoration Plan is that actions to protect, restore, and enhance wild strains of salmon and steelhead will be given the highest priority. Actions that will maximize habitat restoration for naturally spawning salmon and steelhead will be given second priority. Artificial production will be limited to actions that will fully compensate for fish populations that existed at the time their historic habitat was permanently lost due to blockage by dams or other human causes (Resources Agency 1989).

The GCID diversion is included as one of the Fisheries Restoration Plan projects. The plan recommends (Resources Agency 1989):

- "[Restoring] the elevation of the river at the head of the GCID diversion channel sufficiently to reduce water velocities through the screen to acceptable levels and to assure that adequate bypass flows are maintained to return screened fish to the river."

- Modifying the existing screens to "work properly in conjunction with the above solution" or installing a "new screening system using state-of-the-art knowledge."

- "To the extent possible, use of alternative water supplies to reduce the amount of water diverted, especially during the critical migration period."

- "Reduce fish predation in the oxbow channel."

3.1.3 Regional Setting

The Sacramento River is the largest river in California. It has an average annual runoff of 22.4 maf and yields 35 percent of the State's water supply (DWR 1994a). Upper Sacramento River flows are largely controlled by upstream CVP storage and diversion facilities operated by Reclamation and local irrigation districts. CVP facilities affecting upper Sacramento River flows include Shasta, Keswick, Trinity, Lewiston, Whiskeytown, and Spring Creek Debris dams; Red Bluff Diversion Dam (RBDD); and the Tehama-Colusa and Corning canals **(Figure 3.1-1)**. Shasta Reservoir is the largest CVP reservoir, storing up to 4.5 maf of water.

Flows released into the Sacramento River from Keswick Dam support a variety of beneficial uses including: municipal and industrial water supply; agricultural practices of irrigation and stock watering; recreational swimming, canoeing, and rafting and other non-contact uses; warm and cold freshwater habitat; warm and cold-water fishery migration; and spawning and wildlife habitat. Minimum releases are based upon river temperature objectives, hydropower requirements, and Sacramento-San Joaquin River Delta (Delta) water quality objectives.

Sacramento River diversions are made in accordance with water rights and water contracts with Reclamation. In recent years, resource agency and Congressional mandates for fisheries protection and restoration, and Delta water quality improvement objectives have changed the operation of storage and diversion facilities (described in Section 3.1.2, Regulatory Setting).

Scheduling water releases from Keswick Dam involves day-to-day operations adjustments by Reclamation so that fisheries, navigation, GCID, other diversion, water transfer, and water quality needs are met. Water temperatures between Keswick Dam and Hamilton City are of particular interest to fishery resource management agencies. The recent completion of a temperature control device at Shasta Dam allows for generation of electrical power while releasing cooler water into the Sacramento River during critical periods of chinook salmon spawning (Reclamation 1991).

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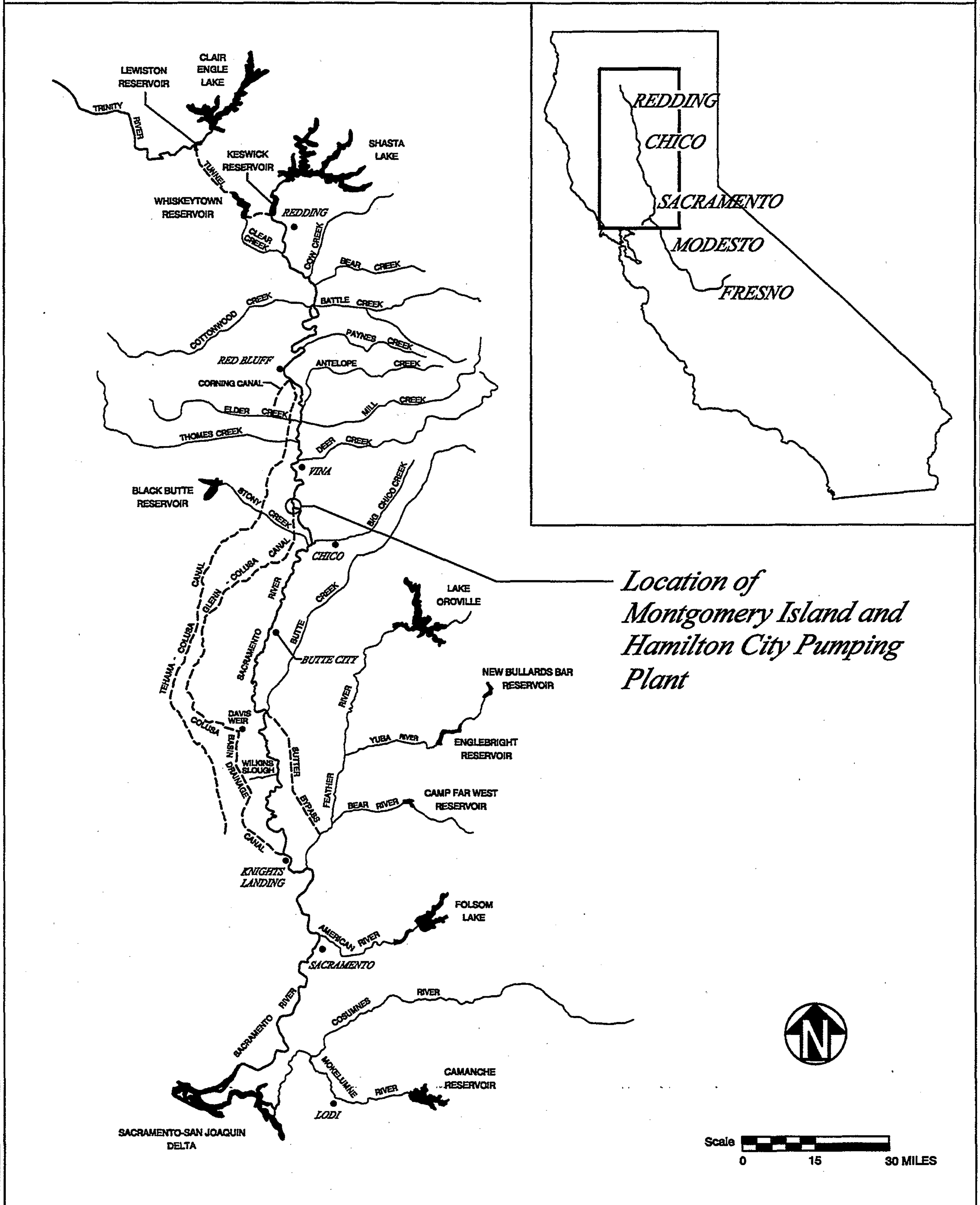
FIGURE 3.1-1. SACRAMENTO RIVER BASIN AND TRIBUTARIES



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3.1.4 Local Setting

The local setting for hydrology and water resources includes the upper Sacramento River between Keswick Dam and its confluence with the Colusa Basin Drain; the GCID service area; the lower Colusa Basin; RBDD and HCPP diversion facilities; and the Tehama-Colusa Canal (TCC), Glenn-Colusa Canal, and the Colusa Basin Drain conveyance facilities as shown on Figure 1.1-1.

The GCID service area relies on Sacramento River water diverted at the HCPP to satisfy a large portion of its demands. Water diverted at RBDD to the TCC also serves the GCID service area and nearby National Wildlife Refuges (i.e., Sacramento, Colusa, and Delevan). Outflow from the GCID service area flows into the Colusa Basin Drain for recapture and/or use by downstream lower Colusa Basin users. Runoff from the GCID service area and lower Colusa Basin eventually returns to the Sacramento River, via the Colusa Basin Drain, near Knights Landing.

This section describes Sacramento River and oxbow flow conditions, river channel stability, river water quality, and the operations of the GCID service area and lower Colusa Basin, including:

- GCID demands;
- water supply;
- operations of the HCPP and other GCID facilities;
- water management programs;
- the lower Colusa Basin and Colusa Basin Drain outflow; and
- groundwater conditions.

3.1.4.1 GCID Deliveries

GCID seasonal and peak demands, supply sources, operations at the HCPP, and water management programs are described below.

GCID Demand

HCPP diversions serve the 170,000-acre GCID service area comprised of farmland and three National Wildlife Refuges. Water demands vary from year-to-year and throughout each year, depending in part on precipitation events (Figure 1.5-1). Early season (e.g., February through May) demands are driven by the need to irrigate crop plantings and flood the rice fields immediately following planting. Planting and flooding for rice usually occur from mid-April to mid-May, depending upon the timing of spring rains. Following initial flooding, water deliveries decline for several weeks, then increase to average summer demands between mid-June and the end of August. Demands decrease during late August and early September and continue through the fall when duck ponds are filled, and rice decomposition and wildlife refuge needs increase (Figure 1.5-2).

Two types of demands are associated with GCID: annual and instantaneous (peak). Annual demand is the total yearly amount of water required for irrigation, usually expressed in a volume (acre-feet (ac-ft)). Instantaneous demand is the peak daily amount of water required to meet near-

C-085488

C-085488

term irrigation needs. This is usually expressed as flow (cfs). The peak demand may exceed GCID's diversion and groundwater pumping capacity. In these instances, demand is shifted (e.g., planting time for crops is shifted) until water is available.

National Wildlife Refuges Demand

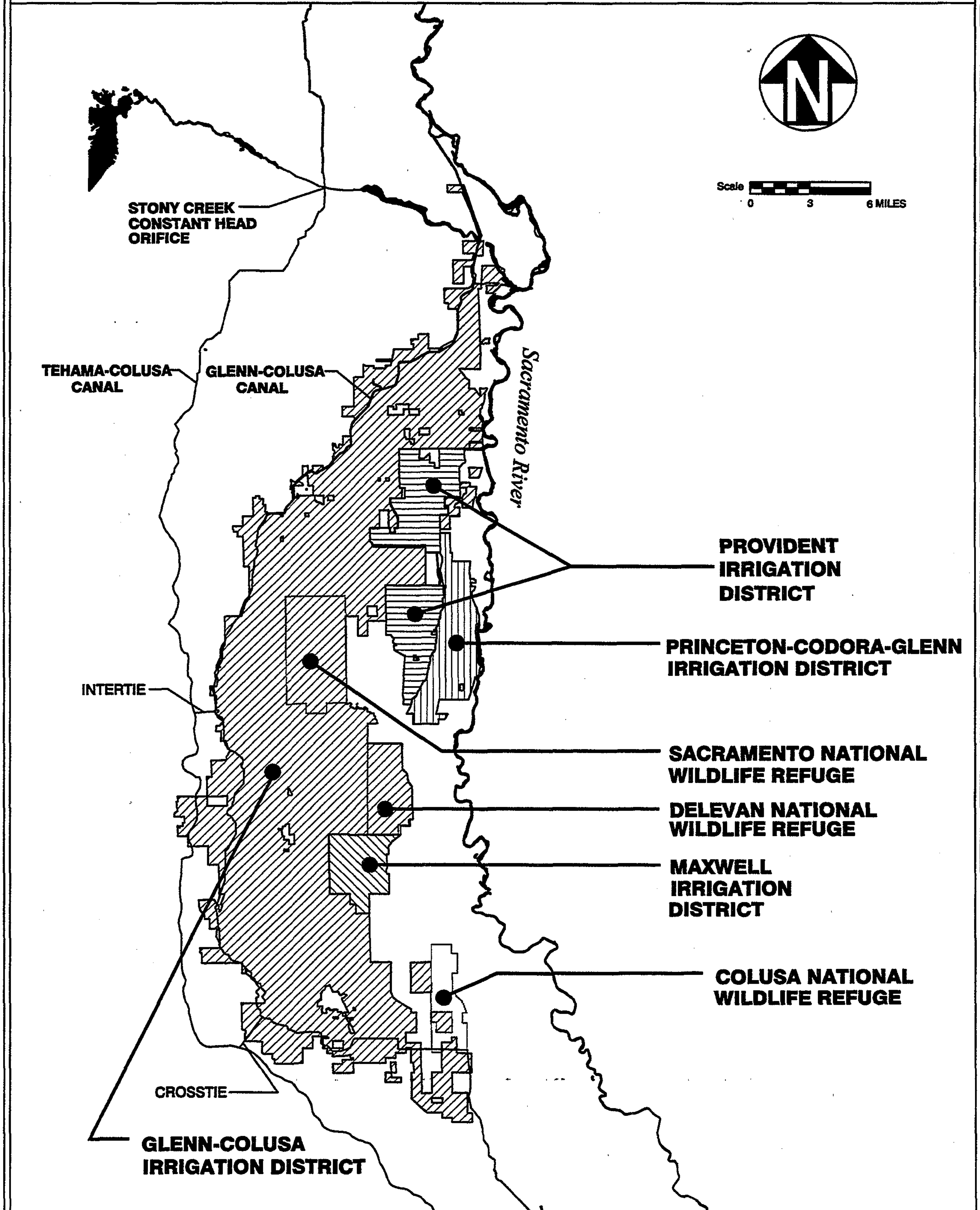
Throughout the year, but predominantly from August to December, GCID wheels CVP project water to three National Wildlife Refuges (Sacramento, Delevan, and Colusa, see **Figure 3.1-2**) under terms of a contract with Reclamation. Full supplies of water to the refuges are 50,000, 30,000 and 25,000 ac-ft per year, respectively. Since the refuges have limited appropriative water rights, deliveries of refuge water supplies through GCID facilities are done in accordance with the Reclamation/GCID contract on a cooperative basis depending on conveyance capacity, HCPP operations, river levels, and CVP water availability. For the most part, however, the refuges receive a full "Level 2" supply (i.e., the current average annual water supply).

The 1995 GCID Water Measurement Report (1996a) shows that the 10-year average annual water supply (1986-1995) delivered to the refuges from April through October was approximately 38,400 ac-ft. (Water is generally delivered to the refuges after October and before April, but is not summarized in the reports because the Reclamation contract for water supply begins April 1 and ends October 31.) The quantity of water historically delivered is approximately 37 percent of the future "Level 4" (i.e., the supply identified for optimum habitat management) supply of 105,000 ac-ft listed in the Refuge Water Supply Conveyance Alternatives Refinement Memorandum prepared for the U.S. Department of the Interior (1995).

Reclamation makes the refuge water supply available to GCID at the TCC intertie, Glenn-Colusa Canal crosstie, and at the HCPP. Water can be gravity-fed to the lower half of the Sacramento Refuge and all of the Delevan and Colusa refuge acreage. The upper half of the Sacramento Refuge must be supplied by the Glenn-Colusa Canal. This water is either diverted at HCPP or diverted from Stony Creek. In recent years, the Stony Creek conveyance has become less reliable due to the Tehama-Colusa Canal Authority (TCCA) installation of a gravel dam on the creek at the TCC crossing.

GCID and refuge conveyance systems are configured to allow mixing Sacramento River water and recovered drain water. The proportion of drain water to river water varies from year-to-year due to variations in water year type, precipitation, GCID conveyance capacity, and refuge water management options. During wet years, the river water component may be in excess of 75 percent of total supply. During critical and dry years, the drain recapture water component may yield 50 percent of the supply. The proportioning is accomplished through regulation of the amount of river water released into those channels which are used to commingle flows and regulate water quality.

FIGURE 3.1-2. IRRIGATION DISTRICTS AND REFUGES WITHIN THE COLUSA BASIN



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GCID Water Supply

Sources of GCID water include: 720,000 ac-ft per year of base supply water from Sacramento River and Stony Creek; 105,000 ac-ft per year of CVP contract water from the Sacramento River; additional water that may be purchased from Reclamation under Contract 855A; recaptured agricultural runoff water; and groundwater (Section 3.1.4.4, Groundwater, provides a description of the groundwater basin underlying the GCID service area). GCID has recently established a groundwater conjunctive use program from which its current groundwater pumping capacity is 500 cfs. As described in Section 1.5, History of HCPP Diversions and Fish Screens, GCID has historically diverted more than 825,000 ac-ft per year, although the average has been approximately 654,000 ac-ft per year. HCPP operating constraints imposed by the Joint Stipulation of Parties (1993) and Corps dredge permit (1996) limit GCID's annual Sacramento River diversions to about 75 percent of its combined 720,000 ac-ft base supply entitlement and 105,000 ac-ft CVP contract water. Actual deliveries and losses are measured by GCID and reported annually (e.g., GCID 1996a).

GCID diverts its Sacramento River base supply and CVP project water through the HCPP. GCID also obtains these water supplies via the TCC depending on water supply conditions, irrigation demands, available canal capacity, and other operation considerations, such as the placement of the RBDD gates. Reclamation raises the RBDD gates from September 15 through May 15, as required by the NMFS Biological Opinion (1993) for fish passage. Tehama-Colusa Canal available capacity cannot be relied upon to meet GCID's water delivery needs because the available capacity is a function of canal contract user demands; availability is expected to decrease in the future as diversions are maximized according to contracts with Reclamation. Demands not satisfied through Sacramento River and Stony Creek diversions are satisfied through use of recaptured water and groundwater.

Figure 3.1-3 illustrates the average weekly deliveries to GCID for the 70-year (1922-1991) hydrologic period of record, as determined from a GCID water supply operations model developed for this EIR/EIS (Appendix B, Hydrology and Water Resources Technical Report). The model calculated the amount of water GCID uses and the amount of any unmet demand based on existing operations. The model calculated deliveries to GCID using the following priority of use, which is based upon the cost per ac-ft of water:

- Stony Creek flows;
- base supply diverted at the HCPP;
- recaptured water;
- base supply or CVP contract water diverted at the TCC; and
- groundwater.

Figure 3.1-3 differs from Figure 1.5-2 (HCPP Historic and Existing Diversion Patterns) in that Figure 3.1-3 illustrates deliveries for all sources, not just HCPP, and is based on the output of a model that analyzed 70 years of the hydrologic record under existing operating conditions; whereas, Figure 1.5-2 illustrates the typical diversion pattern prior to restrictions imposed at the HCPP by the

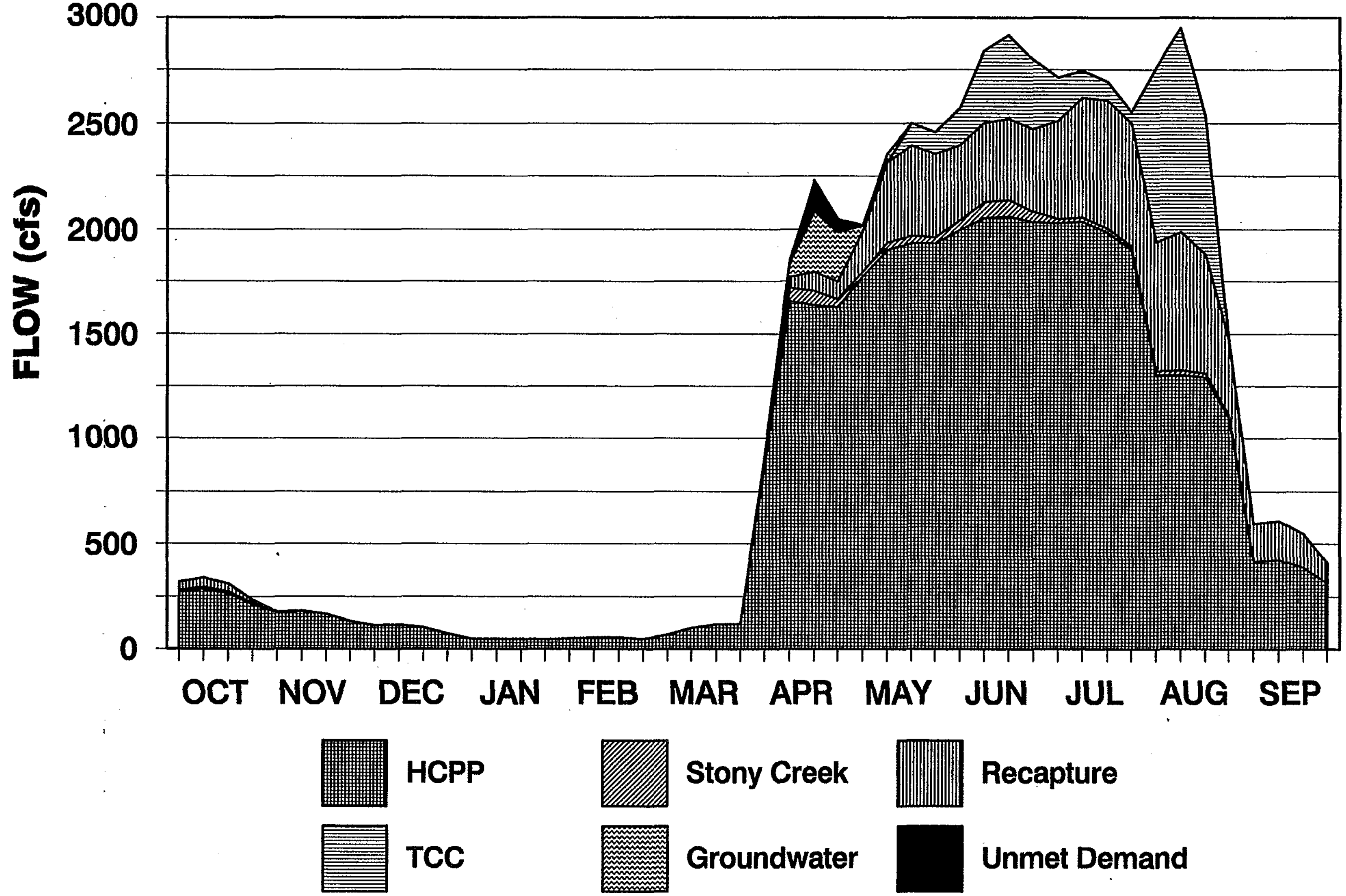

FIGURE 3.1-3. AVERAGE WEEKLY DELIVERIES BY SOURCE FOR THE 70-YEAR HYDROLOGIC RECORD

Source: Output from GCID water supply operations model as described in Appendix B, Hydrology and Water Resources Technical Report

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C-085492

Joint Stipulation of Parties (1993). As shown on Figure 3.1-3, GCID satisfies the majority of its demand with water diverted at the HCPP, followed by recapture, water diverted at the TCC, groundwater, and Stony Creek water. Early in the irrigation season (e.g., April), GCID relies on groundwater to satisfy demand not met through diversion of Sacramento River and Stony Creek water. As the irrigation season progresses, agricultural runoff becomes available for recapture, and this water is used to satisfy demands before groundwater is used. Any unmet demand, usually in April, is accommodated through shifting of planting to later in the season, when water is available. The unmet demand shown on Figure 3.1-3 is the average for the 70-year hydrologic period of record. The actual amount of unmet demand varies year-to-year.

GCID has water exchange agreements with the Provident and Princeton-Codora-Glenn irrigation districts whereby each conveys water to lands within the others' districts. The exchange is made as a matter of convenience and has little impact on the amount of water diverted at GCID operations.

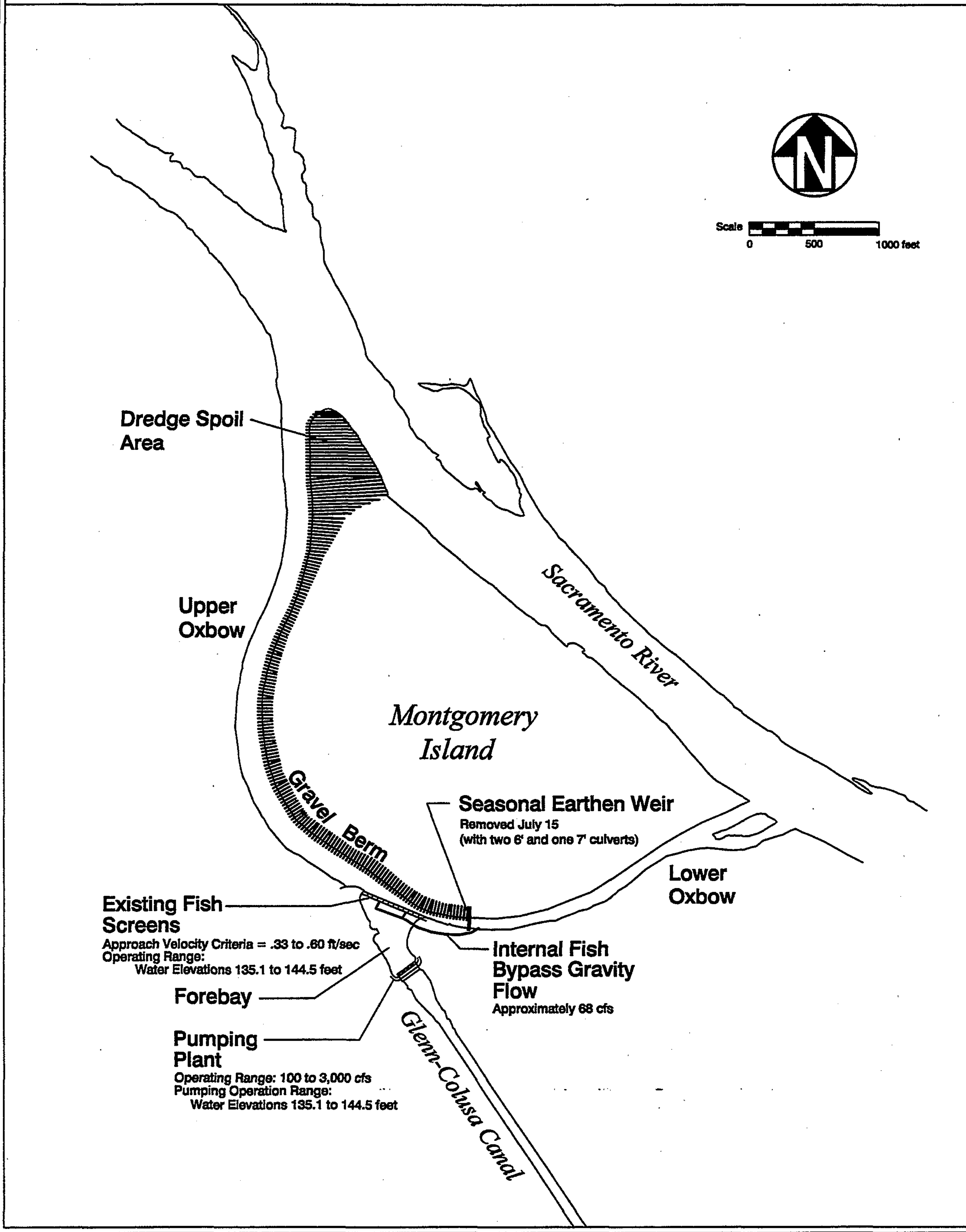
GCID Operations

The principal conveyance facilities involved in delivering water from the Sacramento River to GCID are the HCPP and Glenn-Colusa Canal, and the RBDD and TCC. Water from the TCC is delivered to GCID via one intertie and one crosstie (Figure 3.1-2). Water from the TCC can also be discharged into Stony Creek via the constant head orifice (CHO) for recapture in the Glenn-Colusa Canal for delivery within the GCID service area and national wildlife refuges. The interties have a capacity of about 1,130 cfs (1,500 cfs if the Stony Creek CHO is included). Since Stony Creek traverses a very pervious alluvial fan area, approximately 10 to 40 percent of the CHO water is lost via seepage to groundwater depending upon flows (HDR 1994).

The HCPP consists of 10 pumping units providing a total pumping capacity of 3,000 cfs. **Figure 3.1-4** identifies the existing pump capacity and Sacramento River water elevation operating ranges for the HCPP. Pump performance varies with forebay water elevations and is further limited by the operating range associated with the approach velocity criteria for the fish screens. Approach velocities at the existing fish screens are a function of the pump rate and amount of fish screen area under water. Higher water surface elevations provide a greater fish screen area through which water can flow. In turn, pump rates can increase under these conditions without exceeding the approach velocity criteria.

Flows into the pumping plant forebay (Figure 3.1-4) are modified by a gravel berm guide wall and a seasonal earthen weir. The gravel berm narrows the oxbow channel width in front of the screens to improve sweeping velocities, direct flows into the forebay, and help maintain minimum water velocities through the oxbow for fish return to the river. The seasonal weir includes three culverts (two six-foot diameter and one seven-foot diameter) that regulate flows through the lower oxbow channel. The weir also provides access to Montgomery Island. Upon completion of annual dredging activities, the seasonal weir is lowered to facilitate passage of fish through the oxbow. Lowering the height of the weir allows water to flow over the top, as well as through the culverts.

FIGURE 3.1-4. EXISTING FLOW CONTROL FEATURES AND OPERATING RANGES FOR THE HAMILTON CITY PUMPING PLANT



Sedimentation and Dredging

GCID currently dredges the upper and lower oxbow to remove sediment and debris, and improve flow conditions through the oxbow. The amount of sedimentation and dredging required varies each year and depends upon flow conditions. For high flow water years (peak flows greater than 115,000 cfs), the dredge volumes are usually greater than 90,000 cubic yards. For normal flow water years (peak flows greater than 40,000 cfs and less than 115,000 cfs), dredge volumes are generally 60,000 cubic yards. For low flow water years (peak flows less than 40,000 cfs), dredge volumes are less than 30,000 cubic yards (Reclamation 1997c). During low flow water years, dredging may not be required at all.

Water Management Programs

GCID has implemented and/or is participating in a number of programs to make the most efficient use of available water supplies. This section briefly describes these water conservation, groundwater conjunctive use, water reuse, and water transfer programs.

Water Conservation

Prior to 1991, GCID operated under the conservation guidelines for Reclamation contractors to assure efficient water use. Pumping restrictions at the HCPP have seriously impaired GCID's ability to meet the irrigation demands of its growers. As a result of the limitations imposed on its pumping, GCID has, since 1991, imposed a more stringent water conservation program than was required by Reclamation. Adherence to the program is required for GCID to meet both its annual and instantaneous demands.

GCID's conservation plan was adopted to stretch the limited supply during the high demand periods while minimizing adverse effects on crop yields. In 1991, GCID adopted an incentive-based program that offered a 20 percent rebate on water tolls at the end of the season to growers who voluntarily complied with the program requirements. This approach was not as effective as GCID anticipated and led to the adoption of a mandatory conservation program in 1992. This program incorporated both incentive and punitive measures to control the total amount of water applied to crops. The conservation plan presently in force offers monetary incentives (20 percent reduction in water tolls) for growers who agree to incorporate required conservation methods into their irrigation practices prior to the growing season. The plan also uses punitive measures by incorporating escalating monetary penalties for violations of the conservation rules. The terms of the program and rates charged for violations are explained in the District's Water Conservation Policy (GCID 1996b).

The 1992 conservation plan has experienced mixed results. It has succeeded in stretching the limited water supply, however, at the same time, has created salt build-up in the soil which has affected crop yields, particularly rice in the southern portions of the GCID service area. Since 1992, when the new conservation plan was first implemented, the annual reduction in HCPP diversions has ranged from 20 to 26 percent less than the 10-year mean for the period of 1986-1995. However, as described later in Section 3.1.4.5, Water Quality, the drain outflow leaving the

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GCID boundaries was also reduced by approximately an equal amount and has also shown marked increases in salinity levels.

Groundwater Conjunctive Use Program

GCID has been managing and operating a voluntary groundwater conjunctive use program since 1992. There have been up to 160 landowners in the program, with an estimated combined production capacity of approximately 500 cfs. GCID uses this capacity during periods in which its surface water supply delivery capability does not meet instantaneous demands (GCID 1996c).

Annual groundwater deliveries made available from the program range from a low of 0 ac-ft during 1993, to a high of 65,500 ac-ft during 1994. The annual quantity pumped is a function of demand and the ability to meet this demand from less expensive alternative sources such as the TCC or drain water recapture. GCID pays for groundwater on a delivered ac-ft basis. GCID also makes a minimum incentive payment to well owners to encourage their ongoing participation in the program, whether or not their particular well is used to pump water (GCID 1996c).

Water Reuse (Drain Recapture)

As noted above, GCID has a program for recapturing drain water for reuse within its system. Drain flows include both groundwater seepage and tailwater runoff from cultivated fields. GCID facilities include both gravity systems and pump systems. Recaptured drain flows are delivered into either the Glenn-Colusa Canal or a lateral to be reused by GCID.

The amount of water that can be recaptured varies significantly from year-to-year and seasonally, and is a function of many factors, including surface water diversions, groundwater pumping, and precipitation. **Table 3.1-3** shows the annual amounts of water that were recaptured during the 1973 to 1995 period for both gravity and pumping systems. These data are plotted against the total GCID surface water diversions in **Figure 3.1-5**. During the last few years, recapture amounts have steadily increased in conjunction with decreased surface water diversions.

Water Transfer Program

In recent years, there has been growing pressure on senior water rights holders, such as GCID, to market water surplus to their needs. Water markets assume water is put to reasonable, beneficial uses to the maximum degree possible. In this regard, the market can act to reallocate water while recognizing the importance of prior rights in water. Through its water management programs, GCID has improved its water conservation and conjunctive use practices, potentially providing water for market. In 1995, GCID adopted a water transfer policy (GCID 1995b) to market surplus water resulting from conservation practices, conjunctive use practices, and variations in seasonal and annual water supply conditions.

Table 3.1-3 - GCID Drain Recapture for the Period 1973 - 1995

Year	Drain Pumps (ac-ft)	Gravity Diversions (ac-ft)	Total Recapture (ac-ft)
1973	114,000	74,299	188,200
1974	118,400	81,900	200,300
1975	148,200	73,700	221,900
1976	138,300	76,400	214,700
1977	83,900	51,300	135,200
1978	115,500	78,100	193,600
1979	141,600	101,400	243,000
1980	124,700	100,000	224,700
1981	128,500	107,500	236,000
1982	88,600	98,600	187,200
1983	24,300	66,500	90,800
1984	54,300	98,400	152,700
1985	39,600	93,200	132,800
1986	42,600	91,600	134,200
1987	38,300	82,400	120,700
1988	79,500	68,000	147,500
1989	108,500	76,000	184,500
1990	92,400	63,200	155,600
1991	79,700	67,700	147,400
1992	57,900	48,900	106,800
1993	78,400	56,100	134,500
1994	86,600	69,800	156,400
1995	95,200	80,600	175,800

Source: GCID 1996a, HDR 1994

The program provides that surplus water will be marketed to other users according to the following priority:

- other agricultural areas within the Sacramento River watershed;
- environmental purposes;
- urban water agencies north of the Delta; and
- agricultural or urban water users south of the Delta.

3.1.4.2 Lower Colusa Basin Drain Deliveries

The Colusa Basin Drain is a multi-purpose drain that is used both as an irrigation supply canal and as an agricultural return flow facility. The drain flows south along the east boundary of the Colusa Basin (Figure 3.1-1) and eventually discharges into the Sacramento River through regulated outfall gates at Knights Landing or, during flood periods, into the Yolo Bypass through the Knights Landing Ridge Cut (City of Sacramento 1995). Existing beneficial uses for the Colusa Basin Drain flow, as described in the WQCP (CVRWQCB 1994), include: agricultural practices of irrigation and stock watering; recreational swimming, canoeing and rafting; warm

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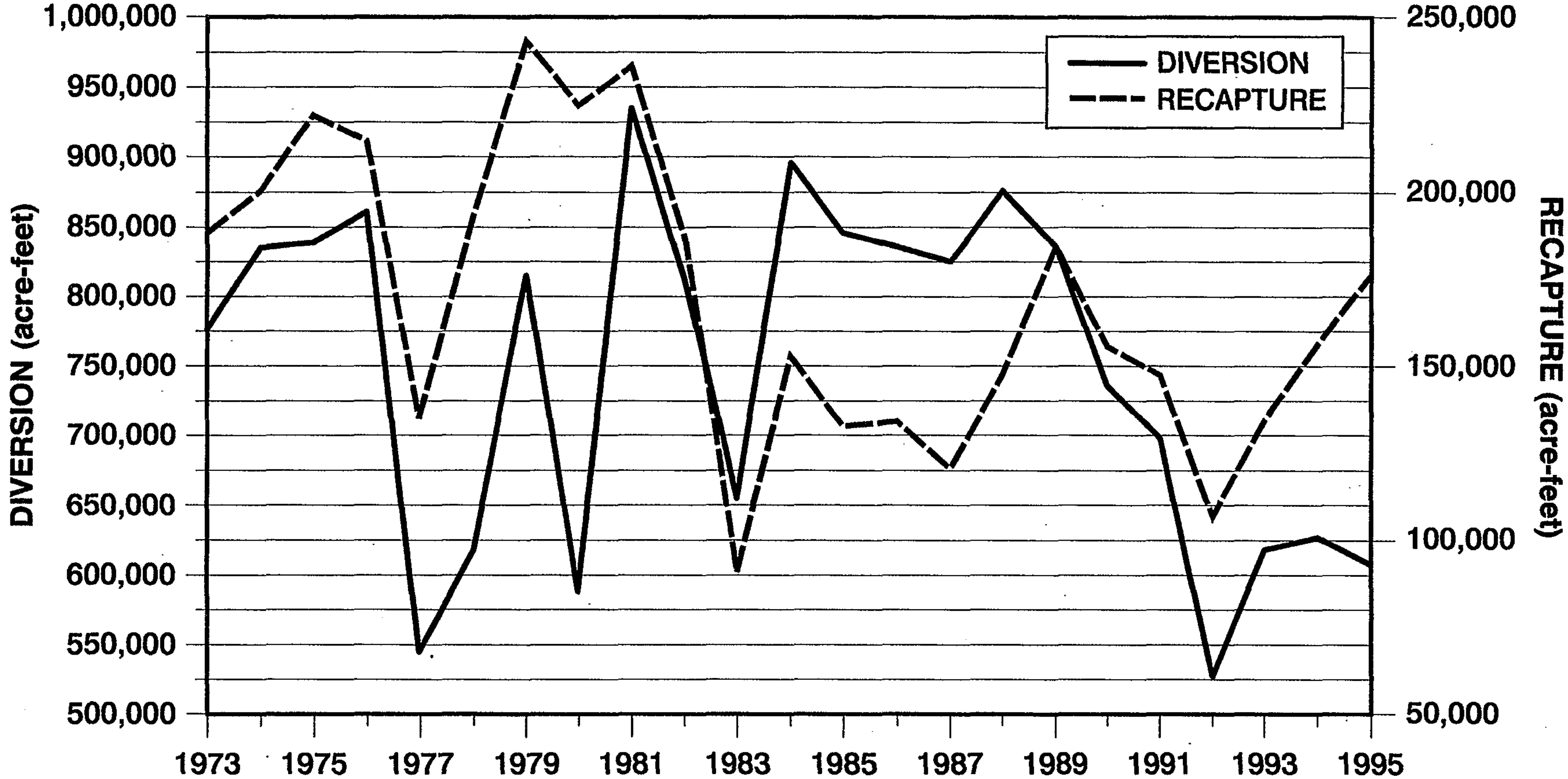
FIGURE 3.1-5. GCID DIVERSIONS VS. RECAPTURE[a]



a) GCID diversions include Sacramento River and Stony Creek water only.

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freshwater habitat to support warm water ecosystems; warm freshwater corridors to support migration and spawning of aquatic organisms; and wildlife habitat.

Downstream water users use most of GCID's drain water. About 50 percent of the water supplied to the Provident Irrigation District is GCID return flow, while about 25 percent of Princeton-Codora-Glenn's supply is from GCID and Provident return flows. This water reuse practice is repeated throughout the Colusa Basin. Virtually all downstream irrigation districts rely on return flows for a significant portion of their water supply (HDR 1994).

A study by the Department of Water Resources (DWR 1975) concluded that irrigation efficiency in the basin was approximately 70 percent which was "...considered moderately high, particularly with a rice culture that requires spillage of large amounts of ponded water in the fall months." The amount of drainage water leaving GCID is shown in **Table 3.1-4.**

From the early 1900s to the drought of 1976-77, water supply in the Colusa Basin Drain had been sufficient to meet the needs of irrigated lands that acquire water from this source. Historically, there were shortages of water in the drain for short periods of time when flooding of rice fields was at its peak, but slight offsetting of planting times by downstream irrigators generally abated any water shortage problems (Murray et al. 1994). However, since 1991, GCID outflow has decreased significantly to lows of 93,100 ac-ft, 121,200 ac-ft, and 107,000 ac-ft in 1992, 1993, and 1994, respectively. Late April, May, and early June rainstorms contributed to the excessive outflow in 1995 (GCID 1996b). Reduced surface water supply conditions have caused farmers to rely on groundwater supplies to a much greater extent than before 1991 (B. Wallace, pers. comm., 1996; Murray et al. 1994).

3.1.4.3 Sacramento River Flows

As mentioned previously, Reclamation operates CVP storage and conveyance facilities that largely control the flows in the upper Sacramento River. For planning purposes, Reclamation developed the PROSIM model to characterize flows under various hydrologic and operating conditions. A description of this model and how it was used to describe the existing conditions and alternatives analyses for Sacramento River flows is presented in Appendix B, Hydrology and Water Resources Technical Report.

The monthly average Sacramento River flow frequency shown in **Table 3.1-5** was derived from PROSIM output, and represents the 70-year (1922-1991) hydrologic trace under existing (1995) hydrologic conditions. **Figure 3.1-6** shows the average monthly flows for the 70-year hydrologic period of record (1922-1991) below the RBDD.

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Table 3.1-4 - Summary of GCID Drain Water Outflows for the Period 1973 - 1995	
Year	**Total Outflow (ac-ft)**
1973	215,600
1974	257,500
1975	243,500
1976	183,800
1977	132,400
1978	252,400
1979	212,400
1980	262,400
1981	268,800
1982	254,800
1983	239,400
1984	301,300
1985	305,800
1986	271,600
1987	277,400
1988	241,300
1989	231,200
1990	192,500
1991	144,500
1992	93,100
1993	121,200
1994	107,000
1995	155,100
Source: GCID 1996a, HDR 1994	

Table 3.1-5 - Simulated Flow Frequency for the Sacramento River for the 70-Year Hydrologic Period of Record (1922 - 1991) Below Red Bluff Diversion Dam[a]	
Mean Monthly Flow (cfs)	**Percent of Time Flow Value is Exceeded**
3,700	100
4,100	99
4,400	98
4,500	97
4,700	96
4,800	95
5,200	90
6,100	80
6,600	75
9,200	50
12,500	20
19,100	10
27,300	5
30,800	4
35,400	3
42,400	2
49,200	1
86,000	0

[a] Monthly average flows based upon PROSIM output as described in Appendix B, Hydrology and Water Resources Technical Report.

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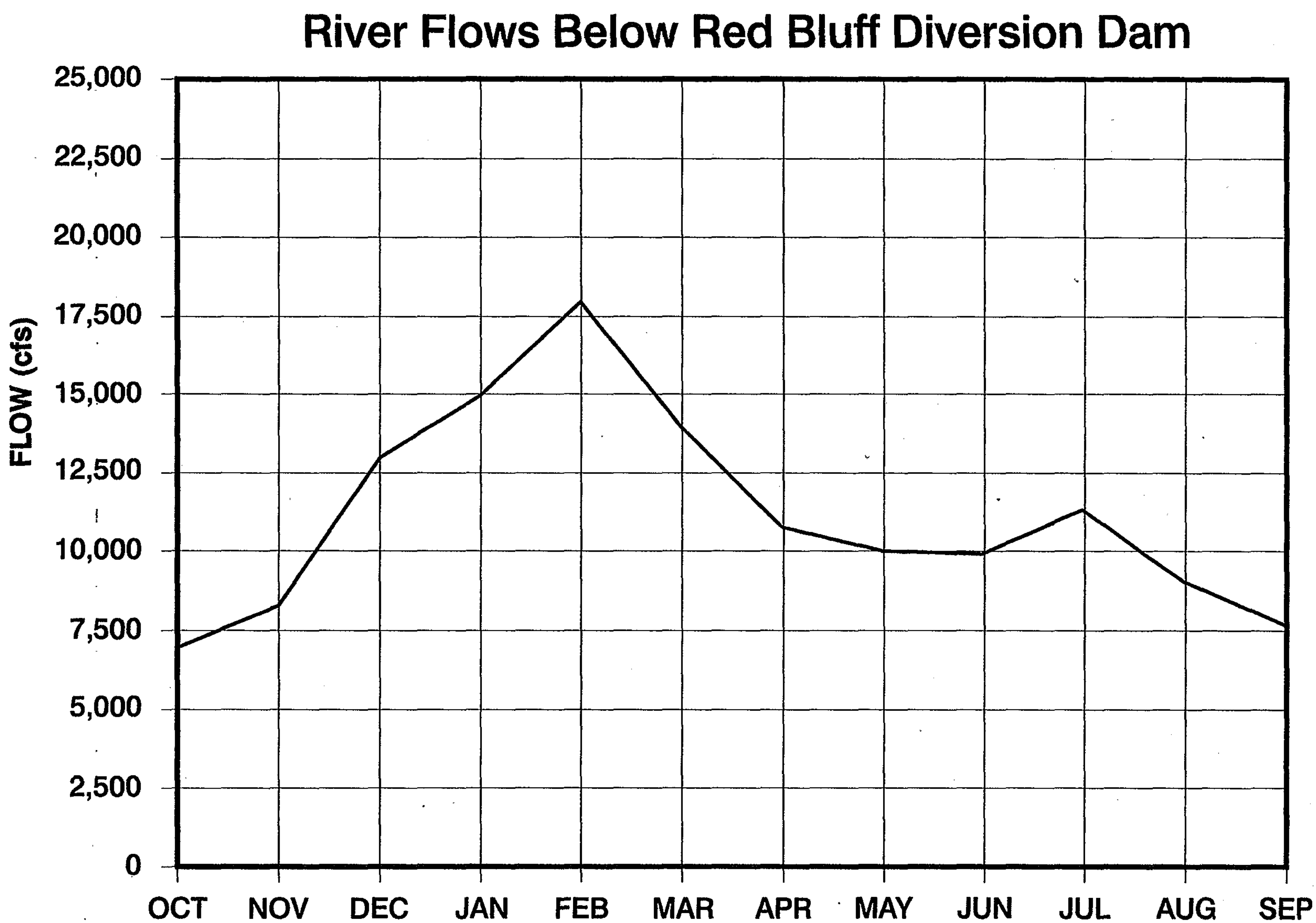


Source: PROSIM output for the period 1922-1991. Appendix B, Hydrology and Water Resources Technical Report, contains the data on which this figure is based.

FIGURE 3.1-6. AVERAGE MONTHLY SACRAMENTO RIVER FLOWS FOR THE 70-YEAR HYDROLOGIC RECORD

Sacramento River and Oxbow Flow Split at Hamilton City Pumping Plant

The flow split between the Sacramento River and the oxbow varies according to river flow, and is a function of the path of least hydraulic resistance. The flow split is also a function of pumping and the resulting pumping plant forebay water elevation, lower oxbow bypass flow, and channel characteristics. Channel roughness and the length and slope of the channel around Montgomery Island affect the flow split. During periods of pumping, the water surface in front of the plant is drawn down, thus increasing the energy slope and the flow from the river into the upper oxbow channel. Under low river flow conditions, the flow split is more specifically a function of the upper oxbow cross section, GCID pumping rate, and the hydraulic performance of the seasonal earthen weir in the oxbow.

3.1.4.4 Groundwater

Information on groundwater conditions in the study area is available from the California Department of Water Resources (DWR 1994b, 1994c) monitoring program in Glenn and Colusa counties. Data from the following wells (locations shown on **Figure 3.1-7**) were selected to generally represent the physical characteristics and groundwater level trends in the Colusa Basin drainage area:

GCID Service Area

- Well 15N/2W-19E01, near Williams
- Well 17N/3W-10C01, near Delevan and Interstate 5
- Well 20N/2W-11A02, near the northern junction of the Glenn-Colusa Canal and the Colusa Basin Drain

South of the GCID Service Area

- Well 13N/2W-04G01
- Well 13N/2W-15J01
- Well 14N/2W-29J01

Near the Colusa Basin Drain (south of College City)

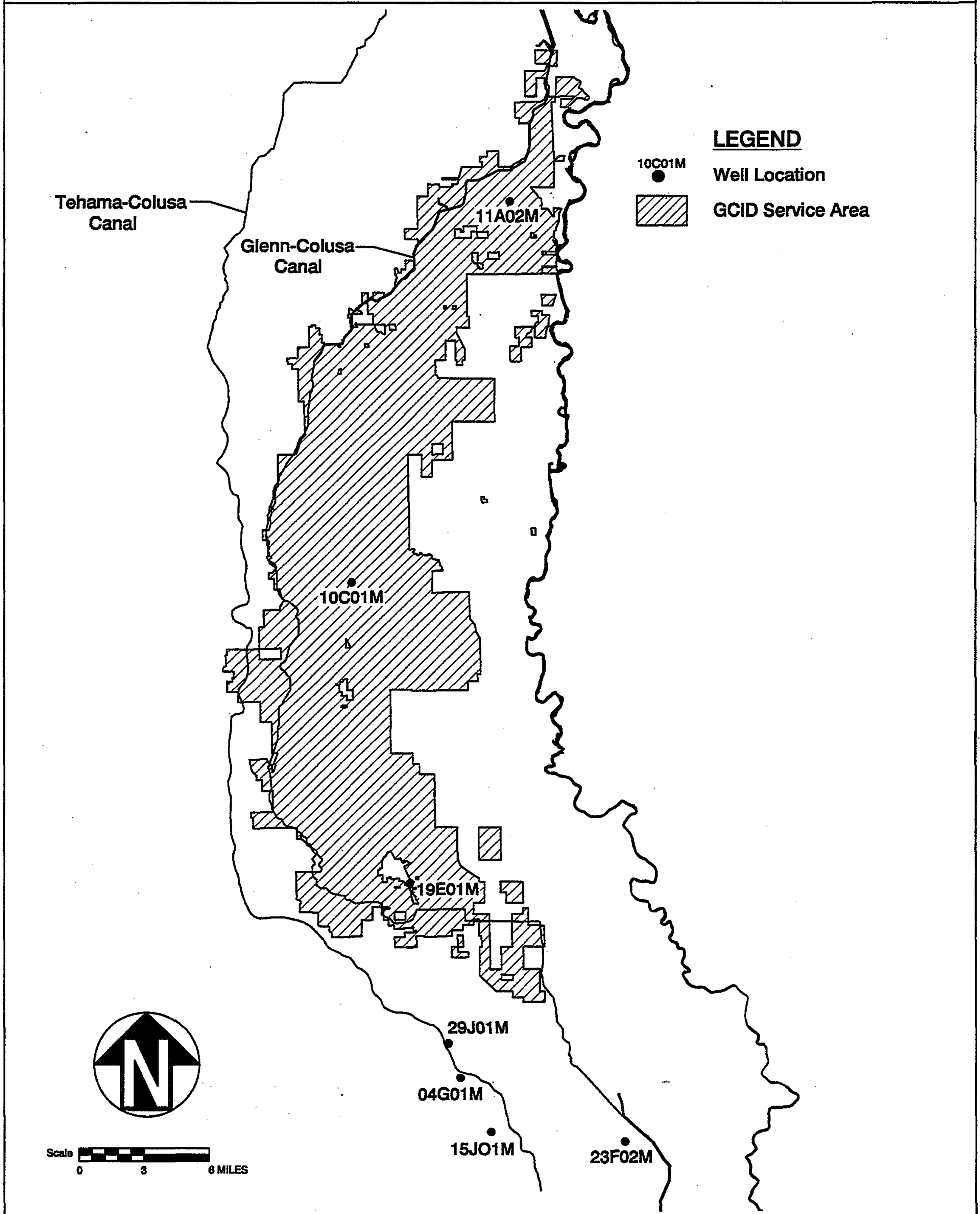
- Well 13N/1W-23F02

These wells were chosen because the frequency of measurement and period of record are sufficient for detecting long-term and seasonal trends and because they are located in the project area. These wells represent the groundwater characteristics in the Colusa Basin drainage area.

Aquifer Characteristics

Confined, unconfined, semi-confined (appears confined locally, but is unconfined regionally), and composite of confined and unconfined aquifers exist within the Colusa Basin drainage area. Generally, the aquifers in the northern part of the basin are composite, with interspersed

FIGURE 3.1-7. LOCATIONS OF SELECTED WELLS IN COLUSA BASIN DRAINAGE AREA



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unconfined and confined aquifers. The aquifers in the central part of the basin are generally unconfined. The aquifers in the southern part of the basin are generally confined or composite. Some aquifers south of the GCID service area (in the lower Colusa Basin) are part of the Tehama Formation, a geologic unit that includes lenses of gravel (P. Huckabay, pers. comm., 1996). **Table 3.1-6** summarizes the geology of the aquifers at the selected wells.

Table 3.1-6 - Aquifer Geologic Characteristics

Well Number	Aquifer Type	Degree of Certainty	Water Bearing Material
GCID Service Area			
15N/2W-19E01	Confined	Definite	Alluvial Fan Deposits
17N/3W-10C01	Unconfined	Probable	Alluvial Fan Deposits
20N/2W-11A02	Confined	Definite	Quaternary Alluvial Fan Deposits
South of GCID Service Area			
13N/2W-04G01	Confined	Definite	Alluvial Fan Deposits & Tehama Formation
13N/2W-15J01	Composite	Probable	Alluvial Fan Deposits
14N/2W-29J01	Confined	Probable	Alluvial Fan Deposits & Tehama Formation
Near Colusa Basin Drain (South of College City)			
13N/1W-23F02	Confined	Possible	Alluvial Fan Deposits & Tehama Formation

Definite Evidence is conclusive.
Probable Evidence is not conclusive, but includes fairly convincing evidence.
Possible Evidence is not conclusive and not as firm as probable, but evidence indicates that it could be or that it is possible.
Source: DWR 1994b

Groundwater Levels

The data show seasonal and long-term variation in groundwater levels. The long-term variations at the wells are consistent with the amount of rainfall and the water year type (i.e. dry, normal, wet). The highest groundwater levels correspond to periods following "above normal" rainfall and the lowest levels correspond to periods following "below normal" rainfall. In general, groundwater levels recovered from the 1976-77 drought levels to pre-drought levels during the wet period of the early 1980s. Most groundwater levels recovered from the 1987-92 drought during 1993. Wells producing from the unconfined aquifer east of the Glenn-Colusa Canal show almost no seasonal fluctuation. The groundwater table is near the surface, because groundwater is not used much in this area and local canals, streams, and the Sacramento River rapidly recharge the aquifer. Deep percolation from surface water irrigation maintains high groundwater levels (DWR 1994b).

The seasonal variations in groundwater levels are consistent with irrigation demand patterns. Groundwater levels are highest in the spring, prior to the start of the irrigation season, and lowest in the fall, at the end of the growing season.

Table 3.1-7 summarizes the high and low groundwater levels at the selected wells in the Colusa Basin drainage area. Water levels within the GCID service area vary, with the low level being 50 feet above mean sea level (msl) (35 feet below ground level) in 1977 at Well 15N/2W-19E01, and the high level being 119 feet above msl (6 feet below ground level) in 1983 at Well 20N/2W-

11A02. The most stable groundwater level was recorded east of the Glenn-Colusa Canal (Well 17N/3W-10C01).

Table 3.1-7 - High and Low Groundwater Levels at Selected Wells

Well Number	Ground Surface Elevation (feet above msl)	High (feet above msl)	Year	Low (feet above msl)	Year
GCID Service Area					
15N/2W-19E01	85	80	1984	50	1977/79
17N/3W-10C01	94	91	1990	82	1966
20N/2W-11A02	125	119	1983	99	1978/92
South of GCID Service Area					
13N/2W-04G01	186	115	1987	38	1964/66
13N/2W-15J01	210	100	1986/87	30	1980
14N/2W-29J01	160	105	1986	52	1968
Near Colusa Basin Drain (south of College City)					
13N/1W-23F02	40	32	1986	-15	1980
Source: DWR 1994b					

The data were reviewed to determine how changes in GCID operations might be affecting groundwater levels within the GCID service area and the lower Colusa Basin. As mentioned previously, during 1990-1992, GCID experienced increased pumping restrictions at the HCPP. As a result, GCID increased its use of recaptured water and instituted a conjunctive use groundwater program. Lower Colusa Basin users also turned to groundwater to make up for the lower flow in the Colusa Basin Drain, but there were no noticeable changes in groundwater levels in the lower Colusa Basin that could be attributed strictly to changes in GCID operations. Groundwater levels generally recovered during 1993, even though the lower Colusa Basin was relying more on groundwater as a result of changes in HCPP operations and GCID outflow.

3.1.4.5 Water Quality

This section describes water quality conditions in the Sacramento River, the lower Colusa Basin, Colusa Basin Drain, and the groundwater basin underlying the GCID service area.

Sacramento River

Temperature

Average monthly Sacramento River temperatures for existing conditions were simulated using Reclamation's temperature models. The hydrologic period 1922-1990 was simulated in order to determine the ranges of temperatures experienced in the Sacramento River for various flows and current CVP operations. A description of the Sacramento River models is provided in Appendix B, Hydrology and Water Resources Technical Report.

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The results of the simulation are summarized in **Table 3.1-8** for Vina and Butte City locations. Included in Table 3.1-8 are the average, maximum, and minimum monthly temperatures over the 70-year period of record. The model results provide a basis for comparison in Chapter 4, Impact Analyses.

Table 3.1-8 - Simulated Average Monthly Temperatures (°F) in the Sacramento River Existing Conditions

Month	Average	Maximum	Minimum
Vina			
Oct.	55.7	63.0	50.6
Nov.	51.4	55.9	47.0
Dec.	46.7	51.3	42.1
Jan.	44.5	47.3	39.2
Feb.	47.9	50.5	45.0
Mar.	51.8	55.7	49.0
Apr.	55.6	58.6	52.4
May	58.2	63.0	55.1
Jun.	60.4	64.3	56.7
Jul.	60.9	67.6	56.8
Aug.	61.4	70.1	59.0
Sep.	58.7	67.8	53.6
Butte City			
Oct.	57.3	63.7	52.3
Nov.	51.3	55.1	47.6
Dec.	46.0	50.7	40.9
Jan.	44.1	47.0	38.3
Feb.	48.2	50.9	45.4
Mar.	52.5	57.6	49.5
Apr.	57.6	61.9	52.9
May	61.8	68.0	57.5
Jun.	65.8	70.8	62.0
Jul.	67.2	75.0	61.7
Aug.	67.0	74.0	63.7
Sep.	62.8	70.7	57.4

Electrical Conductivity, Pesticides, and Turbidity

Water quality in the Sacramento River is variable and depends on flows in the river, temperature, agricultural return flow quality, and inflow from tributaries. Monitoring has shown levels of pesticides, disinfection by-product precursors, toxic metals, and other constituents of concern are generally not detectable or have been present only in small concentrations (DWR 1994a). Levels of rice pesticides in the river water have been within performance goals since the early 1980s (Gorder and Lee 1995). Electrical conductivity levels in the Sacramento River above Knights Landing at the confluence of Colusa Basin Drain and the Sacramento River typically do not exceed water quality objectives (DWR 1988).

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Pumping itself at HCPP does not substantially affect Sacramento River flow water quality or flows entering the Glenn-Colusa Canal. Increases in suspended sediment levels occur during dredging operations, over an approximately two-month period each spring, and are under the water quality control provisions of the Corps permit (1996). The Regional Water Quality Control Board has issued a waiver of the Section 401 certification for GCID's dredging activities as part of the approval process for GCID's Corps permits.

Lower Colusa Basin and Colusa Basin Drain

A combination of increased conservation practices, pesticide holding periods, and increased HCPP restrictions in the early 1990s have had a substantial effect on water quality in the lower Colusa Basin. There is agreement within the farming community that salinity in Colusa Basin Drain water has been increasing and may be high enough to adversely affect rice crops (B. Wallace, pers. comm., 1996; Scardaci et al. 1995). These observations prompted studies to begin quantifying salinity levels in the Colusa Basin Drain. Scardaci et al. (1995) observed electrical conductivity values in the lower Colusa Basin Drain at Highway 20 and the Davis Weir during June, July, and August 1993 and 1994 to be 0.72-1.71 deci-Siemens per meter (dS/m) which are above sensitivity levels for rice (Hanson et al. 1993).

In the central Colusa Basin area, water supply sources between Highway 162 in Glenn County and Maxwell Road in Colusa County had electrical conductivity values of 0.34 - 0.58 dS/m during June, July, and August 1993 and 1994 (Scardaci et al. 1995), which are within acceptable limits for rice growth. Monthly electrical conductivity samples for the Glenn-Colusa Canal in northern Glenn County and the Colusa Basin Drain at the Davis Weir near southern Colusa County are shown in **Table 3.1-9**.

As shown in Table 3.1-9, electrical conductivity levels are much higher in the lower part of the GCID service area (Davis Weir) than in the upper portion of the service area (Main Canal at Canal Mile 8.2). More importantly, there has been a clear increase, often a doubling, of electrical conductivity in the Colusa Basin Drain values between the late 1980s and the early 1990s.

Pesticides in drainage water is another water quality issue in the Colusa Basin Drain related to GCID outflow. In the lower Colusa Basin Drain near Knights Landing in Yolo County and Highway 20 in Colusa County, molinate and thiobencarb have exceeded performance goals at least one day (often more than one day), every year from 1981-1994, except for 1990 and 1991 when thiobencarb met performance goals **(Table 3.1-10)**. Carbofuran exceeded performance goals at the Colusa Basin Drain at Highway 20 in 1995; methyl parathion and malathion exceeded goals in 1993 (Gorder and Lee 1995). These exceedances are most likely due to aerial drift during spraying and seepage from recently sprayed fields. These pesticides can take up to 30 days to dissipate to acceptable levels. Therefore, these discharges would contain close to full concentrations of rice pesticides, thus reaching the Colusa Basin Drain in high concentrations. Dilution of these drift and seepage transported discharges in the Colusa Basin Drain would require that GCID outflow to the Colusa Basin Drain have both high flows and pesticide concentrations well below performance goals (M. Lee, pers. comm., 1996).

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Table 3.1-9 - Electrical Conductivity Values in the Glenn-Colusa Canal and Colusa Basin Drain for 1986 - 1995

Year	April	May	June	July	August	Sept.	Oct.	Mean
Main Canal at Canal Mile 8.2 (dS/m)								
1986	0.20	0.18	0.23	0.12	0.18	0.18	0.12	0.14
1987	0.18	0.12	0.14	0.12	0.14	0.18	0.12	0.14
1988	0.15	0.15	0.16	0.16	0.14	0.14	0.12	0.15
1989	0.19	0.14	0.16	0.12	0.12	0.14	0.18	0.14
1990	0.18	0.16	0.14	0.15	0.14	0.18	0.14	0.16
1991	0.14	0.16	0.17	0.18	0.14	0.13	0.14	0.15
1992	0.19	0.17	0.15	0.16	0.14	0.13	0.17	0.16
1993	0.19	0.14	0.14	0.14	0.12	0.14	0.15	0.14
1994	0.13	0.12	0.11	0.18	0.09	0.12	0.14	0.13
1995	0.31	0.32	0.10	0.08	0.12	0.12	0.11	0.13
Colusa Basin Drain at Davis Weir (dS/m)								
1986	0.70	0.26	0.32	0.30	0.26	0.39	0.34	0.34
1987	0.28	0.40	0.30	0.28	0.41	0.39	0.47	0.36
1988	0.25	0.50	0.36	0.59	0.48	0.46	0.26	0.43
1989	0.75	0.28	0.60	0.52	0.48	0.41	0.44	0.48
1990	0.83	0.50	0.60	0.62	0.48	0.43	0.65	0.56
1991	0.68	0.50	0.68	0.51	0.53	0.56	0.56	0.57
1992	1.04	0.48	0.65	0.65	0.81	0.52	0.69	0.64
1993	0.43	1.12	1.00	0.85	0.62	0.72	0.44	0.62
1994	0.28	0.55	1.15	1.35	0.94	0.48	0.50	0.50
1995	0.78	0.46	0.74	0.73	0.70	0.60	0.34	0.59

dS/m deci-Siemens per meter
Class I Suitable for irrigation under most conditions 0 - 1 dS/m
Class II Depends upon crop, climate, et al. 1 - 3 dS/m
Class III Unsuitable under most conditions Above 3 dS/m
Source: Water Quality Criteria, 2nd Edition; State of California, Water Resources Control Board Publication 3-A, Page 273

Table 3.1-10 - Peak Concentrations of Molinate and Thiobencarb in the Colusa Basin Drain 1991 - 1995

	Concentration of Molinate (ppb)		Concentration of Thiobencarb (ppb)	
Year	**CBD1**	**CBD5**	**CBD1**	**CBD5**
1981	340	357	21	23
1982	204	697	57	170
1983	211	228	11.3	9.0
1984	110	120	7.5	14
1985	95	100	19	18
1986	77	88	7.4	6.9
1987	43	53	3.7	1.5
1988	67	89	4.5	0.6
1989	51	60	1.34	.55
1990	51	59	nd	nd
1991	18	17	nd	nd
1992	6.2	24	5.7	6.7
1993	69.1	96.1	4.87	3.68
1994	21	57	15.8	37.4
1995	na	25	na	3.5

ppb Parts per billion
na Indicates no data is available
nd Indicates that these chemicals were not detected
CBD1 Colusa Basin Drain at Roads 109 and 99E near Knights Landing in Yolo County
CBD5 Colusa Basin Drain at Highway 20 in Colusa County
Source: Gorder and Lee 1995

Groundwater Quality

Salinity data (reported as electrical conductivity) were obtained from the Department of Water Resources (Northern District) database, but the data were limited. The period of record (1985 to 1992) only contains measurements taken from three times a year to once every two to three years.

Reported salinity measurements varied from 0.40 dS/m in the northern part of GCID, to 0.90 dS/m in the central part of the GCID, to 0.60 dS/m in the southern part of GCID. A salinity concentration of 2.0 dS/m was measured in the central-eastern part of the GCID, near the Colusa Basin Drain.

No trends in long-term or seasonal concentrations could be derived from the limited data, as the measurement intervals were sporadic and the number of measurements taken during the period of record was small (approximately three to four).

3.1.4.6 River-Channel Stability

The Sacramento River has a history of meandering in the project vicinity (DWR 1984). Generally, meander rates can be highly variable, changing little for a number of years, then changing drastically during one flood event. Meandering of rivers may be controlled by "hard points," such as riprap and erosion-resistant geologic formations. Changes in meander and slope can lead to changes in the water surface elevations at points upstream and downstream of the project location, as evidenced in 1970, when a large bend in the river at River Mile (RM) 205 was cut off.

The result of the 1970 flood and cut-off was a shorter Sacramento River channel in the project vicinity. This led to a decrease in water surface elevation and also reduced the difference in the water surface elevations between the North and South Island gages (head differential) **(Figure 3.1-8)**.

Figure 2.3-1 shows river water elevations from two the staff gages near the north and south ends of Montgomery Island, which correspond to the upstream and downstream ends of the oxbow channel (RM 205 to RM 206.2). The plot is based upon river gage flow readings at Hamilton City and north and south island staff gage readings recorded by GCID personnel for the period from 1970 through early 1996. The gage heights plotted in Figure 2.3-1 represent the values computed from a regression analysis for each year at a flow of 7,000 cfs.

The analysis results indicate that for a flow of 7,000 cfs, the water surface elevation at the North Island Gage dropped by approximately 3.5 feet (from 140.5 feet in 1970 to less than 137.0 feet in 1983) and then recovered slightly to around 137.3 feet (1983 to present). The South Island Gage follows a similar trend, but lacks recorded gage data prior to 1977. The trend exhibited by the data confirms that a significant reduction of water-surface elevation occurred during the period 1970 through 1983.

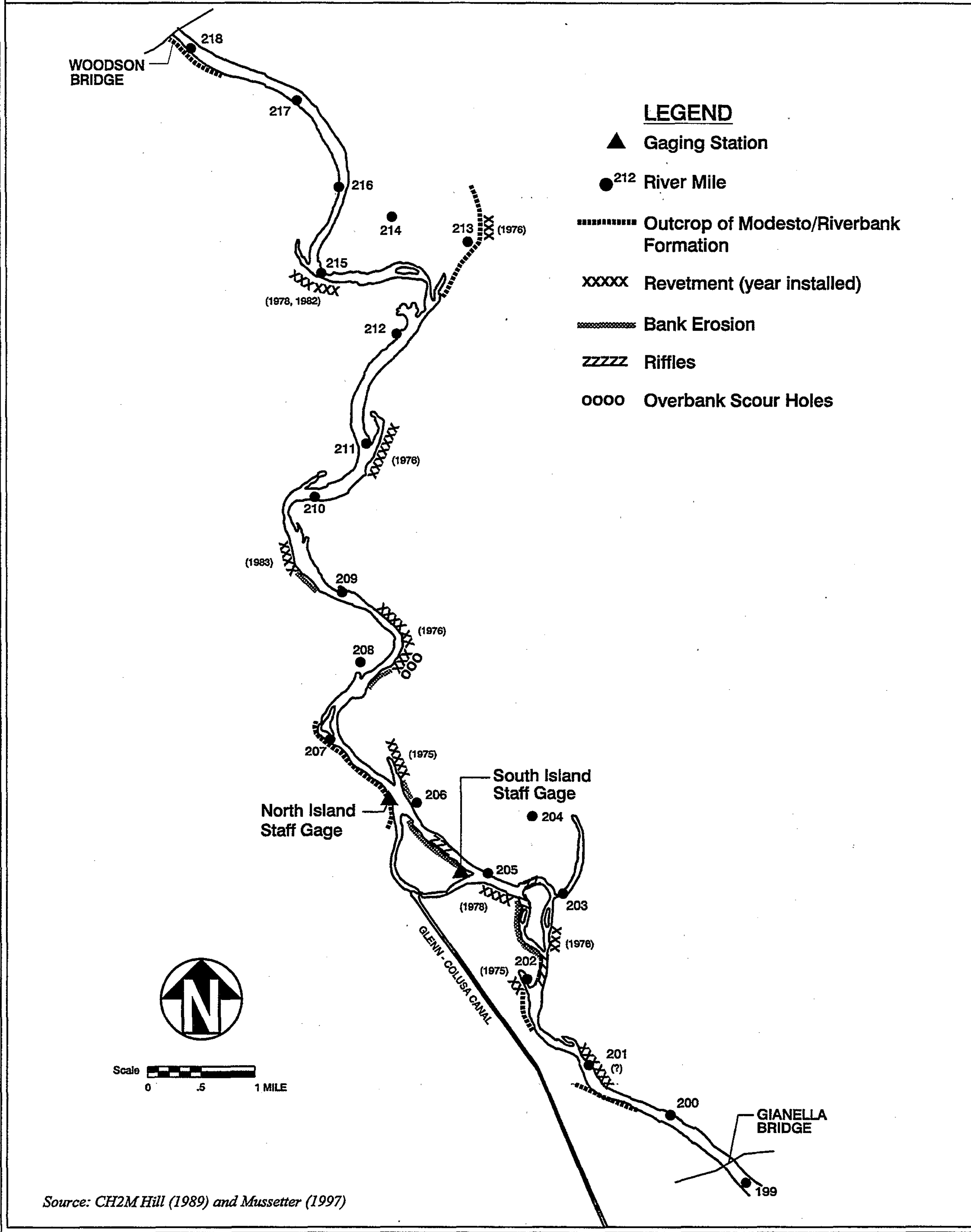
During the period from 1983 to 1995, the North Island Gage remained relatively constant with the exception of 1995, which indicated a gage increase of approximately 0.7 feet. The South Island gage readings during this period exhibited a slight decrease of roughly 0.7 feet and also showed an increase of approximately 0.6 to 0.7 feet in 1995. The increase in gage readings that occurred in 1995 for both gages are likely the result of deposition that occurred during a high flow period in early 1995.

The following sections describe the erosion/deposition processes and geologic features affecting the Sacramento River head differential and channel alignment in the project vicinity.

Riffle Stability

Most streams are composed of a series of *riffles* and *pools*. Riffles are the topographic high points on a bed profile composed of the coarsest bed material being transported by the river. Pools are sand-covered depressions between the riffles (Mount 1994). Riffles in the project area that control water surface elevations and the head differential between the North and South Island gages include the riffles at RM 205.6, 203.2, and 202.5.

FIGURE 3.1-8. APPROXIMATE SACRAMENTO RIVER ALIGNMENT AND RIVER MILE LOCATIONS



Source: CH2M Hill (1989) and Mussetter (1997)

The riffle at RM 205.6 (Figure 3.1-8) provides hydraulic control for the water surface elevation at the North Island Gage under low flow (less than 20,000 cfs) conditions. It is composed of an upper layer of river gravel materials, several feet thick, located over the Modesto/Riverbank Formation (a geologic unit that is made up of fine-grained cohesive materials and hardened materials which requires blasting to be excavated) (Reclamation 1996c). The source of the upper layer includes river sediment load and ~~is~~ dredge spoils transported during high flows from the north end of Montgomery Island (Reclamation 1996b). Sediment sampling indicates the riffle at RM 205.6 is composed of finer sediments than other riffles in the reach. This fact is consistent with the origin of the sediment (dredge spoils) and explains mobility. The dredge spoils deposit on the riffle at flows greater than 20,000 cfs. A recent survey indicates that this riffle has degraded by about three feet since 1995 (Ayres 1996c).

The riffle at RM 203.2 provides hydraulic control for the water surface elevation at the South Island Gage. The bed material making up this riffle is relatively coarse and not readily mobilized. Motion analyses conducted by Resource Consultants & Engineers, Inc. (RCE 1994a) indicate the sediment in this riffle would not be mobilized until river flows reached 90,000 cfs.

The riffle at RM 202.5 also provides hydraulic control for the water surface elevations at Montgomery Island. Any decrease in bed elevation at this riffle would lead to a decrease in water surface elevation at low flows (less than 20,000 cfs).

River Meander

The Sacramento River meander is controlled to an extent by "hard points" in the river. In the project vicinity, several hard points exist, including revetments (riprap) upstream and downstream, and the Modesto/Riverbank Formation, which consists of erosion-resistant material. Figure 3.1-8 and **Figure 3.1-9** show the locations of existing revetments and other geologic features of the Sacramento River channel. **Figure 3.1-10** shows selected historic Sacramento River channel alignments.

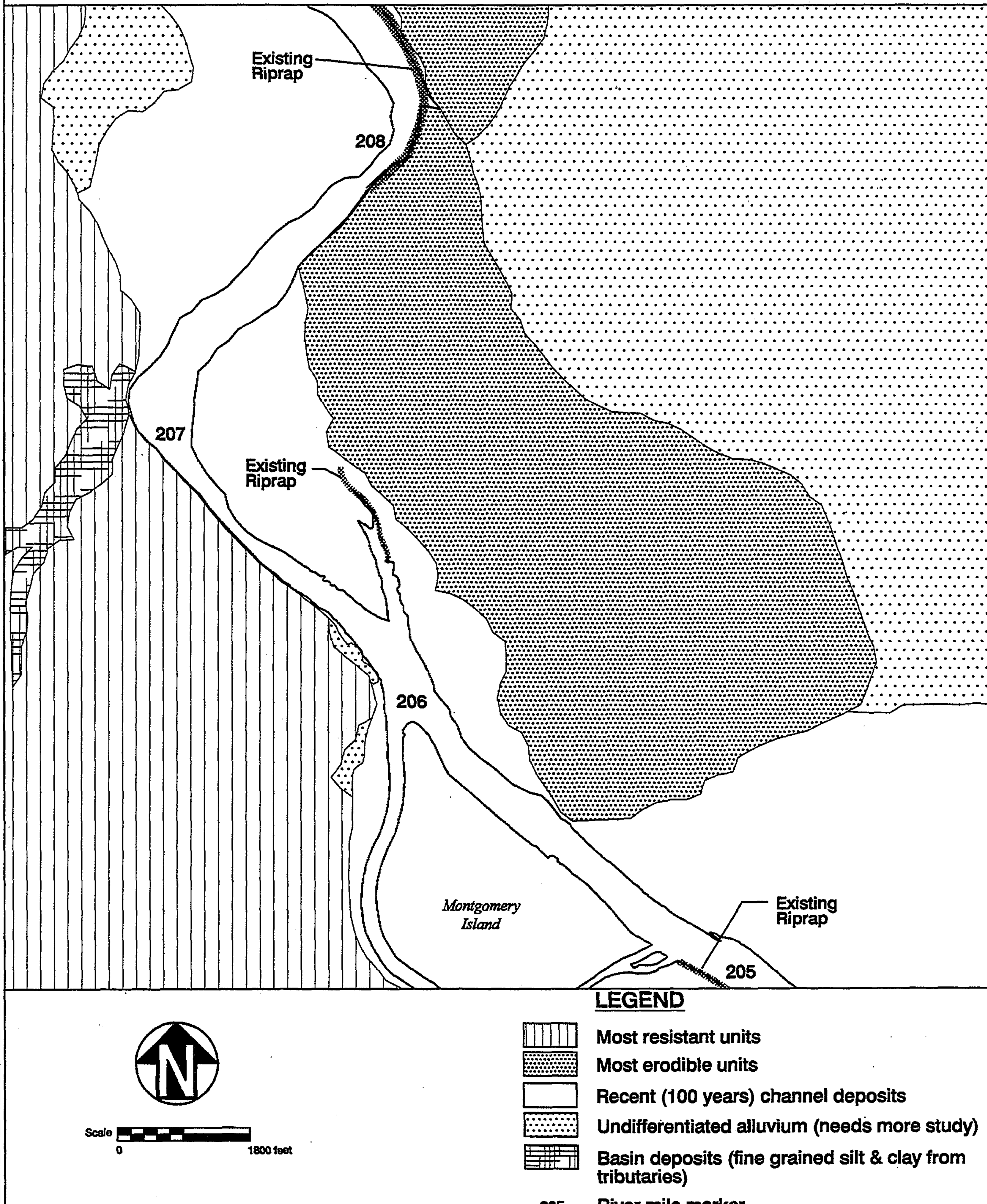
According to Mussetter (1997), the river channel is bounded by the Modesto/Riverbank Formation at the:

- right bank from approximately RM 200.3 to 201;
- right bank from approximately RM 201.5 to 202; and
- right bank from approximately RM 206 to 207.

The existing revetments at RM 208 and 209.1 to 209.7 and RM 211 control the alignment of the river channel upstream of the GCID reach (RM 206 to 209). This portion of the river has a relatively low sinuosity that is unlikely to change in the next 50 years (Mussetter 1997).

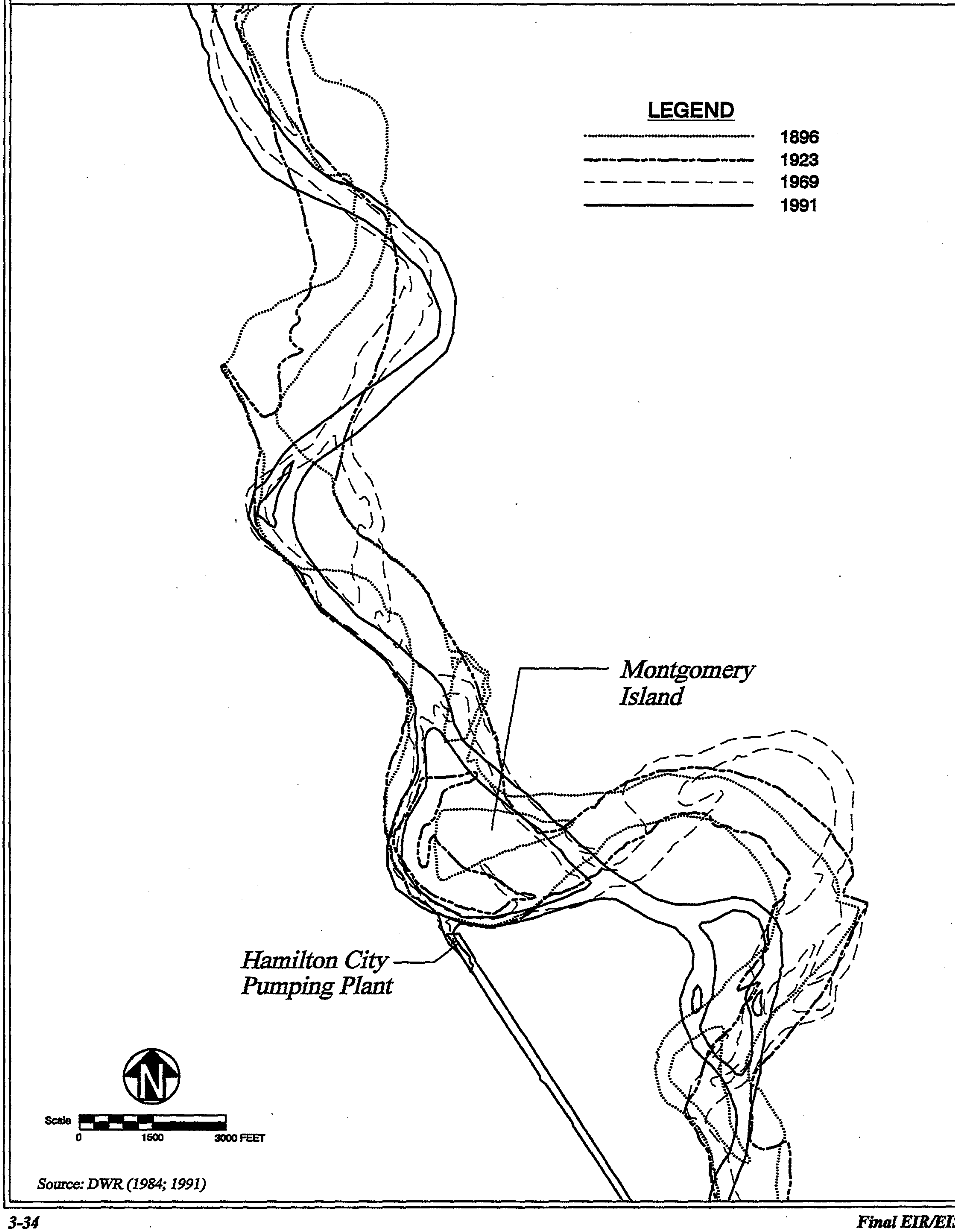
Some unprotected regions of the river channel are subject to erosion. Downstream of Montgomery Island, the river is eroding to the west at RM 202.5, just downstream of the riffles at the flow bifurcation (Figure 3.1-8) and is projected to do so until it comes in contact with the Modesto/Riverbank Formation. The sediments at this location consist of non-cemented sands

FIGURE 3.1-9. ERODIBILITY OF GEOLOGIC UNITS IN PROJECT AREA



Source for riprap locations: DWR 1984
Source for geology: DWR 1996a

FIGURE 3.1-10. HISTORIC SACRAMENTO RIVER CHANNEL ALIGNMENTS



Source: DWR (1984; 1991)

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and gravels overlain by finer sands and silts, and provide little resistance to erosion. The edge of the Riverbank Formation is located about 900 feet west of the present channel (Mussetter 1997).

The east bank of Montgomery Island is eroding between RM 205.2 and 206 (Mussetter 1997). Since 1991, the bank has retreated approximately 50 feet. In addition to bank retreat, a 200-foot long scour hole, 40 feet wide and 10 feet deep, is present along the east bank of the island. This scour hole appears to have formed in an area occupied by the river channel in 1937. During the January 1997 flood, a significant amount of erosion also occurred at the head of Montgomery Island, resulting in a large proportion of the dredge spoils being removed and deposited in Picnic Riffle, creating a low-relief, mid-channel bar (Mussetter 1997). The January 1997 high flows also caused approximately 200 feet of the left bank at RM 206.1 to erode. Also, some erosion of the more resistant Modesto/Riverbank Formation outcrop occurred at the right bank at RM 207.

The January 1997 flood severely damaged the revetment at RM 208 (near Snaden Slough, Figure 1.1-2), and a number of scour holes on the order of 20 feet deep formed on the land side of the revetment. The scour holes appear to be the result of debris jams in the neighboring orchard. There is no indication that there was any erosion and deepening of Snaden Slough that would lead to future realignment of the river; and to the contrary, deposition occurred in the slough and its feeder channels. The upper end of Snaden Slough has not been occupied by the river since 1896. The area has been subject to overbank flows for at least 100 years, and there is no indication of enlargement of the slough in that period of time (Mussetter 1997).

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3.2 Aquatic Resources

3.2.1 Introduction

This section describes the regulatory, regional, and local setting of the project with respect to aquatic resources. A detailed review of listed species (i.e., listed and proposed listed species under the State or Federal endangered species acts), listed species habitat requirements, and potential interrelationship to the proposed project are provided in the Biological Assessment (Appendix A). For purposes of addressing aquatic resources in this EIR/EIS, the regional study area is defined as the Sacramento River between Keswick Dam and the intersection of the river and the Colusa Basin Drain at Knights Landing (Figure 3.1-1).

3.2.2 Regulatory Setting

Management of non-anadromous fish and other aquatic biological resources in the project study area is the responsibility of the U.S. Fish and Wildlife Service (USFWS). Management of anadromous fish is the responsibility of the National Marine Fisheries Service (NMFS). The California Department of Fish and Game (CDFG) has jurisdiction over all aquatic species within the State of California. Sensitive aquatic resources in the project study area are regulated by the Endangered Species Act of 1973, as amended (ESA), and the California Endangered Species Act (CESA). The ESA is administered by the USFWS and NMFS, and the CESA is administered by the CDFG.

NMFS requires the Bureau of Reclamation (Reclamation) to maintain certain flows and temperatures in the upper Sacramento River. Regulation of flow through the Hamilton City Pumping Plant (HCPP) fish screens and lower oxbow is stipulated by the U.S. Army Corps (Corps) permit from December 1 through July 31 of each year (Corps 1996), and by the Joint Stipulation of Parties (1993) from August 1 through November 30. These flow regulations are detailed in Section 3.1, Hydrology and Water Resources. In addition, the Draft Anadromous Fish Restoration Program (AFRP) and Senate Bill 1086 (SB 1086), Upper Sacramento River Fisheries and Riparian Habitat Plan, require certain flow and habitat quality restorations.

3.2.2.1 Draft Anadromous Fish Restoration Program

Congress directed the Secretary of the Interior (Secretary) to develop and implement a program that makes all reasonable efforts, including increased river flows, to restore and enhance anadromous fish habitat in the rivers and streams of California's Central Valley (excluding the San Joaquin River upstream of Mendota Pool). The program has an overall target of doubling the natural production of anadromous fish relative to the average levels attained during the period 1967-1991 (Section 3046(b)(1) of the Central Valley Project Improvement Act (CVPIA); Public Law 102-575). Section 3046(b)(1) is referred to as the Anadromous Fish Restoration Program. The Secretary directed the USFWS and Reclamation to jointly implement the CVPIA; implementation of the AFRP is required by the year 2002 (USFWS 1995b).

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3.2.2.2 SB 1086 Upper Sacramento River Fisheries and Riparian Habitat Plan

Senate Bill 1086 (SB 1086) established the Upper Sacramento River Fisheries and Riparian Habitat Advisory Council and called for an advisory management plan to protect, restore, and enhance the fish and riparian habitat and associated wildlife of the upper Sacramento River. The resulting advisory management plan is the SB 1086 Upper Sacramento River Fisheries and Riparian Habitat Plan (SB 1086 Plan). The SB 1086 Plan presents a program for protecting and restoring fish and riparian habitat and identifies a series of priority actions with specified timeframes, estimated costs and benefits, and proposed funding sources. This plan establishes goals for the participating agencies to incorporate in their planning activities. See Section 3.1.2.5, SB 1086 Upper Sacramento River Fisheries and Riparian Habitat Plan, for additional information on the SB 1086 program.

3.2.3 Regional Setting

The portion of the Sacramento River that supports anadromous fisheries (i.e., species which spend a portion of their life cycle at sea but return to freshwater to reproduce) extends from River Mile (RM) 302 near Keswick Dam to RM 0 at Chipps Island in the Sacramento-San Joaquin River Delta (Delta) (Figure 3.1-1). The Sacramento River provides a diversity of aquatic habitats, ranging from fast water riffles (relatively shallow, turbulent water flowing over cobbles) and glides (deeper, slower moving water) in the upper reaches to slow-water pool and glide habitats under tidal influence in the lower reaches. The Sacramento River also serves as an important migration corridor for anadromous fish moving between Sacramento Valley rivers and tributaries and the Delta. Furthermore, its flows contribute significantly to the Delta estuarine ecosystem. The Sacramento River system north of the confluence of the Feather River is the largest producer of chinook salmon (*Oncorhynchus tshawytscha*) in California (Richardson and Harrison 1990). Minimum flows in the upper Sacramento River are determined by releases from Shasta and Keswick reservoirs. Releases from these reservoirs vary depending on a variety of factors, as described in Section 3.1, Hydrology and Water Resources. Actual daily releases are dependent on day-to-day decisions made by Reclamation operators to meet downstream fishery, navigation, water quality, diversion, and other water management objectives.

3.2.3.1 Shasta and Keswick Reservoirs

Shasta Reservoir (Figure 3.1-1) is a deep reservoir supporting a wide variety of warm- and cold-water fish species. Seasonal water surface elevation fluctuations of the reservoir average 55 feet. In addition to water surface elevation fluctuations, the littoral zone aquatic habitat areas (i.e., shallow, nearshore areas) are subject to disruption resulting from wave action caused by wind and boats. Fish inhabiting the reservoir include several species of trout, landlocked salmon, largemouth and smallmouth bass, channel catfish, white catfish, threadfin shad, Sacramento sucker, Sacramento squawfish, and common carp.

The area between Shasta and Keswick dams is characterized as a cold-water impoundment supporting a rainbow and brown trout sport fishery. Keswick Dam is a complete barrier to the upstream migration of anadromous fish. Some of the migrating anadromous fish impeded by the

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structure are captured in a fish trap at the dam and transported to the Coleman National Fish Hatchery (Reclamation 1991) located on Battle Creek (southeast of the town of Anderson).

3.2.3.2 Clair Engle Reservoir

Clair Engle Reservoir lies on the Trinity River behind Trinity Dam. A portion of the water from this reservoir enters Lewiston Reservoir, and is directed through the Clear Creek Tunnel into Whiskeytown Reservoir and then into Keswick Reservoir. This water mixes with water from Shasta and is released into the Sacramento River. Clair Engle Reservoir supports both warm- and cold-water fish species. Common fish species in the reservoir include smallmouth bass, largemouth bass, white catfish, and rainbow trout (Corps 1991).

3.2.3.3 Upper Sacramento River

The upper Sacramento River extends from Keswick Reservoir to approximately Princeton (Figure 3.1-1). This reach is differentiated from the headwaters of the river which lie upstream of Shasta Reservoir. The upper Sacramento River provides a diversity of aquatic habitats, ranging from fast-water riffles and glides in the upper reaches to slow-water pool and glide habitats. The upper Sacramento River also serves as an important migration corridor for anadromous fish moving between Sacramento Valley streams and rivers and the Delta. The upper Sacramento River, particularly in its upper reaches, contains the spawning grounds used by a variety of anadromous fish including chinook salmon and steelhead.

3.2.3.4 Lower Sacramento River and Sacramento/San Joaquin River Delta

For the purpose of this analysis, the lower Sacramento River is defined as that portion of the river from Princeton to the Delta. The lower Sacramento River is predominantly leveed, is bordered by agricultural land, and has poor water clarity and little habitat diversity. Fish species composition in the lower portion of the Sacramento River is similar to that of the upper Sacramento River, including resident and anadromous fish and warm- and cold-water species. Anadromous fish, such as chinook salmon, striped bass, American shad, and sturgeon, primarily use this section of the Sacramento River as a migration route to upstream spawning areas. The lower Sacramento River, along with the Delta, provides rearing and nursery habitat for juvenile anadromous and resident fish.

The Delta connects with San Francisco Bay, and the Delta and the Bay together compose the largest estuary on the west coast (EPA 1993). The estuary's importance to fisheries is illustrated by the over 120 fish species which rely on its unique habitat characteristics (EPA 1993). Fish found in the Delta include anadromous, freshwater, brackish water, and saltwater species. Some species, such as the longfin smelt (*Spirinchus thaleichthys*), can withstand wide ranges of salinity throughout their life span.

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3.2.3.5 Colusa Basin Drain

According to the Water Quality Control Board Plan (WQCP) (CVRWQCB 1994) for the area, the Colusa Basin Drain supports a warm-water fishery, warm freshwater corridors for downstream migration and spawning of aquatic organisms, and wildlife habitat. Return flows from Glenn-Colusa Canal, other irrigation deliveries, and natural surface and groundwater flow travel through the Colusa Basin water system as groundwater seepage or as agricultural tailwater ultimately entering the Colusa Basin Drain. In addition, some outflow from the Glenn-Colusa Irrigation District (GCID) service area enters the Colusa Basin Drain directly at the Davis Weir. Section 3.1, Hydrology and Water Resources, provides a more complete description of the Colusa Basin Drain hydrologic characteristics.

Water levels in the Colusa Basin Drain have decreased over the last 10 years because of drought, GCID's increased recapture of agricultural runoff, and increased irrigation efficiency. Decreased flows in the Colusa Basin Drain have resulted in lower water quality. The Colusa Basin Drain showed nearly a 50 percent increase in salinity in 1991, when outflow levels dropped to 144,500 acre feet (ac-ft), down from 192,500 ac-ft in 1990 (HDR 1994). Lower water levels in the Colusa Basin Drain, along with a decrease in water quality, have reduced the value of the Colusa Basin Drain for freshwater habitat, aquatic organisms, and wildlife habitat.

3.2.4 Local Setting

The following subsections provide background information for the project relative to aquatic resources. The subsections are categorized by the issues that were identified in Chapter 2, including impingement and entrainment, internal fish bypass system performance, predation, fish migration, and aquatic habitat.

3.2.4.1 Impingement and Entrainment

Impingement (i.e., when a fish becomes stuck to the face of the fish screen) and entrainment (i.e., when a fish becomes trapped behind the fish screen face and can be carried into the forebay and the main canal) are functions of fish screen mesh size openings in the screen structure and hydraulics in the vicinity of the fish screen.

Reductions in water surface elevation during the past 25 years have led to less wetted surface area for the fish screens and higher approach velocities at the screen face for the same pumped flow. Sweeping velocity (i.e., the velocity of water parallel to the screens) is important because it moves fish either along the face of the screen to the fish bypass ports or past the screen to the lower oxbow channel, thereby reducing possible impingement on the screen. Currently, the minimum sweeping velocity recommended is at least two times the approach velocity. A shoreline gravel bar and gravel berm wall are maintained by GCID along the left bank of the oxbow channel opposite the screens to help regulate the sweeping flows across the screens. Studies by Vogel and Marine (1995) have indicated that improvements (e.g., eddy deflector and modifications to the weir) have been successful in improving fish passage at HCPP.

The Joint Stipulation of Parties (1993) requires an approach velocity of 0.33 feet per second (ft/s) from August 1 through November 30 while an improved screen is developed (Table 3.1-1). The allowable pumping rate is currently determined by multiplying the screen approach velocity (e.g., 0.33 ft/s) by the affected wetted screen area in square feet. Wetted screen area is a function of the elevation of water in the oxbow.

The existing flat-plate screens were installed in 1993 and are constructed of 3/32-inch open-space wedge wire mesh. The screens are continuously cleaned by brushes on a carriage assembly. There are two entrance ports to an internal fish bypass. The internal fish bypass minimizes screen exposure time and returns fish to the lower oxbow. The two entrance ports are part of a previous bypass system and were connected to the interim screen to improve entrance hydraulics of the bypass system. The results of recent hydraulic monitoring at HCPP are summarized in **Table 3.2-1.**

Diversions at the HCPP are currently restricted from historic levels pending the installation of new fish screens (Table 3.1-1). The current pumping restrictions reduce the approach velocity in front of the flat-plate screens, particularly during critical periods when juvenile fish are migrating past the pumping plant (e.g, Coleman Hatchery fish release in the spring and winter-run chinook salmon emigration in the late summer/fall) (Figure 1.5-2).

3.2.4.2 Internal Fish Bypass System Performance

The existing flow conditions in the oxbow affect both approach velocities and the potential to create predator habitat, both of which affect the survival rate of juvenile fish encountering the screen. The internal fish bypass system, designed to address these issues, contains two 18-inch wide full-depth bypass ports which serve to bypass juvenile fish passing in front of the existing screen face. From the bypass port, fish enter a graduated pipeline which increases to 60 inches in diameter and transports them to the oxbow approximately 300 feet downstream of the screen below the seasonal weir (Figure 3.1-4).

Velocities recommended to reduce predation in the lower oxbow, particularly near the bypass outfall, are 2.0 ft/s or greater (Table 3.1-1). Based on 1991 data, flow conditions did not produce a minimum bypass channel velocity of 2.0 ft/s until the main river flow was 40,000 cubic feet per second (cfs), and the intake channel flow was 7,000 cfs. However, 1991 had lower than average river flows, and GCID has since made improvements in the channel (e.g., gravel berm) to improve velocities (Reclamation 1996d).

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Table 3.2-1 - 1996 HCPP Hydraulic Monitoring Data

Date	River Flow (cfs)	River Elevation (cfs)	Pumping Rate (cfs)	Average Approach Velocity (ft/s)	Max/Min Approach Velocity (ft/s)		Average Sweeping Velocity (ft/s)	Max/Min Sweeping Velocity (ft/s)		Sweeping Approach Velocity Ratio (ft/s)
May 2, 3	12,955	137.52	2,500	0.57	0.72	0	2.17	2.72	0	3.74
May 8, 9	10,970	136.80	2,400	0.59	0.75	0	2.37	2.78	0	3.84
June 4, 5	16,275	139.33	1,900	0.37	0.48	0	1.65	2.06	0	4.40
June 18, 19	13,755	138.64	2,000	0.41	0.51	0	1.79	2.34	0	4.30
July 2, 3	13,950	138.36	2,000	0.42	0.99	-1.2	2.52	3.78	0	3.49
July 23, 24	13,495	138.13	2,050	0.44	0.70	-0.3	2.85	4.10	0	4.62
August 13, 14	14,405	138.62	1,400	0.29	0.66	-1.2	2.24	3.37	0	4.76
September 11, 12	9,996	137.75	750	0.17	0.49	-0.5	1.48	2.48	0	5.53
September 25, 26	8,920	137.59	450	0.10	0.29	-0.5	1.13	2.01	0	6.78

Source: GCID 1997

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A 1994 evaluation of the fish screen and bypass system included a mark and recapture study to assess the transport time of fish past the screen (Vogel and Marine 1995a). A component of this study was a release of fish directly into the internal bypass system. The results are summarized in **Table 3.2-2**. The fish took from about 7 minutes up to 14 hours to be recaptured below the bypass outfall.

Table 3.2-2 - Internal Fish Bypass System Study Results

	Hrs:min:sec
Number of Fish Released	19
Number of Fish Recovered	17
Average Time of Recovery	03:31:20
Standard Deviation of Recovery Time	04:58:44
Minimum Time of Recovery	00:07:08
Maximum Time of Recovery	14:05:44
Median Time of Recovery	07:03:46
Source: Vogel and Marine 1995a	

Stress and disorientation likely result in an increased vulnerability to predation by squawfish and other predatory fish species (Mesa 1994). Studies in the Columbia River area (Mesa 1994) found that juvenile salmonids are capable of avoiding predators within one hour after being subjected to stress. Mesa (1994) suggested that reductions in the sources of stress (e.g., improvements to the bypass system) could help to reduce predation rates. Vogel and Marine (1995b) conducted an initial study of vulnerability of bypassed fish to predation in conditions more similar to those of the HCPP. Although conditions vary among bypass systems that have been studied, and uncertainties remain regarding the degree of predation that occurs in bypass systems, the potential exists for injury or increased stress levels in juvenile fish.

3.2.4.3 Predation

Predation of juvenile salmon can be significant, particularly where juveniles are concentrated and/or disoriented (Hall 1979; Pickard et al. 1982; Garcia 1989). Squawfish are considered to be a primary predator of fry and juvenile salmon in the Sacramento River. Consumption of juvenile salmon by individual squawfish can be substantial. For example, as many as 39 salmon were found in an individual squawfish captured below the Red Bluff Diversion Dam (RBDD) (Garcia 1989). In studies intended to evaluate the extent of predation by squawfish at the HCPP, Cramer & Associates (1993) concluded that squawfish abundance and predation on juvenile chinook salmon was low. However, CDFG and others have questioned these conclusions on the basis of sampling difficulties and insufficient data. CDFG indicates that squawfish predation in the oxbow may be significant (P. Ward, pers. comm., 1996). In particular, predation is believed to occur at the fish bypass outlet (Joint Fisheries Agreement 1989), although its significance has been questioned by some investigators (Cramer & Associates 1990 and 1992).

Predation may also be due to striped bass (*Morone saxatilis)* and American shad (*Alosa sapidissima*). Striped bass and American shad captured just below RBDD have, upon stomach content analysis, been found to contain juvenile salmonids (Garcia 1989). Predation by these species has not been directly observed at HCPP. Large striped bass were caught, however, in the project area in August and September during one study (Ward 1990). Although predation by these species has not been studied directly at HCPP, they may contribute significantly to the predation of juvenile fish at the HCPP diversion.

More recently, Vogel and Marine (1995a) concluded that predation was a factor that decreased the survival of juvenile salmonids moving through the oxbow during the 1994 investigation. The magnitude of predation that occurs was not quantified. Areas of known or suspected predation, as identified by Vogel and Marine (1995a), are shown on **Figure 3.2-1**. Further evaluations are needed to determine the extent of predation occurring in the upper oxbow. In the time since the majority of the above studies were conducted, several improvements have been made to reduce predation in the oxbow channel (e.g., an eddy deflector curtain at the upstream end of the screen between the abutment and the screen, and a broad-crested weir at the roadway crossing).

The culverts near the HCPP fish screens exacerbate predation because juvenile salmonids tend to avoid entering dark culverts and will back-up on the upstream end. It is also believed that predatory fish congregate around the culverts in the channel. Additional areas of suspected predation are: (1) adjacent to the sheet pile wall at the downstream end of the fish screens; and (2) in the riprap transition zone from the wall to the channel. Back eddies may create holding/feeding habitat for predatory fish species (Vogel and Marine 1995a). As discussed above, GCID has made facility improvements that are believed to reduce predatory habitat and holding areas.

Predation is likely to be more intense at certain times of the year, such as when piscivorous fish (fish that eat other fish) are migrating, juvenile fish are present, water temperatures are relatively warm, and turbidity is low (Garcia 1989). Fall-run chinook salmon are most likely to encounter predation at the HCPP diversion in the spring when smolts are migrating downstream, irrigation demands are high, and the squawfish are migrating upstream. Winter-run chinook salmon are most likely to encounter predation as fry migrating downstream in the summer and fall. However, predation observations on winter-run chinook salmon during summer and fall are scarce (Garcia 1989).

3.2.4.4 Fish Migration In the Project Vicinity

The Sacramento River supports several anadromous fisheries, including chinook salmon, steelhead, green sturgeon, river lamprey, and American shad. Fish migration can be affected by disruption of adult fish immigrating upstream or disruption of juvenile fish emigrating downstream.

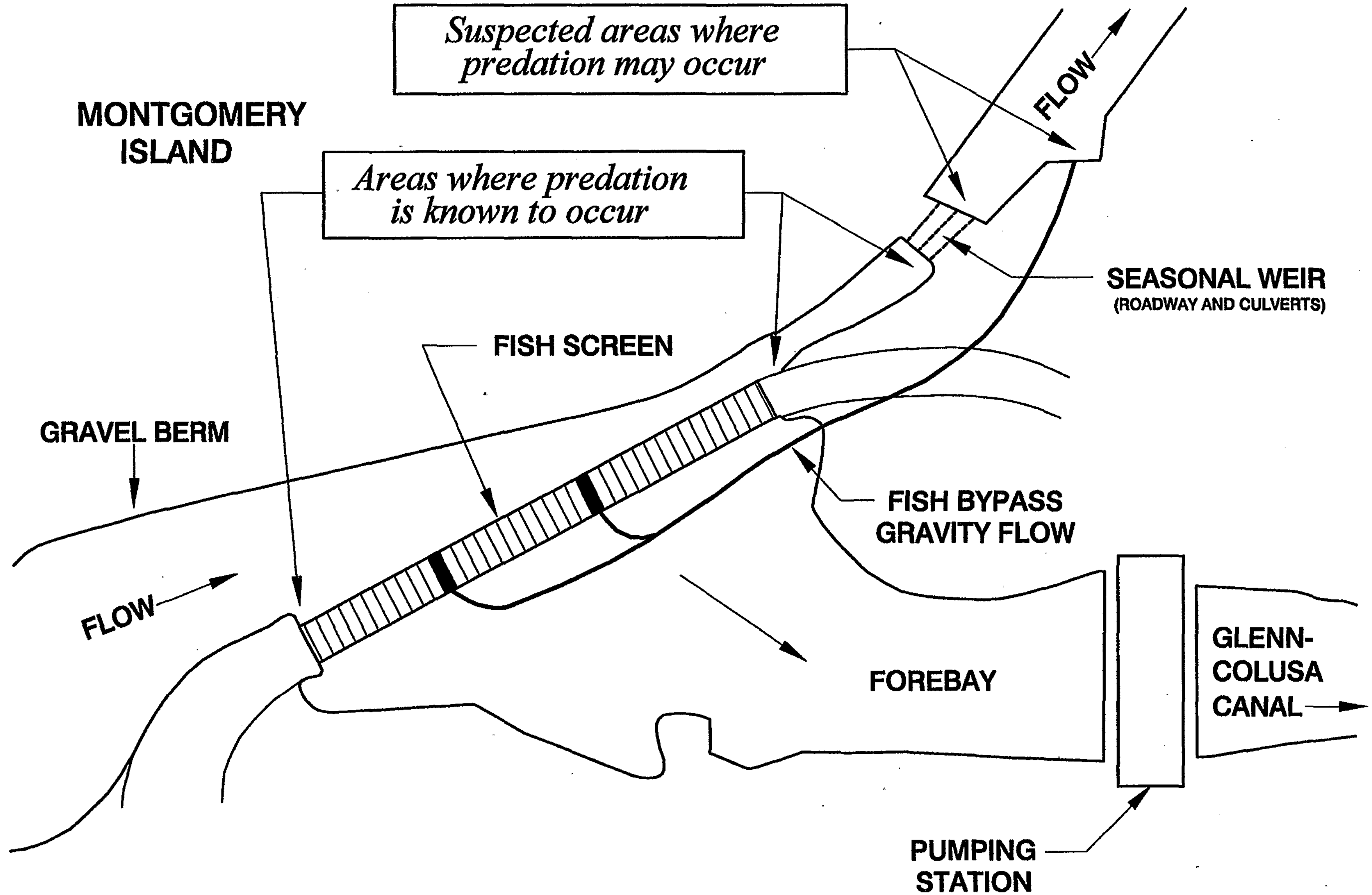

FIGURE 3.2-1. AREAS OF KNOWN OR SUSPECTED PREDATION OF YOUNG SALMONIDS AT THE EXISTING HCPP FISH SCREEN

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An access road connects Montgomery Island to the mainland via an earthen weir that is seasonally installed over a permanent weir (spring) and modified (mid-July) based on flow, fish passage, and island access requirements. Water passes through this earthen dam via three culverts ranging from six feet to seven feet in diameter, and over a broad-crested weir. Adult fish may be hesitant to enter the culverts in the oxbow channel due to high velocities; however, adult migration is not necessarily blocked because the main river channel is available as an alternate route.

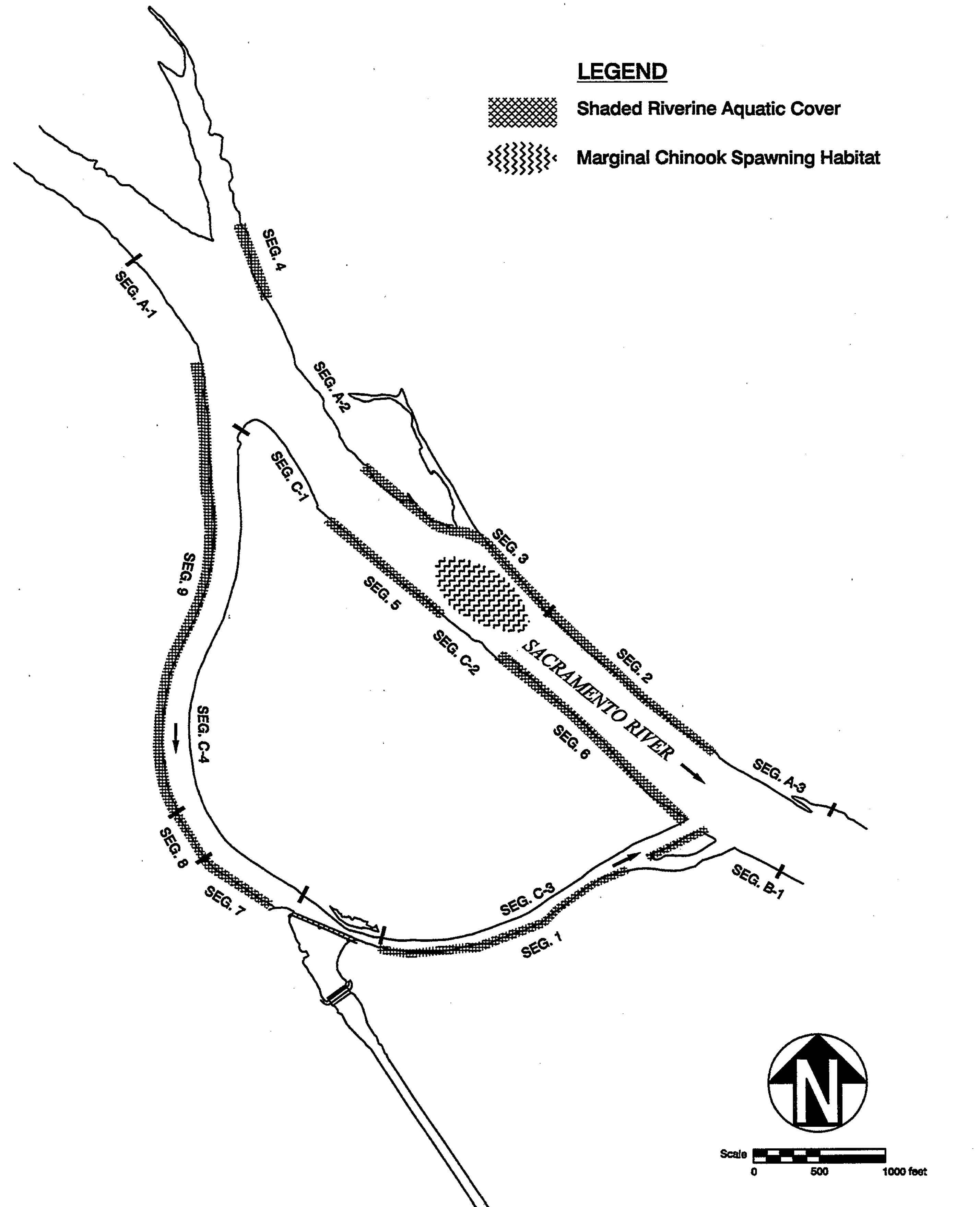
Juvenile fish emigration is affected by losses of juvenile fish emigrating downstream past the fish screen, as described in Section 3.2.4.1, Impingement and Entrainment. A study of fish passage at RBDD (Vogel et al. 1988) to estimate the proportion of downstream migrants diverted into the Tehama-Colusa Canal (TCC) assumed that downstream migrant salmon are diverted into the TCC headworks in direct proportion to the amount of flow diverted. This assumption was based on the results of studies of fish distribution across the channel and the configuration of the intake structure (Vogel et al. 1988).

By comparison to the main channel of the Sacramento River, the dredged oxbow channel is deeper, flow velocities are relatively constant, and the streambed is composed primarily of sand and small-sized materials. As water flowing downstream in the Sacramento River approaches the split between the oxbow and the river at the north end of Montgomery Island, it tends to follow the path of least resistance into the river or oxbow. Pumping affects this natural flow by increasing the gradient and therefore amount of water entering the oxbow. The extent to which the flow split between the river and the oxbow changes depends on the forebay elevation, lower oxbow flow requirements and channel characteristics (Reclamation 1996d). Previous studies (Schaffter 1980; Hallock 1959; Wales 1954; Fast et al. 1986 as cited in Ward 1989) indicated that the increased flow could proportionally increase the number of fish entering the oxbow. Studies by Cramer & Associates (1990) indicated that there was no correlation between the proportion of fish diverted into the oxbow and the proportion of flow diverted. However, Cramer recommended further studies to determine if this result was from variation in current flow at the oxbow inlet or from sampling biases. CDFG suggests that the diversion of fish from the river may be proportional to the amount of water that is diverted (Ward 1989).

3.2.4.5 Aquatic Habitat

The HCPP is located between RM 206 and RM 205 on an oxbow on the west side of the Sacramento River. The local setting is generally defined as the oxbow and the area of the Sacramento River between approximately RM 206.5 and RM 204.5 (from slightly upstream to slightly downstream of Montgomery Island). This area is characterized by natural and revetted banks, sand and gravel bars, and a diversity of in-river habitat types. **Figure 3.2-2** shows the primary aquatic habitats in the area.

FIGURE 3.2-2. AQUATIC RESOURCE HABITATS SCHEMATIC SHOWING SHADED RIVERINE AQUATIC COVER



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The east bank of the oxbow channel on Montgomery Island upstream and downstream of the screening facility has been modified to improve the flow characteristics at the screens and in the lower oxbow. The entire upstream bank, composed primarily of gravel and cobble, slopes steeply upward from the water's edge and supports virtually no riparian vegetation. Conversely, downstream of the facility, the east bank supports stands of mature riparian vegetation. A gravel berm was constructed in 1993 along the water's edge. Aquatic habitat downstream is influenced by the berm, composed of gravel dredge spoil deposits, which narrows the oxbow channel to help maintain velocities for returning fish to the river.

Shaded Riverine Aquatic Cover

Shaded Riverine Aquatic Cover (SRA Cover) has been defined by the USFWS as the nearshore aquatic area occurring at the interface between a river and adjacent woody riparian habitat. The principal attributes of this cover type include: (1) the adjacent bank composed of naturally erodable material; (2) riparian vegetation that either overhangs or protrudes into the water; and (3) the water containing variable amounts of woody debris (such as leaves, logs, branches and roots) as well as variable water depths, velocities, and currents (USFWS 1992). Consequently, SRA Cover provides habitat complexity and diversity in the form of instream cover.

SRA Cover provides high-value feeding areas, predator escape cover, and moderate water temperatures for many fish species (USFWS 1992). The importance of SRA Cover was demonstrated in studies conducted by the USFWS (DeHaven 1989). In early summer, juvenile chinook salmon were found exclusively in areas of SRA Cover, and none were found in nearby riprapped areas (DeHaven 1989). Because of the importance of SRA Cover and its declining abundance, the USFWS has designated SRA Cover on the upper Sacramento River as Resource Category 1 habitat. A Resource Category 1 habitat is defined by the USFWS as one that is unique and irreplaceable with a mitigation goal of no loss of existing habitat value. Within the local setting defined above, nine segments of continuous SRA Cover have been identified on the west side of the oxbow downstream and immediately upstream of the HCPP fish screen and along the east and west banks of the Sacramento River adjacent to Montgomery Island (Figure 3.2-1). SRA Cover within the project area was initially delineated through review of 1996 aerial maps. Confirmation of SRA Cover locations was performed through field review in the spring of 1997.

With the exception of the existing fish screen facility, the west bank of the oxbow channel supports vegetation along its entire length. Immediately upstream of the screening facility, shrubs and small trees provide some overhead cover and shading of the channel but little instream structure due to routine removal of woody debris from the channel. Similar conditions exist immediately downstream of the screening facility, with SRA Cover being somewhat more abundant.

The project area contains eight segments of non-vegetated erodable shoreline (Figure 3.2-2) that do not currently provide overhanging cover or instream structure for the stream channel. These areas do not represent unique habitat for any fish species.

The lower oxbow currently serves as a bypass corridor for those fish that have encountered the screen facilities. Management objectives for fish protection through the oxbow include returning fish to the river as quickly as possible. Juvenile fish are potentially more susceptible to predation due to concentration resulting from narrowing of the channel, and from potential disorientation resulting from passage through the bypass system. Given these conditions and agency concerns regarding predation in the lower oxbow, SRA Cover in this area does not provide the same habitat value for juvenile fish as does the SRA Cover located along the Sacramento River.

Winter-run Chinook Salmon Critical Habitat

Critical habitat, as defined in Section 3(5)(A)(i) and (ii) of the ESA, is "the specific area(s) within the geographic area occupied by a species...on which are found those physical or biological features (1) essential to the conservation of that species, and (2) which may require special management considerations or protection, and specific area(s) outside the geographical area occupied by the species...upon a determination by the Secretary that such areas are essential for the conservation of the species." Under Section 7 of the ESA, Federal agencies are required to ensure that their actions are not likely to result in the destruction or adverse modification of a listed species' critical habitat. Critical habitat for the winter-run chinook salmon is defined to occur in the Sacramento River from Keswick Dam (RM 302) to Chipps Island (RM 0) in the Delta (NMFS 1993). Critical habitat includes the river bottom, river water, and the immediately adjacent riparian zone.

Littoral Zone Habitat

Post-emergent anadromous salmonid fry typically occupy the shallow and slow-moving near-shore littoral zone areas and progressively move into deeper and faster water for rearing as they increase in size (Bryant 1983; Shirvell 1990). Chinook salmon juveniles have been observed to exhibit this behavioral trend in the lower American River, a major tributary to the Sacramento River (P. Bratovich, pers. comm., 1997), and in the Sacramento River itself (D. Vogel, pers. comm., 1997).

Complexity and diversity are important habitat attributes for rearing juvenile fish, including anadromous salmonids. Numerous studies have demonstrated the importance of habitat complexity and diversity associated with near-shore littoral zone habitats for rearing juvenile salmon and steelhead (Bryant 1983; Dolloff 1986; Shirvell 1990; Meehan 1991; Lonzarich and Quinn 1995). Near-shore littoral zone areas which contain complex and diverse habitats also provide "escape cover" for rearing juvenile salmonids to avoid predation (Schlosser 1987; Harvey 1991).

Riverine Habitat

The aquatic habitat within the oxbow channel and the Sacramento River channel in the area of the project is predominantly "run" habitat, having relatively fast-moving, moderately shallow, non-turbulent water and a streambed dominated by gravel and cobble. The gravel bar near the site of the gradient facility has supported limited, marginal fall-run chinook salmon spawning in the past (P. Ward, pers. comm., 1996). The riverine habitat in the oxbow channel is affected by dredging and channel maintenance activities.

3.2.5 Life History/Occurrence Accounts for Potentially Affected Species and Habitat

More than 30 species of fish are known to use the Sacramento River (**Table 3.2-3**). Of these, a number of species are anadromous and, therefore, use the river during only a portion of their life cycles. Aquatic insects, non-anadromous fish species, and certain mammals are considered residents of the Sacramento River system because they complete their life cycle entirely within freshwater, often within a localized area. Some resident species migrate seasonally within the river system. The timing of migration and the duration of juvenile and/or adult residency in the project area are highly species-specific.

Table 3.2-3 - Fish Species Potentially Occurring Within the Local Project Study Area

Family/ Common Name	Scientific Name	Status Federal[a]/State[b]
Petromyzontidae		
Pacific lamprey	*Lampetra tridentata*	--/CSC
River lamprey	*Lampetra ayresi*	SC/CSC
Acipenseridae		
Green sturgeon	*Acipenser medirostris*	SC/--
White sturgeon	*A. transmontanus*	--/--
Clupeidae		
American shad [c]	*Alosa sapidissima*	--/--
Threadfin shad [c]	*Dorosoma petenense*	--/--
Salmonidae		
Chinook salmon (spring-run)	*Oncorhynchus tshawytscha*	--/CSC
Chinook salmon (fall-run)	*O. tshawytscha*	--/--
Chinook salmon (late-fall run)	*O. tshawytscha*	--/--
Chinook salmon (winter-run)	*O. tshawytscha*	E/E
Steelhead	*O. mykiss*	PE/CSC
Cyprinidae		
Hardhead	*Mylopharodon conocephalus*	--/CSC
Sacramento squawfish	*Ptychocheilus grandis*	--/--
Hitch	*Lavinia exilicauda*	--/--
California roach	*Hesperoleucus symmetricus*	--/--
Sacramento splittail	*Pogonichthys macrolepidotus*	PT/CSC
Catostomidae		
Sacramento sucker	*Catostomus occidentalis*	--/--
Ictaluridae		
White catfish [c]	*Ictalurus catus*	--/--
Brown bullhead [c]	*I. nebulosus*	--/--
Channel catfish [c]	*I. punctatus*	--/--
Serranidae		
Striped bass [c]	*Morone saxatilis*	--/--
Centrarchidae		
Sacramento Perch	*Archoplites interruptus*	--/--
Bluegill[c]	*Lepomis macrochirus*	--/--
Pumpkinseed[c]	*Lepomis gibbosus*	--/--
Largemouth bass[c]	*Micropterus salmoides*	--/--

C-085529

C-085529

Table 3.2-3 - Fish Species Potentially Occurring Within the Local Project Study Area (Continued)

Family/ Common Name	Scientific Name	Status Federal[a]/State[b]
Smallmouth bass[c]	*Micropterus dolomieui*	--/--
White crappie[c]	*Pomoxis annularis*	--/--
Poeciliidae		
Mosquitofish[c]	*Gambusia affinis*	--/--
Gasterosteidae		
Threespine stickleback	*Gasterosteus aculeatus*	--/--
Cottidae		
Riffle sculpin	*Cottus gulosus*	--/--
Embiotocidae		
Tule perch	*Hysterocarpus traski*	--/--

a Federal Status: E = Endangered; T = Threatened; PE= Proposed Endangered; PT = Proposed Threatened; C= Candidate for listing; SC = Species of Concern

b California State Status: E = Endangered; T = Threatened; SCT = Candidate for Threatened Status; CSC = Species of Concern

c Introduced

Source: Moyle et al. 1995; Nehlsen et al. 1991; and CDFG 1996; USFWS 1997a

The following life histories for fish species that occur in the project area are presented with emphasis on species with the greatest potential risk of being impacted by the project and/or species of management concern, as identified by resource agencies. Although Sacramento squawfish are not anticipated to be adversely affected by the project, a life history account is presented because it is believed to be an important predator of juvenile trout and salmon.

3.2.5.1 Fish

Chinook Salmon (Oncorhynchus tshawytscha)

The Sacramento River is unique among rivers and streams along the Pacific coast because it contains four distinct "runs" of chinook salmon. These four runs, including fall-run, late fall-run, winter-run, and spring-run, are distinguished by seasonal peaks in the timing of adult upstream migration and spawning. Although each run is characterized by a fairly distinct spawning period, some overlap of spawning activity does occur. As a result, migrating and spawning adults from different runs may be found concurrently in the Sacramento River. Outmigrant juvenile fish are present in the vicinity of HCPP at RM 206 throughout the year (**Figure 3.2-3**). The optimal temperature range for immigration and spawning is reported as 7°-13°C (44°-56°F) (Bovee 1978; Raleigh et al. 1986). Upstream migration has been documented to cease at temperatures above 21°C (70°F) and resumes once waters cooled to 18°(65°F) (Hallock et al. 1976).

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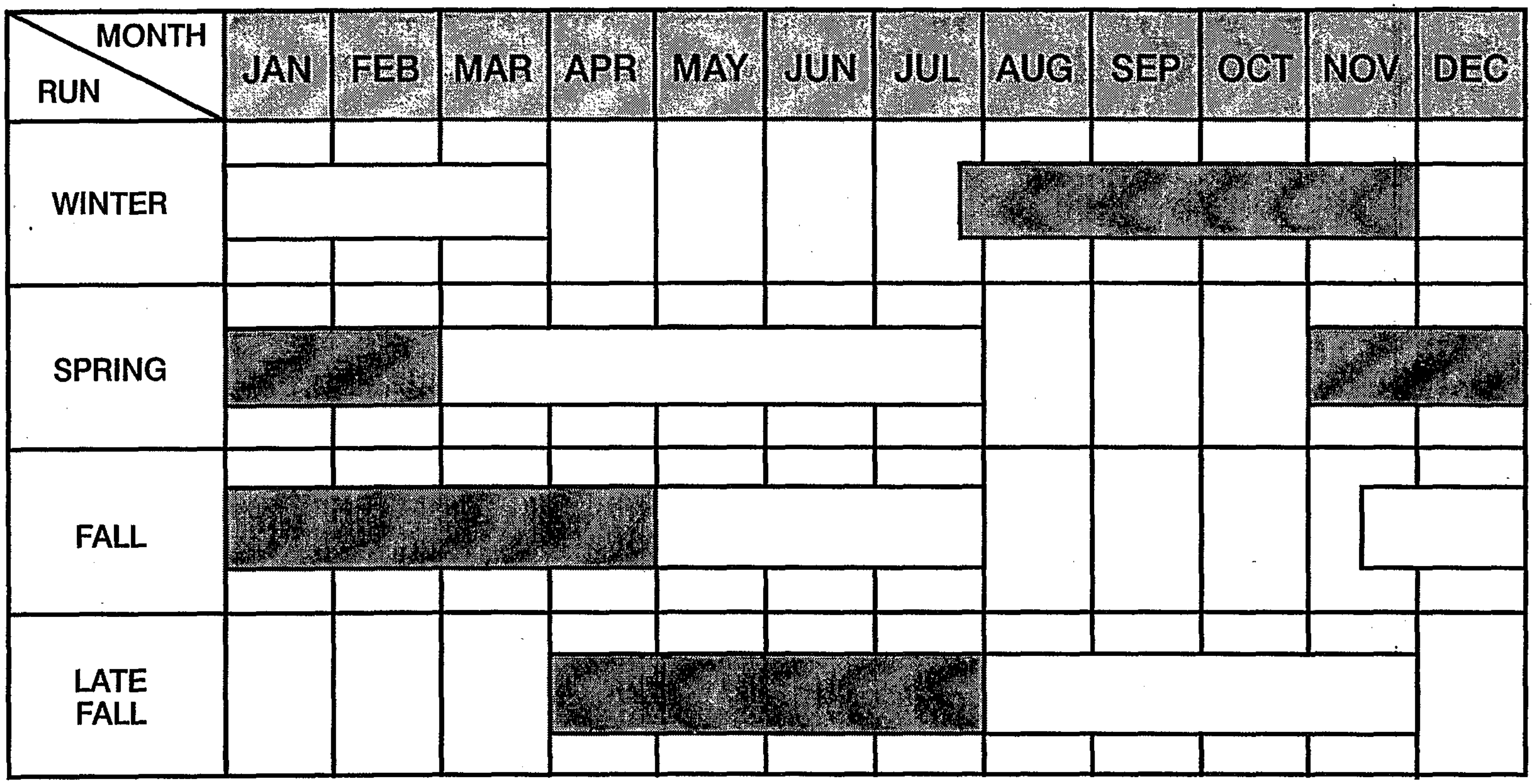
C-085530



Shaded areas indicate when fry ≤ 40 mm may be present at HCPP.

Unshaded areas delineate when juveniles larger than 40 mm may be present at the HCPP Fish Screen. Fish larger than 40 mm may also occur with fry.

Source: Vogel & Marine 1991; USFWS 1995

FIGURE 3.2-3. TIMING OF JUVENILES OF THE FOUR CHINOOK SALMON RUNS AT THE HAMILTON CITY PUMPING PLANT

C-085531

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Streamflow appears to influence the timing and magnitude of juvenile chinook salmon emigration and to affect the proportion of fish that emigrate as fry versus smolts. Presumably, higher streamflows induce fry migration through either physical displacement or an active search for more suitable rearing habitat (Vogel et al. 1988).

CDFG (unpublished data) has collected data at the HCPP regarding the relative abundance, seasonality, and size distribution of juvenile chinook salmon since 1986. Based on this data, juvenile fall-run chinook salmon are by far the most abundant of the four chinook salmon runs at the HCPP, followed in abundance by spring-run (whose numbers may be affected upwardly by releases of fall-run juveniles at the Coleman Fish Hatchery), winter-run, and late fall-run, respectively. Because the four races of salmon are usually identified by a length-frequency distribution chart developed by CDFG, it is possible that juvenile chinook salmon could be classified incorrectly, which would affect the accuracy of the determination of relative abundance of the four races of juvenile chinook salmon.

Winter-run Chinook Salmon (Federal Endangered/State Endangered) – Most of the life cycle of winter-run chinook salmon occurs in the ocean (two to four years). Adult migration into freshwater rivers and streams occurs for the purpose of spawning. Spawning takes place in habitats of suitable water quality, depth, current velocity, and substrate. Adult salmon perish soon after reproducing in freshwater streams and rivers. After several months, fry emerge from the gravel and begin to feed. These juveniles may begin their migration to the ocean immediately, or they may delay onset of emigration for several months. Water temperature is critical to early life stage development and survival (Richardson and Harrison 1990).

The annual spawning run size of winter-run chinook salmon in the Sacramento River system has exhibited a drastic decline in recent decades. Numbers have dropped from over 100,000 in the late 1960s to only 533 in 1989 (Richardson and Harrison 1990); the 1994 count at RBDD was 189 (CDFG, unpublished data). Several human-induced circumstances have contributed, and continue to contribute, to the decline of the winter-run chinook salmon in the Sacramento River system. These include, but are not limited to:

- blockage of upstream spawning migration by Shasta Dam, Keswick Dam, the Anderson-Cottonwood Irrigation District (ACID) Dam, and the RBDD;
- juvenile fish mortality at dams and water diversion facilities (e.g., ACID, RBDD, TCC, and the Glenn-Colusa Canal);
- flow reductions and fluctuations in the upper reaches of the Sacramento River following construction of Keswick and Shasta dams;
- elevated water temperatures in the upper reaches of the Sacramento River following construction of Keswick and Shasta dams;
- cumulative loss of Sacramento River riparian habitat, including SRA Cover;
- reductions in available spawning habitat due to changes in river flows, channelization, and loss of appropriate spawning substrates;

- mortality associated with State Water Project and Central Valley Project pumping plants in the Sacramento-San Joaquin Delta;
- pollution; and,
- sport (freshwater and ocean) and commercial (ocean) harvests.

Keswick and Shasta dams prevent migrating salmon from reaching upstream waters. Loss of historical spawning and rearing habitat due to these migration barriers and elevated water temperatures in the unobstructed portions of the Sacramento River are believed to have contributed greatest to the decline of the winter-run chinook salmon. Immigration of adult winter-run chinook salmon into the Sacramento River system begins in mid-December with spawning occurring from mid-April through mid-August. Peak spawning generally occurs from May through June. The majority of winter-run spawning presently occurs from just downstream of the Keswick Dam to the vicinity of Cottonwood Creek. Fry generally begin emerging from the gravel in late July and August (Moyle 1976). Migration to the ocean begins with fry emergence and extends through March.

Data collected by CDFG on juvenile chinook salmon timing of occurrence and size distribution indicate that winter-run chinook salmon are present at HCPP from mid-July through late March. Fry less than or equal to 40 millimeters (mm) in length first appear at the HCPP facility during late July, and generally occur through mid-November (Figure 3.2-3). Winter-run chinook salmon fry rearing in the upper Sacramento River exhibit peak abundance during September, and juveniles migrate past Red Bluff from August through March (Reclamation 1992). Peak emigration (downstream migration) of winter-run chinook salmon juveniles near Red Bluff is believed to occur during September and October.

Spring-run Chinook Salmon (State Species of Concern) – The spring-run chinook salmon is currently a species of special concern in California. Because of the high probability that spring-run chinook will be proposed for listing or listed under the CESA before the initiation of construction on this project, this species is discussed in both the EIR/EIS and in the Biological Assessment (Appendix A).

Populations of spring-run chinook salmon have declined throughout the Central Valley and, in some places, the run is maintained only by hatchery production (Moyle et al. 1989). In California, the once abundant spring-run has been reduced to small populations in the Klamath, Trinity, and Sacramento-San Joaquin River drainages. Dams constructed in the 1940s and 1950s blocked access to holding areas, causing extinction of local historical populations (Moyle et al. 1989). Hatchery production maintains the majority of spring-run populations in both the Sacramento River and Klamath-Trinity River drainages (Moyle et al. 1989). Mill and Deer creeks, upstream of HCPP, are two of the most important spawning streams for spring-run chinook salmon in the Sacramento River system.

Spring-run chinook salmon enter freshwater during late winter through spring, when river flows usually are high due to rain and snow-melt runoff. Adults hold in areas downstream of spawning grounds during the summer months until their eggs fully develop and become ready for spawning. This is the primary characteristic distinguishing the spring-run from the other runs of chinook salmon.

Spring-run chinook salmon fry less than or equal to 40 mm in length may be present at the HCPP from November through February. Juvenile spring-run chinook salmon greater than 40 mm in length may be present at the HCPP from March through July (Figure 3.2-3).

Fall-run Chinook Salmon (No Status) – The fall-run of chinook salmon is the largest run of chinook salmon in the upper Sacramento River. The number of fall-run chinook salmon returning annually to the Sacramento River exceeds that of all other runs combined. Natural escapement of fall-run chinook salmon to the Sacramento River increased from an estimated 54,000 fish in 1982 to an estimated 133,000 fish in 1988. The annual returning population averaged an estimated 94,000 naturally spawning fish through the 1980s, supplemented by Coleman National Fish Hatchery on Battle Creek (Reclamation 1991). Fall-run chinook salmon represent the greatest percentage of all four runs and continue to support commercial and recreational fisheries.

In general, adult fall-run chinook salmon migrate into the Sacramento River and its tributaries from late summer through December, with a peak in immigration occurring from mid-October through November. CDFG indicates that adult fall-run chinook salmon may enter the Sacramento River as early as June (J. Brown, pers. comm., 1997). Spawning generally occurs from October through December, with fry emergence usually beginning in late December and January. Fall-run chinook salmon fry less than or equal to 40 mm in length are present at the HCPP from January through April, but may appear in late November and December. Juvenile fall-run chinook salmon greater than 40 mm in length may be present at the HCPP intake primarily from April through July, but may also be present through August (Figure 3.2-3). A few individuals may be present in September, October, and November. Coleman Fish Hatchery has historically released fall-run chinook salmon smolts between May 1 and May 15. From 1989-1992, salmon smolts were trucked and released below the GCID diversion because of the drought. In 1993, the smolts were released in April.

Late-fall-run Chinook Salmon (No Status) – The upstream spawning migration of adult late-fall-run chinook salmon generally begins in October, peaks in December, and ends in April (Reclamation 1991). The average annual run size is significantly smaller than that of fall-run chinook salmon. Reclamation (1991) reports an annual average of 11,000 returning adult spawners. As with the fall and winter runs of chinook salmon in the Sacramento River, primary spawning grounds of the late-fall-run chinook salmon are located upstream of RBDD. Spawning generally occurs from January into April. Juvenile late-fall-run eggs begin hatching in April and emigration generally continues through November (Vogel and Marine 1991).

C-085534

Late-fall-run chinook salmon fry less than or equal to 40 mm in length may be present at the HCPP primarily from April through July. Juvenile late-fall-run chinook salmon greater than 40 mm in length may be present at the HCPP from July through November. Relatively few fry are present after early June, and no fry are present from August through March (Figure 3.2-3).

Steelhead (Oncorhynchus mykiss) (Federal Proposed Endangered/State Species of Concern)

The Central Valley population of steelhead are currently proposed for listing as endangered under the ESA and are considered a State species of special concern. Steelhead (an anadromous variant of the rainbow trout) are closely related to Pacific salmon. Steelhead were once abundant in California coastal and Central Valley drainages from the Mexican to Oregon borders. Population numbers have declined significantly in recent years, especially in the tributaries of the Sacramento River. Steelhead typically migrate to marine waters after spending one or more years in fresh water. In the marine environment, they typically mature for one to three years prior to returning to their natal stream to spawn as three- or four-year olds. Unlike other Pacific salmon, steelhead are capable of spawning more than once before they die. The steelhead spawning season typically stretches from December through April. After several months, fry emerge from the gravel and begin to feed. Juveniles rear in fresh water from one to four years (usually two), then migrate to the ocean as smolts. The period of emigration for steelhead juveniles near Red Bluff is believed to be from November through June, with the peak in January and February (B. Snider, pers. comm., 1996).

Adult steelhead, generally averaging 600 to 800 mm (Moyle et al. 1989), migrate through the Sacramento River system beginning in early fall and continuing into April. Peak adult immigration occurs in October (Reclamation 1991). Juvenile steelhead less than or equal to 60 mm in length are rarely captured at HCPP, and it is believed that the fry remain in the general area of adult spawning activity above RBDD (P. Ward, pers. comm., 1996). Based on unpublished CDFG data on fish captures in the rotary screw trap at HCPP in 1992, peak juvenile steelhead abundance at the facility occurred during January (142 fish) and February (309 fish) (P. Ward, pers. comm., 1997). Fish captured during the two-month period ranged from 160 to 280 mm in length. Juvenile steelhead abundance decreased from March through May with a total of 81 fish (184 to 290 mm in length) captured over the three-month period.

Delta Smelt (Hypomesus transpacificus) (Federal Threatened/State Threatened)

The species list provided by the USFWS (USFWS 1997a) identified the State and Federal threatened delta smelt (*Hypomesus transpacificus*) as potentially occurring in the project area. Delta smelt are commonly found in the surface and shoal waters of the lower reaches of the Sacramento River below Isleton and into Suisun Bay. The upstream limit for this species in the Sacramento River is believed to be at the mouth of the American River (Stevens et al. 1990). During extremely high river flows, delta smelt may move temporarily into San Pablo Bay (Moyle et al. 1995). Delta smelt, therefore, do not occur in the project area and are not addressed further in this document.

C-085535

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Sacramento Splittail (Pogonichthys macrolepidotus) (Federal Proposed Threatened)

The Sacramento splittail is an endemic California minnow that was once widely distributed in lakes and rivers throughout the Central Valley, including the Sacramento River upstream to Redding and in the American River as far east as Folsom (Moyle et al. 1995). Present distribution includes Suisun Bay, the Napa and Petaluma rivers (Moyle et al. 1995), the Sacramento River as far north as Hamilton City (J. Brown, pers. comm., 1997), portions of the Delta, and the San Joaquin River upstream of the confluence of the Tuolomne (Moyle et al. 1995).

Adult splittail usually reach sexual maturity in their second year. They then migrate upstream in the late fall to early winter prior to spawning activities. Spawning occurs from mid-winter through July in water temperatures between 9-20°C (48°-68°F) (Wang 1986) at times of high winter or spring runoff (Moyle et al. 1995). Eggs acquire adhesive properties following exposure to water and adhere to vegetation or other benthic substrates (Wang 1986). Fertilized eggs generally hatch in three to five days and larvae begin feeding on plankton soon thereafter. Juvenile splittail inhabit shallow areas with abundant vegetation that are devoid of strong currents (Wang 1986) as they travel downstream from the spawning grounds to the Delta.

Mature splittail are generally found in the shallows of sloughs in edgewater habitat by emergent vegetation. They feed primarily on benthic invertebrates and aquatic insect larvae (Moyle 1976). Although tolerant of brackish water (Moyle 1976), splittail tend to move from areas of relatively high salinity to those characterized by fresh water (Moyle et al. 1995).

The HCPP is near the northern extent of splittail habitat in the Sacramento River. Recent records collected by CDFG of splittail occurrence at HCPP are displayed in **Table 3.2-4**. Although these records suggest a low abundance of splittail at the HCPP, CDFG's trapping and data recording at the facility has focused on salmonids. Juvenile minnows captured incidentally, including splittail, were not generally identified to species.

Table 3.2-4 - Splittail Occurrence at the Hamilton City Pumping Plant During 1993-1996[a]

Month[b]	1993	1994	1995	1996
March	6	0	0	0
April	0	0	0	0
May	0	0	0	2
June	0	0	0	0
July	0	0	0	0
August	0	2	3	0
September	0	1	3	0
October	0	1	0	na
November	0	1	1	na
December	0	0	1	na

[a] J. Brown, pers. comm., 1997
[b] No splittail were found at HCPP during the months of January and February in 1993-1996
na Data not available

C-085536

C-085536

Green Sturgeon (Acipenser medirostris) (Federal Species of Concern)

The green sturgeon is known to occur in the lower reaches of large rivers from the Delta north including the Klamath, Eel, and Smith rivers (Moyle 1976). It has also been found in saltwater from Ensenada, Mexico to the Bering Sea and Japan (Miller and Lea 1972). Adults of this species tend to be more marine than the more common white sturgeon (*Acipenser transmontanus*); however, spawning populations have been identified in the Sacramento and Klamath rivers (Beak 1993). Virtually all green sturgeon spawning occurs upstream of the HCPP. Green sturgeon are thought to be spawning upstream of the RBDD following modifications to the operation of that facility (D. Kohlhorst, pers. comm., 1997). The preferred spawning substrate is thought to be large cobble, although the substrate type may range from clean sand to bedrock. Fertilization of eggs occurs in the water column of relatively fast-flowing rivers (Emmett et al. 1991 *in* Moyle et al. 1992). In the Sacramento River, green sturgeon presumably spawn at temperatures ranging from 8-14°C (46°-57°F) (Beak 1993).

Green sturgeon have been reported in the Sacramento River as far north as Red Bluff. Sturgeon larvae have been collected over the last three years at the HCPP. The larvae were small when collected, but were identifiable after being kept for six to eight weeks in a laboratory. All the juvenile sturgeon collected from HCPP for identification by U.C. Davis, as well as sturgeon collected at RBDD, have been identified as green sturgeon (P. Foley, pers. comm, 1996).

River Lamprey (Lampetra ayresi) (Federal and State Species of Concern)

The river lamprey is relatively small (averaging 17 centimeters (cm)) and highly predaceous (Moyle 1976). They are anadromous and will attack fish in both fresh and salt water (Moyle 1976). A great deal of what is known about the river lamprey is from information on populations in British Columbia. There, adults migrate from the Pacific Ocean into rivers and streams in September and spawn in the winter months. Adults will excavate a saucer-shaped depression in sand or gravel riffles where the eggs are deposited. After spawning, the adults perish. Juvenile river lamprey, called ammocoetes, remain in backwaters for several years, where they feed on algae and microorganisms (Moyle et al. 1989). The metamorphosis from juvenile to adulthood begins in July and is complete by the following April. From May through July, following completion of metamorphosis, the river lamprey aggregate in the Delta prior to entering the ocean.

The river lamprey is distributed in streams and rivers along the eastern Pacific Ocean from Juneau, Alaska to San Francisco Bay. It may have its greatest abundance in the Sacramento-San Joaquin River system although it is not commonly observed in large numbers (Moyle et al. 1989). There have been lamprey ammocoetes similar to those of the river lamprey in the HCPP vicinity year-round, although these have not been identified to species (P. Ward, CDFG, pers. comm., 1996).

Longfin Smelt (Spirinchus thaleichthys) (Federal and State Species of Concern)

Longfin smelt is an euryhaline species, meaning they can tolerate a wide range of salinities. This is particularly evident in the Sacramento-San Joaquin Delta where they are found in areas ranging from almost pure seawater upstream to areas of pure fresh water. In this system, they are most abundant in San Pablo and Suisun bays (Moyle 1976). They tend to inhabit the middle to lower portion of the water column. The longfin smelt spends the early summer in San Pablo and San Francisco bays, generally moving into Suisun Bay in August. Spawning occurs in the winter months when this species congregates in upper Suisun Bay and the upper reaches of the Delta (Moyle 1976). Young longfin smelt move downstream and back into the bays in April and May (Ganssle 1966).

Longfin smelt feed primarily on opossum shrimp (*Order Mysidacea*), copepods, and other crustaceans (Moyle 1976). Spawning presumably takes place from December through February (Moyle 1976). The majority of adults perish following spawning. The eggs have adhesive properties and are probably deposited on rocks or aquatic plants in the lower Sacramento River upon fertilization.

Longfin smelt are rarely observed upstream of Rio Vista in the Delta (Moyle et al. 1995). They do not occur in the project study area and are not addressed further in this document.

Hardhead (Mylopharodon conocephalus) (State Species of Concern)

Hardhead occur mostly in large, undisturbed low- to mid-elevation rivers and streams (Moyle 1976). They are widely distributed throughout the Sacramento-San Joaquin river system.

Hardhead sexually mature following their second year. Based on observations of May and June upstream migrations of adults into smaller tributary streams, they presumably begin spawning in the spring. Spawning activity has not been documented, but reproductive behavior may involve mass spawning in upstream gravel bed riffles (Moyle et al. 1989).

Juvenile hardhead have been observed holding in the relatively quiet water at the HCPP. Hardhead abundance at HCPP has not, however, been specifically examined.

American Shad (Alosa sapidissima) (No Status)

American shad were introduced into the Sacramento River near Tehama in 1871 (Painter et al. 1980). The introduced American shad rapidly became abundant, and by 1879 a commercial shad fishery had developed in California. Legislative action in 1957 terminated the commercial fishery (Painter et al. 1980) in favor of the rapidly developing sport fishery (Moyle 1976). American shad are now found in the Sacramento River up to RBDD.

An anadromous fish species, American shad migrate from the ocean to freshwater to spawn. Adults returning from the ocean begin passing through the Delta in late March or April. They increase substantially in numbers through April, and peak during May in the Sacramento River at

Clarksburg (CDFG 1987b). American shad are broadcast spawners, with fertilization of eggs occurring in the water column. Eggs and fry move downstream with currents following spawning. Historically, American shad spawned throughout Delta tidal fresh waters upstream into both the Sacramento and San Joaquin rivers. Spawning has apparently declined in the San Joaquin system, leaving the north Delta and Sacramento River system upstream from Hood as the primary spawning areas (CDFG 1987b). Not all American shad die after spawning, and the downstream return of spawned fish is believed to continue through August.

The magnitude and timing of juvenile American shad migration in the Sacramento River system is believed to be influenced by water temperature and relative volume of flow, as is true with most fish species using the Sacramento River system as a migration corridor (Snider and Gerstung 1986).

Information on the timing of adult American shad spawning migrations past RM 206 on the Sacramento River is generally lacking. However, based upon the timing of presence of adult American shad at the RBDD, adult American shad are expected to be immigrating and spawning in the vicinity of the HCPP from April through May, with a concurrent movement of eggs and fry downstream.

Striped Bass (Morone saxatilis) (No Status)

Striped bass were introduced into the Sacramento-San Joaquin estuary in 1879 and 1882 (Moyle 1976). The species rapidly became abundant and provided the basis for a commercial fishery by 1888. Striped bass supported a commercial fishery until 1935, when it was discontinued in order to develop the sport fishery. The sport fishery has been very popular in California; in 1980, one million striped bass were taken by sport fishermen (McGinnis 1984).

The timing of the adult striped bass spawning migration is variable. From September to November, some fish migrate upstream from San Francisco Bay to San Pablo Bay through the Carquinez Straits and into Suisun and Grizzly bays. These fish overwinter in the Delta and remain there until spring, when they disperse throughout the Sacramento River, the San Joaquin River, and the Delta to spawn during the period April through June. After spawning, striped bass adults return to brackish or salt water.

Two major spawning areas and a number of minor spawning areas are used by striped bass in California. The spawning area closest to HCPP is located in the Sacramento River between Sacramento and Colusa (RM 144) (Moyle et al. 1989). Although adult striped bass have been observed in the Sacramento River upstream of RM 206, little spawning is believed to occur upstream of Colusa. Few juvenile striped bass would, therefore, be expected to be rearing in the vicinity of the HCPP. Examination of CDFG data collected by fyke net and rotary screw traps from 1986 through 1992 showed that only two striped bass, both about 25 mm in length, were captured at the HCPP. However, juvenile and adult striped bass have been collected by angling in front of the screen bays during the squawfish predation surveys (S. Cramer, pers. comm., 1996). Juvenile chinook salmon were identified in the stomach content analysis of adult striped bass caught in front of the fish screen bays during these surveys.

Sacramento Squawfish (Ptychocheilus grandis) (No Status)

Sacramento squawfish are found throughout the Sacramento-San Joaquin River system. Regular downstream migrations occur when stream flows decline (in the summer), and upstream migration for spawning and feeding occurs when stream flows are high (in the spring). Recaptures of tagged squawfish have shown that some individuals migrate between the upper Sacramento River and the Delta (Garcia 1989). A substantial proportion of migrating squawfish spawn in tributaries of the Sacramento River (Garcia 1989). Fish ready to spawn move upstream during April or May to spawn in gravel riffles.

Squawfish are considered to be a primary predator of fry and juvenile salmon in the Sacramento River. Consumption of juvenile salmon by individual squawfish can be substantial, with as many as 39 salmon found in an individual squawfish captured below the RBDD (Garcia 1989).

Studies attempting to evaluate the impact of predation on salmonids have concluded that predation, especially by squawfish, is significant where prey species are concentrated and/or are disoriented by water currents. These conditions are commonly present at or near barriers, dams, and diversions, or where large hatchery releases are made. Significant predation of juvenile salmonids has been documented in the Sacramento River at RBDD (Hall 1979), at the salvaged fish release site at Horseshoe Bend (Pickard et al. 1982), and in the Yuba River at the Hallwood-Cordua Fish Screen (Hall 1979). At both the RBDD and Hallwood-Cordua fish screen, emigrating juvenile salmonids are stressed and disoriented by the unusual flow patterns associated with the facilities. This stress and disorientation of the juvenile chinook salmon likely results in an increased vulnerability to predation by squawfish and other predatory fish species.

Although heavy predation resulting from the artificial conditions created by dams and diversion facilities has been documented, squawfish and other piscivorous fish are generally not considered to prey upon juvenile salmonids to the same degree in free-flowing, unobstructed streams (Vondracek and Moyle 1983).

In studies intended to evaluate the extent of predation by squawfish at the HCPP, Cramer & Associates (1993) concluded that squawfish abundance and predation on juvenile chinook salmon was low. However, CDFG and others have questioned such conclusions. The CDFG continues to indicate that squawfish predation in the oxbow may be significant (P. Ward, pers. comm., 1996).

March through June is the principal time of upstream migration for Sacramento squawfish past HCPP (Cramer & Associates 1992). However, Sacramento squawfish have been known to reside at the HCPP throughout the year (Garcia 1989). Juvenile squawfish are about three times as abundant as adults at HCPP (Cramer & Associates 1992) and are present in the vicinity of GCID from April through November, with peak abundance occurring in June and July (P. Ward, pers. comm., 1996). In the time since the majority of the above studies were conducted, several improvements have been made to reduce predation in the oxbow channel, as previously mentioned.

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3.2.5.2 Aquatic Invertebrates

A diverse aquatic invertebrate community is believed to exist in the area of the proposed project. Habitats within the project area that support aquatic invertebrates include wetlands, riparian vegetation and snags, cut banks, and a variety of river bottom types. River invertebrates provide an important food source for fish using the project area (Moyle 1976).

Benthic, or bottom dwelling invertebrates, include aquatic insects (e.g., nymphs and midges), crustaceans, aquatic worms, nematodes, and bivalves. These organisms reside in or on various river bottom substrates. Most benthic invertebrate species develop via a series of larval stages prior to becoming terrestrial, aerial adults. The adult phase serves as a reproductive and dispersal phase for these species. Larvae may also disperse passively by entering the water column and moving with river currents. High river flow can markedly decrease local aquatic invertebrate populations by flushing organisms downstream. Other factors, such as sedimentation, can also reduce local populations by adversely affecting feeding, interfering with respiration, and/or reducing dissolved oxygen concentrations in the water column. Generally, as the proportion of fine sediments in the riverbed increase (and the rates of sedimentation increase), benthic invertebrate community diversity and density decrease.

Drift invertebrates consist of benthic forms which have drifted into the water column and insects that have fallen into the river. Most aquatic invertebrate species drift for only a brief time and then settle back to the river bottom.

Aquatic invertebrates serve as an important food source for a variety of fish species, particularly when drifting in the water column. Juvenile salmonids are opportunistic sight feeders that prey upon drift organisms as well as invertebrates attached to bottom substrates. Young salmonids depend more on drift invertebrates, with bottom feeding becoming more important as the fish increase in size. Juvenile white sturgeon feed on smaller benthic invertebrates and aquatic insects (e.g., midges), while larger sturgeon feed on larger crustacea, bivalves, and fish.

Little information is available on the Sacramento River aquatic invertebrate community that exists in the area of RM 206. A one-year study covering the Sacramento River from Red Bluff to Colusa included a survey of drift organisms and a fish stomach content analysis from both upstream and downstream of the proposed project area (Schaffter et al. 1983). In this study, aquatic insects comprised 72 percent of the diet of salmon and 54 percent of the drift community. Midges (family Chironomidae) made up the greatest percentage of dietary items in salmon for all months except April when aphids (family Aphididae) were the most numerous. Mayflies (family Baetidae) and aphids were the second and third most common food items in the diet of salmon. This study concluded that juvenile salmonids feed primarily on drifting aquatic invertebrates.

3.2.5.3 Mammals Dependent Upon Aquatic Habitats

Mammals commonly observed in the area are primarily terrestrial with the exception of beaver (*Castor canadonsis*), muskrat (*Ondatra zibethicus*), and river otter (*Lutra canadensis*), which are most entirely aquatic. Beaver and muskrat live in lodges constructed in marsh areas, streams, or

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lakes. Beaver feed on small trees, which they also utilize in construction of their lodges. Muskrat prefer aquatic vegetation. River otters tend to be scarce in populated areas or in waterways that are polluted (Chapman et al. 1982). Their primary food source is fish, although they also consume small amounts of crustaceans, amphibians, birds, and mammals. Although beaver and muskrat have not been noted in the project study area, river otter have been observed feeding in the upper oxbow and Sacramento River. In addition, a den site on the west bank of the river at RM 205.5 has been observed. It is not known if this den was a temporary or long-term residence.

3.3 Geology and Soils

3.3.1 Introduction

This section presents existing conditions information on geology and soils for the regional and local project area settings.

3.3.2 Regulatory Setting

There are no regulatory entities with jurisdiction over geology and soils.

3.3.3 Regional Setting

The Great Valley geomorphic province was formed by the meandering Sacramento River system and is characterized by marine and alluvial sedimentary deposits. It encompasses a nearly flat alluvial plain extending from the Tehachapi Mountains in the south to the Klamath Mountains in the north, and from the Sierra Nevada Mountains in the east to the Coast Range in the west. While no active faults are known to be present within the immediate project area, the region displays sparse, low-level seismic activity south of Red Bluff. Within the project area, three soil series and one land type are found, as described below.

3.3.4 Local Setting

The following sections provide background information for the project area relative to geology and soils.

3.3.4.1 Topography and Geomorphology

The project area is drained by the Sacramento River, an actively meandering river system (Kondolf 1993). Meandering river systems consist of a main meander channel, point bars that build outward on the inside bend of meander loops, natural levees, flood basins along levees, and oxbow lakes. Alluvial deposits with characteristic grain sizes and sedimentary structures are generated by each element within the meandering river system (Boggs 1987). Changes in flow and sedimentation since the construction of Shasta Dam and Reservoir in 1945, and the implementation of various bank protection projects, have modified the meandering nature of the Sacramento River and appear to be straightening its channel (Kondolf 1993). Section 3.1, Hydrology and Water Resources, provides additional information on the local hydrologic and hydraulic characteristics of the river.

3.3.4.2 Seismicity

A large number of diversely oriented folds and faults are distributed throughout the Sacramento Valley, which displays sparse, low-level activity south of Red Bluff (Harwood and Helley 1987; LaForge and Hawkins 1986). A variety of inactive faults are found in the area, including Willows Fault, Chico Monocline Fault, Corning Fault, and others (Harwood and Helley 1987).

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The largest earthquake to occur in the Valley since the mid-1800s was an estimated 5.0 magnitude event in 1881, located approximately 12 miles southeast of Red Bluff (LaForge and Hawkins 1986; CDMG 1992).

3.3.4.3 Sedimentary Deposits

The Great Valley geomorphic province is filled with a thick sequence of sediments ranging in age from the Jurassic to Recent. Marine sedimentary rocks, ranging in age from early Miocene to Late Jurassic (i.e., 25 to 140 million years old), underlie the deeper parts of the Sacramento Valley. The approximate thickness of these marine sediments may be up to 10,000 to 15,000 feet (CDMG 1966). It is estimated that approximately 900 to 1,150 feet of Cenozoic (i.e., 2 to 65 million years old) alluvial sedimentary deposits cover these marine deposits in the project vicinity (Harwood and Helley 1987). The older alluvial deposits within the area consist of cemented fluvial gravels that are resistant to erosion (Kondolf 1993). The younger alluvial deposits within the area consist of the Modesto Formation, which is comprised of unconsolidated gravel, sand, silt, and clay, and the older Riverbank Formation, which is comprised of weathered reddish gravel and silt (Helley and Harwood 1985). These formations are fairly stable (Kondolf 1993). The Riverbank Formation plays an important role in the current alignment of the Sacramento River in the project vicinity (Section 3.1, Hydrology and Water Resources).

Recent active channel deposits are present on Montgomery Island and the west bank of the intake channel. These areas are subject to rearrangement during high flows (Kondolf 1993). The west bank of the intake channel and the site of the existing Hamilton City Pumping Plant facility are stabilized by an outcrop of the Riverbank Formation. This formation does erode, but at a rate much slower than the surrounding less resistant units; therefore, it can be considered relatively stable (Kondolf 1993).

3.3.4.4 Soils

The following soil series and one land type are found within the project area:

- Arbuckle soils;
- Columbia soils;
- Hillgate soils; and
- Riverwash land type.

Arbuckle soils are found on the west bank of the Sacramento River and the intake channel from about RM 206.3 to 206.8. Slopes in this area range from zero to eight percent. These soils occur as low terraces and support orchard and pasture use.

Hillgate soils are found along the west bank of the intake channel from RM 206.8 to 207 at slopes of three to eight percent. These soils support agricultural uses.

The Riverwash land type is found along the east side of the Sacramento River, the southeast portion of Montgomery Island, and the east bank of the intake channel. These soils are dominated by river gravels.

Columbia soils cover the remaining portion of the project area. Slopes of these soils range from zero to eight percent. The majority of the riparian vegetation within the project area is found on Columbia soils. Columbia soils also support agricultural uses and orchards in the project area.

Each soil series occurs as either one or more map units. The units within a soil series are differentiated by one or more characterizing features, such as surface soil texture, predominant slope of occurrence, or drainage conditions. **Figure 3.3-1** presents the location of the various soil map units within the project area.

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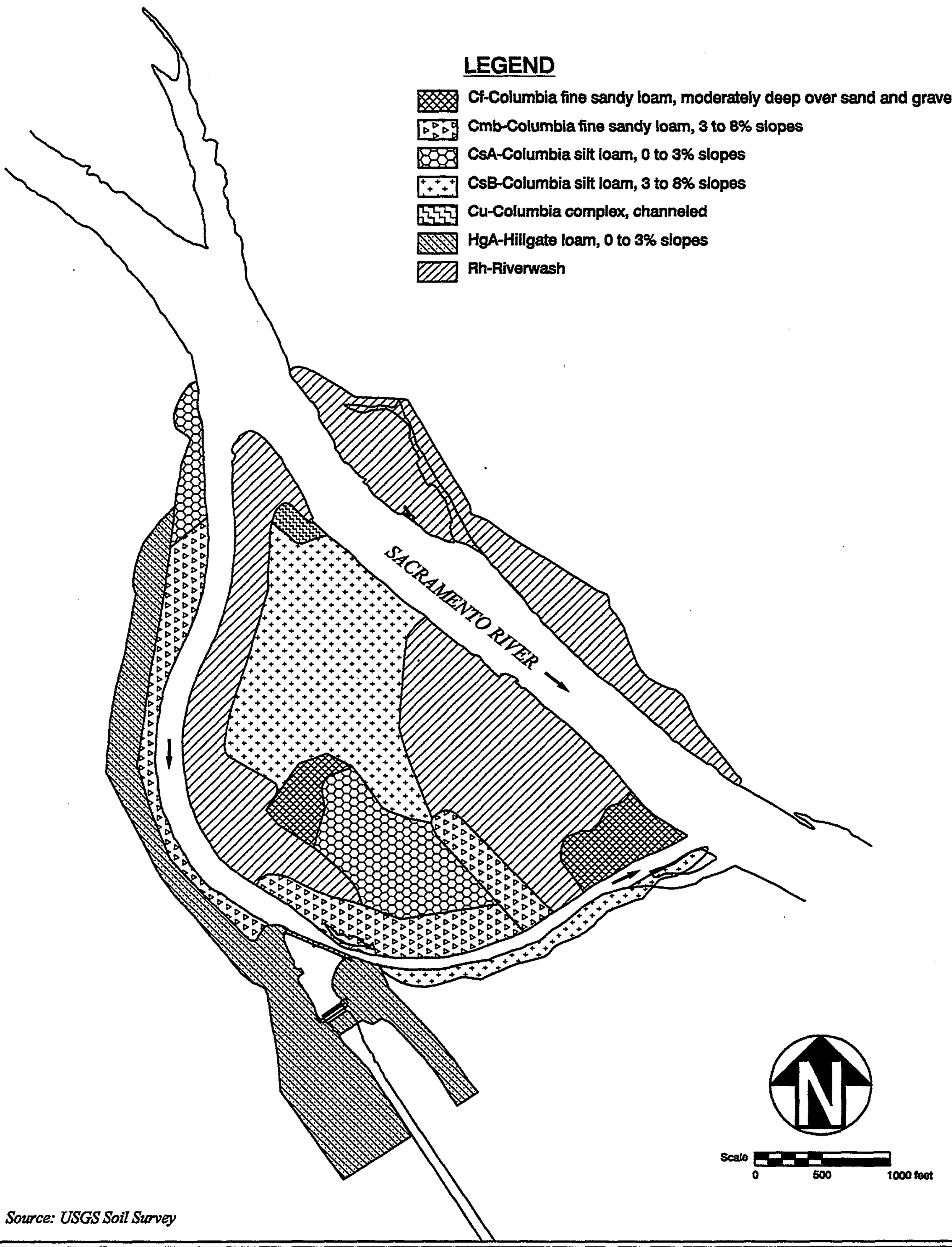
FIGURE 3.3-1. PROJECT STUDY AREA SOIL TYPES



Source: USGS Soil Survey

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3.4 Recreation and Navigation

3.4.1 Introduction

This section presents information on the general setting of the project with respect to existing recreation and navigation conditions.

3.4.2 Regulatory Setting

According to the California Department of Boating and Waterways (CDBW), the public has the right to navigate the State's waterways. The Sacramento River is considered navigable from the Delta north to Keswick Dam. The portion of the Sacramento River within the project area is considered navigable for recreational boats. There are no specific State or Federal criteria concerning depth or flow velocities for recreational uses. The relatively shallow waters within the vicinity of the proposed project do not preclude the area from recreational boating (I. Plescov, pers. comm., 1992).

The CDBW does not permit or enforce boating safety regulations, although it does review proposals for projects and provides recommendations to ensure boating or navigation safety pursuant to Title 14, Article 6, California Code of Regulations. Enforcement of boating and recreation safety along the section of the Sacramento River within the project area is provided by the Glenn County Sheriff's Department.

Senate Bill 1086 (Section 3.1.2.5, SB 1086 Upper Sacramento River Fisheries and Riparian Habitat Plan) mandated the creation of a management plan for the Sacramento River to protect, restore, and enhance fish and riparian habitat within and along the river. While the Upper Sacramento River Fisheries and Riparian Habitat Management Plan does not specifically address goals for recreation and navigation, improvements to fisheries and riparian habitat would improve recreation along the Sacramento River.

3.4.3 Regional Setting

The Sacramento River within the project area supports a variety of recreational activities. Recreational boating is the primary recreational activity. A variety of sites for boat launching are located within the region. The Sacramento River channel in the project area is relatively shallow and contains navigational hazards. Other recreational opportunities within the project area include inner-tubing, angling, and hunting.

3.4.4 Local Setting

The following sections provide background information for the project area relative to recreation and navigation as presented in Table 2.6-2 (Issues Carried Forward for Further Analysis).

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3.4.4.1 Recreational Boating

The section of the Sacramento River south of the Woodson Bridge is used by both motorized and non-motorized boats. The most common boats used on this part of the river are fishing boats, canoes, rafts, and other inflatable craft. Under summer and fall low flow conditions, power boat use of the river upstream of RM 201 is probably constrained to jet boats due to the presence of riffles from RM 201 through RM 205. Jet sleds and jet skis ~~are~~ also used ~~in~~ this area during the summer months (B. Pennock, pers. comm., 1993). Recreational facilities within the vicinity of Hamilton City and the Hamilton City Pumping Plant are shown on **Figure 3.4-1**.

In addition to boating access areas, local property owners moor their boats in various locations along the river and along the western shoreline of the upper oxbow. Currently, five boat docking areas are present in the project vicinity (B. Pennock, pers. comm., 1996).

Bidwell-Sacramento River State Park is located about 5 miles south of the project area near River Mile (RM) 200, just south of State Route 32. The following three boat launching facilities are located within the park:

- Irvine Finch River Access, which is located on the west side of the river immediately south of State Route 32, includes a boat launch, restrooms, potable water, picnic/day use, and parking;
- Pine Creek Landing, which is located on the east side of the river off River Road approximately 0.5 mile south of State Route 32, includes a boat launch (during high flow only), picnic/day use, and parking; and
- Scotty's Boat Landing, which is located on the east side of the river off River Road approximately 1.5 miles south of State Route 32, includes a boat launch, restrooms, potable water, a telephone, and parking.

The Woodson Bridge State Recreation Area is located on the west side of the river and the Tehama County River Park is located on the east side of the river at RM 218. Facilities at these parks include camping, boat launching, restrooms, picnic/day use, potable water, beach access, telephones, and parking.

The section of the Sacramento River between Woodson Bridge and Colusa State Park has not been dredged, and there are no nautical charts indicating water depths or navigational hazards (CDBW, no date). No boating speed limits are imposed in this area (R. Wallace, pers. comm., 1993). During the winter and spring, when the water level is high and the current strong, much debris (comprised of snags and fallen trees) is carried down river. This debris can lodge against docks and bridges or can become wedged in shallow areas and presents the primary hazard to boaters in this section of the Sacramento River (R. Wallace, pers. comm., 1993). Other navigational hazards within the area include pilings from old piers that are broken off below the water surface and are not visible to boaters. Wing dams (i.e., underwater walls of piling or rock

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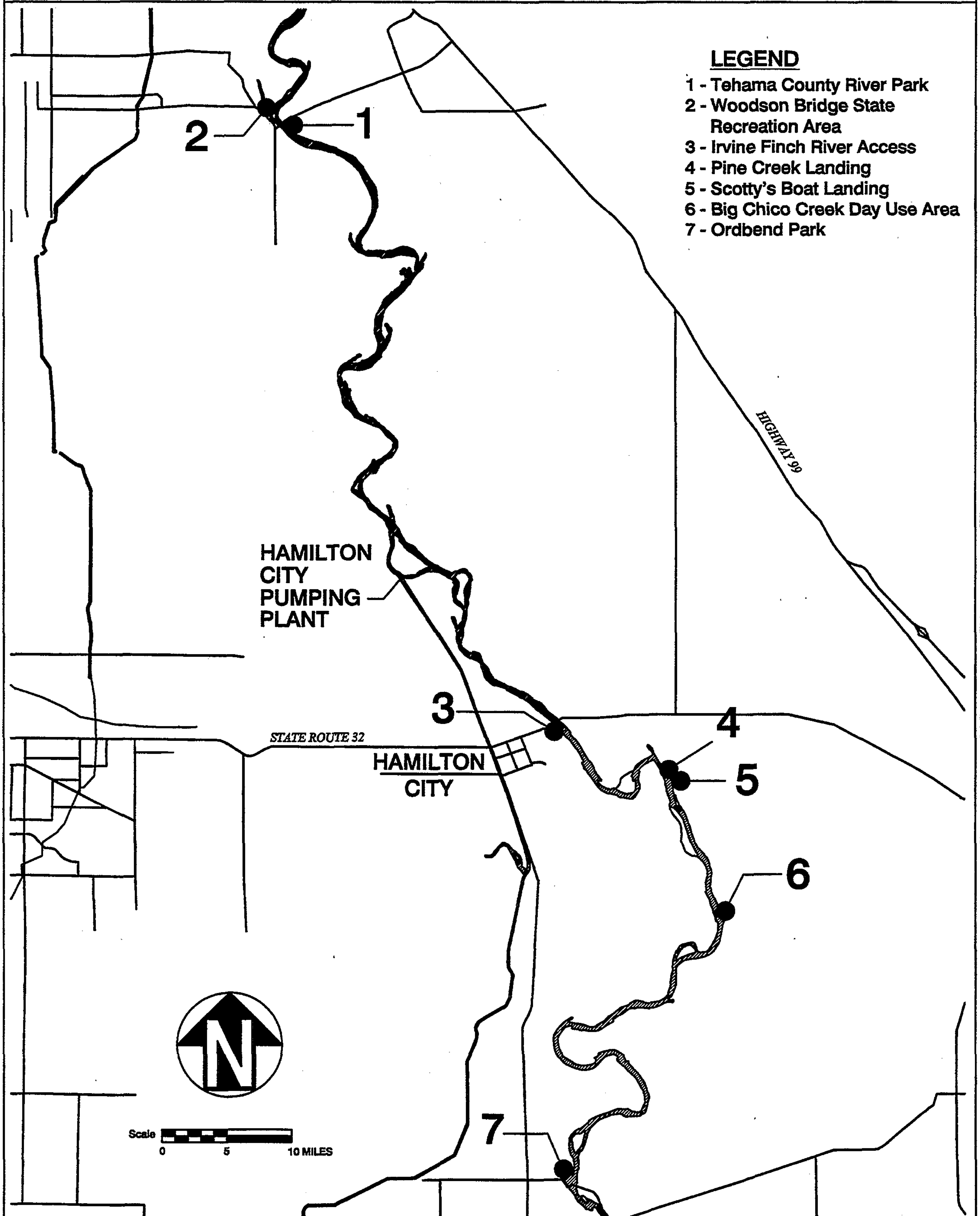
FIGURE 3.4-1. RECREATIONAL FACILITIES IN VICINITY OF HAMILTON CITY PUMPING PLANT



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extending from the bank into the river to prevent bank erosion) are present within the area and are difficult for boaters to see except when the river is low, or when the dams are marked by seasonal buoys. Sandbars, which shift position as the river current changes, also present hazards to boaters in the area (CDBW, no date).

3.4.4.2 Other Recreation Opportunities

Within the project area, hunting and fishing occur on the parcel of public land to the northeast of RM 206. The section of the Sacramento River between Irvine Finch River Access, near RM 200 and the Big Chico Creek Day Use Area at RM 193.5, is a popular inner-tube run (Figure 3.4-1). This area is located approximately five miles downstream of the project area.

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3.5 Terrestrial Biology

3.5.1 Introduction

This section describes the general setting of the project area with respect to terrestrial biological resources. The affected environment includes a discussion of general conditions and a description of the specific habitats and sensitive species that may be impacted by the proposed project. All issues in this section are discussed for consideration in Chapter 4, Impact Analyses.

3.5.2 Regulatory Setting

California State species of concern within the project area are regulated under the California Endangered Species Act (CESA) by the California Department of Fish and Game (CDFG). As California Environmental Quality Act (CEQA) lead agencies, CDFG and Glenn-Colusa Irrigation District (GCID) are obliged to fulfill the requirements described in sections 2053, 2055, and 2090 of CESA. These regulations require that projects be reviewed to ensure that they will not jeopardize the continued existence of endangered or threatened species or their habitat (Section 2053), that conservation of these species will occur (Section 2055), and that consultation, when appropriate, will occur with CDFG to provide mechanisms for accomplishing the above (Section 2090).

Federally-protected terrestrial species in the project area are the responsibility of the U.S. Fish and Wildlife Service (USFWS). Section 7(a)(2) of the Endangered Species Act of 1973 (ESA), as amended, provides that:

> ["Each Federal agency shall, in consultation with and with the assistance of the Secretary, ensure that any action authorized, funded, or carried out by such agency ... is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species.... In fulfilling the requirements of this paragraph each agency shall use the best scientific and commercial data available."]

Proposed and listed species and their habitats are addressed in a comprehensive State/Federal Biological Assessment (Appendix A). Other species of concern and certain rare or declining habitat types are described in this section.

3.5.3 Regional Setting

The Sacramento River corridor provides a diversity of terrestrial habitats, ranging from riparian forests and scrub, to grassland in the more upland areas surrounding the river. Riparian habitat, formerly extensive in the Sacramento Valley, is currently limited to isolated clusters of trees usually growing within 300 feet of the Sacramento River from River Mile (RM) 293 to RM 144.

The majority of the GCID service area is developed as irrigated agriculture. A variety of row crops, orchards, and rice fields represent the primary land use. Rice fields, when flooded, provide habitat

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for migrating waterfowl and wading birds in the fall and winter months. In addition to providing irrigation water, GCID also conveys water to three National Wildlife Refuges: the Sacramento, Delevan and Colusa (Figure 3.1-2). Wildlife refuges also receive agricultural runoff. The refuges are located to the south and are remote from the pumping plant and proposed construction activities.

3.5.4 Local Setting

Adjacent to the Hamilton City Pumping Plant (HCPP) site are undeveloped areas of mixed riparian habitat bordered on the west by farmland. Wetland areas are present along the eastern bank of the Sacramento River opposite Montgomery Island. Terrestrial habitats in the immediate project area include riparian forest, open gravel shoreline, orchard and cropland, and grassland. Riparian forests and open gravel shorelines, although terrestrial in nature, are dependent to a great degree on the Sacramento River to support their associated flora and fauna. A map of habitats in the vicinity of the HCPP is provided on **Figure 3.5-1**. Both riparian and wetland habitats have declined in overall quality and quantity in the Central Valley. Loss of riparian and wetland habitats has contributed to the decline of many species dependent upon these habitats. Some of these species are now listed or proposed for listing under the ESA and/or CESA as threatened or endangered.

3.5.5 Habitats

There are five general types of terrestrial habitats in the vicinity of the proposed project: riparian, gravel shoreline, grasslands, wetlands, and croplands (USFWS 1995a). The riparian area is described in two subsets, the mixed riparian and valley oak riparian forest. Emergent wetlands are evident on the Sacramento River bank opposite Montgomery Island. Habitats were identified using information from ground surveys completed in 1992 and 1993 (Beak 1992 and 1993), and interpretation of aerial photos from 1992 and 1996 (which were further clarified during site visits in 1996 and 1997). See Figure 3.5-1 for the locations of these habitats.

Great Valley Mixed Riparian Forest

This vegetation type is generally found growing within 300 feet of the river's edge and consists of tall winter-deciduous species including Fremont's cottonwood (*Populus fremontii*), box elder (*Acer negundo californica*), Northern California black walnut (*Juglans californica* var. *hindsii*), California sycamore (*Platanus racemosa),* and willows *(Salix* spp.). Understory species include the button bush (*Cephalanthus occidentalis*) and Oregon ash (*Fraxinus latifolia*) (Holland 1986).

Riparian forests provide habitat to a large number of migrant and resident birds, and are used by a variety of reptiles, amphibians, and small and large mammals. They provide important corridors between populations of various species. Montgomery Island supports a maturing forest of Northern California black walnut (WET 1991). Unvegetated vertical banks adjacent to riparian forests, such as those on Montgomery Island, provide nesting sites for the belted kingfisher (*Ceryle alcyon*), northern rough-winged swallow (*Stelgidopteryx serripennis*), and the

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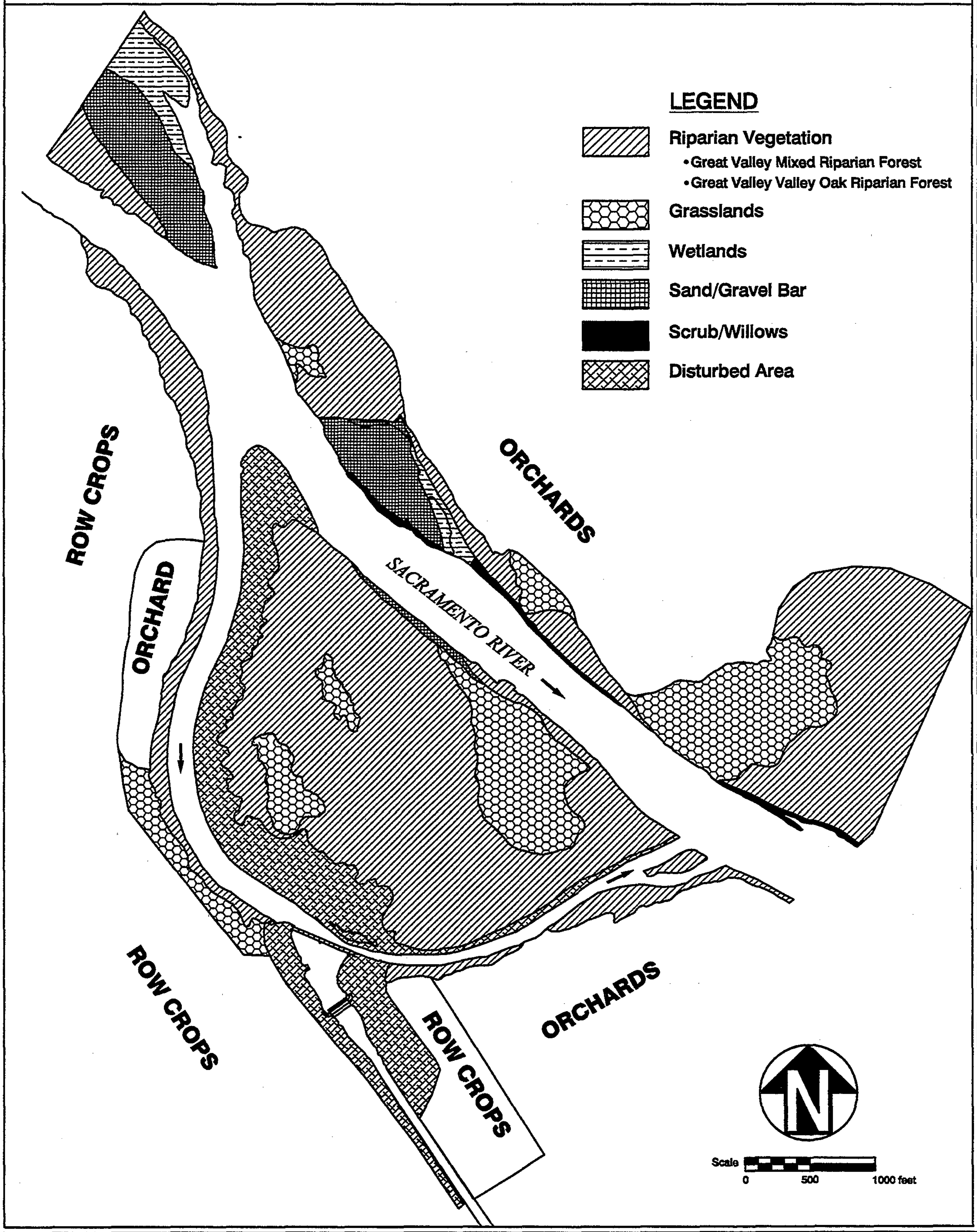
FIGURE 3.5-1. TERRESTRIAL RESOURCES PROJECT STUDY AREA



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bank swallow (*Riparia riparia*), which is listed as threatened by the State of California. Near-shore scrub/willow habitat is indicated on Figure 3.5-1. This habitat generally consists of riparian shrubs growing near the water's edge.

Great Valley Valley Oak Riparian Forest

This community is generally restricted to the highest part of a floodplain and is therefore less subject to inundation and flooding. Oak riparian forests receive beneficial nutrients from alluvium and subsurface water flow, allowing for an extended growing period and increased productivity. The dominant canopy species is the valley oak (*Quercus lobata*). Understory species include the Oregon ash, Northern California black walnut, California sycamore, and young valley oak. The oak riparian forest provides good habitat for raptors, game birds, jay, and a variety of song birds. Oak trees provide nesting sites for raptors and wading birds such as great blue heron (*Ardea herodias*) and common egret (*Casmerodius albus*). Small mammals, such as western gray squirrels (*Sciurus griseus*), California ground squirrels (*Spermophilus beecheyi*), and mice are common, as are larger mammals such as foraging black-tailed deer (*Odocoileus hemionus*). Common reptiles are the western rattlesnake (*Crotalus viridis*) and gopher snake (*Pituophis melanoleucus*).

Sand/Gravel Bar Shoreline

This habitat is found at the water's edge and serves as a broad, low-lying buffer between riparian forests and emergent wetland, and the river. The gravel shoreline is used by a variety of species that forage for seeds, vegetation, ground-dwelling insects, and vertebrate prey (WET 1991). The vegetation consisting primarily of herbaceous species and young shrubs and trees, such as willow and alder (*Alnus rhombifolia*), is sparse due to consistent flooding. These bars provide nesting habitat for birds such as killdeer (*Charadrius vociferus*) and foraging area for spotted sandpiper (*Actitis macularia*). Much of the area across the Sacramento River from Montgomery Island consists of these gravel bars. Man-made structures in the oxbow adjacent to the proposed project site have some of the same physical characteristics as these gravel shorelines.

Grassland

Grassland in the area of the proposed project is located in the upland areas and are interspersed with cropland. The habitat is disturbed and contains a high degree of annual grasses and forbs. Dominant grass species include wild oat (*Avena fatua*), soft chess (*Bromus mollis*), ripgut brome (*Bromus rigidis*), wild barley (*Hordeum murinum*), and foxtail fescue (*Festuca megalura*). Typical forbs include filaree (*Erodium* spp.), turkey mullein (*Eremocarpus setigerus*), and clover (*Trifolium* spp.). Grassland provides forage area for raptors roosting in adjacent forested areas such as red-tailed hawk (*Buteo jamaicensis*) and soaring species such as turkey vulture (*Cathartes aura*). Ring-necked pheasant (*Phasianus colchicus*), quail, and numerous passerine birds are common. Grassland reptiles include the western fence lizard (*Sceloporus occidentalis*), common garter snake (*Thamnophis sirtalis*) and western rattlesnake. It also is important habitat for deer, coyote (*Canis latrans*), skunk (*Spilogale gracilis*) and gray fox (*Urocyon cinereoargenteus*).

Wetland

The backwaters and eddies of old oxbow lakes and river channels form a system of near-shore emergent wetlands. These are particularly evident in the project area along the banks of the Sacramento River immediately across from Montgomery Island and in the downstream inlet of Snaden Island. In the shallows, emergent vegetation such as cattail (*Typha latifolia*) and tule (*Scirpus* sp.) are common. Horsetail (*Equisetum* sp.) is found in the moist upper reaches. Willows are very abundant and the surrounding canopy consists of riparian forest species.

Refuges

Three National Wildlife Refuges (Sacramento, Delevan, and Colusa) (Hydrology and Water Resources, Figure 3.1-2) receive water from GCID facilities and provide important habitat for wildlife. The emergent wetlands common to these refuges provide habitat for resident and seasonally migrating waterfowl along the Pacific Flyway. These wetland refuges provide cover and foraging habitat to a variety of raptors, wading birds, shorebirds, reptiles, amphibians, and mammals. The giant garter snake *(Thamnophis gigas)* is known to be present at all three wildlife refuges (G. Wylie, pers. comm., 1997). In 1995, GCID delivered 61,452 acre-feet (ac-ft) to these wildlife refuges[1]. Most of the water, 43,906 ac-ft, was delivered during the Reclamation Contract period of April through October. The remaining 17,546 ac-ft was delivered during November and December (GCID 1996a). GCID's delivery of Reclamation Contract water to the Sacramento, Delevan, and Colusa refuges averaged about 38,000 ac-ft per year from 1986 through 1995, but varies according to the type of water year (GCID 1996a). A maximum delivery of 105,000 ac-ft has been identified as a future Level 4 allocation for the refuges (Reclamation 1989). GCID has been identified as a potential alternative for delivery of this water.

Cropland

Much of the cropland in the area surrounding the proposed project is planted in rice, orchards, or row crops. A description of crops grown and acreages served is provided in Section 3.7, Land Use. Seasonal water demands are discussed in Section 3.1, Hydrology and Water Resources. These areas provide habitat for species accustomed to human disturbance such as mourning doves (*Zenaida asiatica*), crows (*Corvus brachyrhynchos*), and yellow-billed magpies (*Pica nuttalli*), as well as mice and other small mammals. Row crops can provide important post-harvest food sources for migrating waterfowl along the Pacific Flyway. Current practices in rice farming within the GCID service area and elsewhere include the flooding of fields during the late fall and winter months to facilitate the decomposition of rice straw. These flooded fields provide important habitat to migrating and wintering waterfowl and wading birds.

[1] The amounts of water delivered to the Sacramento, Delevan, and Colusa national wildlife refuges described here are those amounts actually delivered to the refuges and do not include the 20% credit received by GCID to account for water losses during conveyance.

3.5.6 Wildlife and Plants

Most of the species commonly found in the vicinity of the proposed project are associated with riparian woodland habitats. Species such as black-tailed deer, raccoon, California ground squirrel, belted kingfisher, snowy egret, tree swallow, turkey vulture, and hairy woodpecker are all residents of the area.

3.5.6.1 Listed Species and Species Proposed for Listing

As provided by the USFWS (1997a) and CDFG (1996), a number of species either listed or proposed for listing have been identified as potentially occurring in the area of the proposed project. Additional discussion of potentially affected species is provided in the Biological Assessment (Appendix A). These special-status species and their Federal and State status are listed in **Table 3.5-1.**

Plants

No special-status plants, including California Native Plant Society 1B species, were identified in the area of the project (USGS 7.5 Minute Foster Island Quadrangle) although potential habitat for some of these species is known in the area. Field surveys indicate that vernal pools, although found in grasslands of the region, do not occur in the immediate area affected by the project (Beak 1992). For this reason, plants restricted to vernal pools and identified by USFWS (1997a) and/or RAREFIND (CDFG 1996) as potentially existing in the areas surrounding the proposed project site are not further addressed in this document. These include the endangered Butte County meadowfoam (*Limnanthes floccosa* ssp. *Californica*), proposed endangered Greene's tuctoria (*Tuctoria greenei)* and hairy Orcutt grass (*Orcuttia pilosa*), and the proposed threatened Hoover's spurge (*Chamaesyce hooveri*), Colusa grass *(Neostapfia colusana)*, and slender Orcutt grass (*Orcuttia tenuis*).

Other plant species, such as the State and Federal endangered and California Native Plant Society (CNPS) 1B palmate-bracted bird's beak (*Cordylanthus palmatus*) (or the species of concern and CNPS 1B valley spearscale (*Atriplex joaquiniana*) and recurved larkspur (*Delphinium recurvatum*) (Table 3.5-2)), are found in alkali soils. The soils of the Montgomery Island area are generally of the Columbia soil series and are not characterized by an excessively high pH (ECOS 1991). The specialized soil conditions for these species are not found in the project area.

Invertebrates

The Habitat Evaluation Procedures (HEP) analysis and species list from USFWS (1997a) identified the endangered conservancy fairy shrimp (*Branchinecta conservatio*) and vernal pool tadpole shrimp (*Lepidurus packardi)*, and the threatened vernal pool fairy shrimp (*Branchinecta lynchi*), as species potentially occurring in the area of the proposed project. The analysis does not, however, identify vernal pool habitat as a habitat type affected by the proposed project. Further, field surveys conducted in the area and review of 1996 aerial photographs

C-085556

Table 3.5-1 - Federal and State Listed and Proposed Listed Terrestrial Species Potentially Occurring in the Hamilton City Pumping Plant Area

Resource	Common Name	Status Federal[a]/State[b]/CNPS[c]
Plants		
Chamaesyce hooveri	Hoover's spurge	PT/--/1B
Cordylanthus palmatus	Palmate-bracted bird's beak	E/E/1B
Limnanthes floccosa ssp. *Californica*	Butte County Meadowfoam	E/E/1B
Neostapfia colusana	Colusa grass	PT/E/1B
Orcuttia pilosa	Hairy Orcutt grass	PE/E/1B
Orcuttia tenuis	Slender Orcutt grass	PT/E/1B
Tuctoria greenei	Greene's tuctoria	PE/R/1B
Invertebrates		
Branchinecta conservatio	Conservancy fairy shrimp	E/--/--
Branchinecta lynchi	Vernal pool fairy shrimp	T/--/--
Desmocercus californicus dimorphus	Valley elderberry longhorn beetle	T/--/--
Lepiduras packardi	Vernal pool tadpole shrimp	E/--/--
Amphibians and Reptiles		
Rana aurora draytonii	California red-legged frog	T/CSC/--
Thamnophis gigas	Giant garter snake	T/T/--
Birds		
Branta canadensis leucopareia	Aleutian Canada goose	T/--/--
Falco peregrinus anatum [d]	American peregrine falcon	E/--/--
Haliaeetus leucocephalus [d]	Bald eagle	T/--/--
Buteo swainsoni	Swainson's hawk	--/T/--
Coccyzus americanus occidentalis	Western yellow-billed cuckoo	--/E/--
Riparia riparia	Bank swallow	--/T/--
Empidonax trailii brewsteri	Little willow flycatcher	SC/E/--

[a] Federal: E = Endangered; T = Threatened; PE = Proposed Endangered; PT = Proposed Threatened; SC = Species of Concern

[b] California: E = Endangered; T = Threatened; R = Rare; CSC = Species of Concern

[c] California Native Plant Society (CNPS): 1B = Rare, threatened, or endangered in California or elsewhere

[d] Designated by the California Fish and Game Code (Section 3511) as a fully protected species.

Source: USFWS 1997a; CDFG 1996

C-085557

C-085557

indicate that although emergent wetlands occur in seeps and dead-end channels along the eastern bank of the Sacramento River, vernal pools do not occur in the area (Beak 1992).

Potential habitat for the valley elderberry longhorn beetle (VELB) occurs at various locations throughout the project area. VELB is discussed briefly below and is described in more detail in the Biological Assessment (Appendix A).

Valley Elderberry Longhorn Beetle (*Desmocercus californicus dimorphus*) (Federal Threatened) – The VELB is host-specific to elderberry shrubs (*Sambucus* spp.). Elderberry shrubs are most often found in riparian habitat. The VELB depends entirely on the elderberry for its food and reproduction. The first two years of the beetle's life are spent in the spongy pith of the elderberry, first in its larval form and later metamorphosing to the pupa, or chrysalis, phase. Adults emerge from holes (the characteristic shape of which aid in the identification of the presence of this species) in March and feed on the foliage and flowers until late June. Eggs are laid primarily in the bark crevasses of the elderberry shrub in June and the larvae emerge and bore into the plant in 10 days (Arnold et al. 1994). Elderberry shrubs provide the VELB, which is listed as threatened by the USFWS, with its sole source of reproductive habitat and food resources. Because the elderberry is vital to the maintenance and recovery of VELB, a reduction in the quantity of shrubs or quality of elderberry habitat would be considered a potentially adverse impact. Further, impacts which would disrupt the community structure of VELB, including the impedance of genetic flow between populations, would be considered potentially adverse impacts.

Surveys have indicated elderberry shrubs and shrub clusters to occur at 189 sites in the project area (JSA 1996b). Because these recent surveys were conducted in late fall, adults were not observed. Large stands of elderberry were observed during 1993 surveys (Beak 1993) on Montgomery Island. These surveys recorded exit holes, but no adults. Exit holes have been reported at RM 204 and RM 209 (JSA 1987), and possible exit holes were observed during field surveys in 1993 (Beak 1993) on the west river bank at RM 206.

Amphibians and Reptiles

The HEP analysis and species list from USFWS (1997a) identified the threatened giant garter snake (*Thamnophis gigas*) and red-legged frog (*Rana aurora draytonii*) as species potentially affected by activities at the proposed site.

Giant Garter Snake (*Thamnophis gigas*) (Federal Threatened/State Threatened) – The present northern-most extent of the giant garter snake range is in the Llano Seco area south of Chico (G. Wylie, pers. comm., 1997). It is also known from the Sacramento, Delevan, and Colusa national wildlife refuges. Water originating at the HCPP partially supplies these refuges. No locations are identified for this species in the vicinity of the proposed project. This species is described in greater detail in the Biological Assessment (Appendix A).

Red-legged Frog (*Rana aurora draytonii*) (Federal Threatened/State Species of Concern) – The red-legged frog historically resided in the Sacramento Valley (Stebbins 1985). The range of

C—085558

C-085558

these species is now restricted to drainages in the central coast range of California and an isolated location on Pinkard Creek in Butte County (USFWS 1996a). No locations for the species within the vicinity of the proposed project were identified in the California National Diversity Data Base (CNDDB) (CDFG 1996). This species is described in greater detail in the Biological Assessment (Appendix A).

Birds

The USFWS identified seven listed birds with the potential to occur within the project area. Of these, six are considered below, and in detail in the Biological Assessment (Appendix A). The seventh, the little willow flycatcher (*Empidonax trailii brewsteri*), nests in mountainous habitats of northern and central California and would not commonly be found in the project area (McKernan and Whitfield 1994).

Aleutian Canada Goose (*Branta canadensis leucopareia*) (Federal Threatened) – This subspecies has been sighted in Colusa County (CDFG 1996) during flights to and from nesting grounds (Aleutian Islands to the San Joaquin Valley). Aleutian Canada geese winter in California from approximately November through early April. While wintering in California, they gather in harvested fields and forage on winter wheat and remaining post-harvest grains. Nighttime roosting spots are usually in shallow water close to their foraging grounds. In 1990, the USFWS reclassified this subspecies from endangered to threatened. Full recovery of the subspecies is expected to result from the acquisition and preservation and winter habitat in the Central Valley of California (Garrett et al. 1994). The closest recorded population was approximately 8.5 miles to the east of the project site (CDFG 1996).

Swainson's Hawk (*Buteo swainsoni*) (State Threatened) – Swainson's hawks in the Central Valley commonly construct large nests in tall oak, cottonwood, walnut, or willow trees near a riparian area adjacent to their foraging ground. The species breeds in riparian lowlands from Tulare County to northern California, spending the period from mid-March to September in California. Males require large expanses of grassland or agricultural fields (greater than or equal to 2,000 acres) for foraging (Estep 1989).

Swainson's hawk nests are reported from a variety of locations along the Sacramento River. One Swainson's hawk nest was observed on the south end of Montgomery Island during 1993 field surveys (Beak 1993). More recently, a potential nesting pair was observed in cottonwoods along the western bank ~~to~~ of the lower oxbow adjacent to South Island (S. James, pers. comm., 1997; JSA 1997). Suitable habitat for nesting and foraging occurs in several areas within and surrounding the project area.

American Peregrine Falcon (*Falco peregrinus anatum*) (Federal Endangered) – Peregrine falcons prefer open ledges, caves, and potholes on high vertical cliffs as nesting sites. These sites generally overlook rivers, lakes, or the ocean where little cover exists to conceal prey species (Gertsch et al. 1994).

Peregrine falcons do not frequent the Central Valley floor, although occasionally an individual will stray into the valley from the neighboring foothills following a food source. Although resident populations of the peregrine falcon do not occur in the project area, inland mashes and riparian areas with tall trees can play an important role as foraging areas to migrating birds (Gertsch et al. 1994).

Bald Eagle (*Haliaeetus leucocephalus*) (Federal Threatened) – Bald eagles are typically found near open water (e.g., reservoirs, lakes, and rivers). Fish are their primary prey and fall-run and late fall-run chinook salmon are considered to be a principal component of the diet of bald eagles in the project region. Large, dead trees near open water are used for perching and are an important habitat component.

Bald eagles are not common along the Sacramento River, but may use the area for winter foraging. A single bald eagle was sighted periodically during the months of November through February in the vicinity of the HCPP from 1989 to 1991, possibly foraging in the area (P. Ward, pers. comm., 1993). No other records of bald eagle sightings have been made in the area since that time and no nesting sites have been recorded in the surrounding area (Beak 1993).

Western Yellow-Billed Cuckoo (*Coccyzus americanus occidentalis*) (State Endangered) – Yellow-billed cuckoos inhabit riparian forests, preferring large tracts of dense stands dominated by willows and cottonwoods. Nests are commonly placed in dense cover and intermingled with willows. Cuckoos have been sighted on the south end of Montgomery Island and across the Sacramento River between RM 205 and RM 206 (Beak 1992). Suitable habitat for nesting and foraging are present within the project area (Beak 1993). Surveys conducted in June and July 1997 determined that cuckoos were not present in the project area (JSA 1997).

Bank Swallow (*Riparia riparia*) (State Threatened) – The bank swallow prefers nesting colony sites in natural banks, bluffs, and cliffs where erosion, primarily from running water, maintains a vertical surface. The vertical surface discourages growth of vegetation and protects the nest from predation. Soils must be of sand or loam to allow for burrowing (Garrison and McKernan 1994). This species tends to return to the same reach of river, although not necessarily the same bank site, each nesting season (Buechner 1992).

Bank swallows reside in their California breeding grounds from March to early September. Although not dependent on riparian vegetation, the bank swallow is restricted to riparian areas for nesting. Humphrey and Garrison (1986) identified bank characteristics and riparian conditions between RM 143 and RM 243 as the most suitable nesting habitat for this species in California. Field surveys conducted in 1993 indicated active nesting colonies along the west bank of the Sacramento River between RM 203.0 and 203.1, and at RM 201.5 (Beak 1993). Two colonies were identified in 1992 north of the proposed project area near RM 209 (Beak 1992). A bank swallow colony was also reported at RM 205.5 in 1989 and 1990 (ECOS 1991). One bank swallow was reported using a burrow on a newly eroded bank immediately downstream of the fish screen on May 6, 1997 (G. Stern, pers. comm., 1997). Follow-up surveys indicated no nesting colonies at this site or elsewhere within the project area (JSA 1997).

C-085560

C-085560

Mammals

There are no Federal or State threatened, endangered, or proposed threatened or endangered mammal species identified within the general area of the proposed project.

3.5.6.2 Species of Concern

The CDFG provides, through CNDDB, a listing of organisms that, although not listed, proposed for listing, or candidate species, are considered species of special concern. The USFWS provides similar information. Further, CNPS provides a listing of rare species that must be analyzed for potential impacts. Species in these categories having the potential to occur in the general area of the proposed project are summarized in **Table 3.5-2**. These species are, in general, typical to riparian and wetland habitats. These species were all identified by USFWS as potentially occurring in the general area of the proposed project (USFWS 1997a). Data from CDFG gives specific species occurrences (CDFG 1996).

Of those species identified by USFWS and CDFG as potentially occurring in the general area of the project, many do not actually occur, nor is there suitable habitat in the project vicinity. Those that are known to occur in the project area, or those for which suitable habitat has been described in the project area, are described below. Unless noted otherwise, specific surveys have not been conducted for the species discussed below.

Rose-mallow (*Hibiscus lasiocarpus*) (CNPS 2) – The rose-mallow, or California hibiscus, is an emergent, rhizomatous, perennial herb which produces large white flowers from August through September. It is found in small occurrences in freshwater marsh habitat (Skinner and Pavlik 1994). Riverbank alteration is the primary reason for the decline of this species.

Sanford's arrowhead (*Sagittaria sanfordii*) (Federal Species of Concern/CNPS 1B) – This species is an emergent, rhizomatous, perennial herb which grows in shallow freshwater marsh and ditches. It has been extirpated from most of its range within the Central Valley (Skinner and Pavlik 1994). Reasons for the decline include channel alteration, grazing, and development. Sanford's arrowhead blooms from May through August.

Northwestern pond turtle (*Clemmys marmorata marmorata*) (Federal and State Species of Concern) – The northwestern pond turtle ranges from Washington State to the Central Valley. It is an aquatic turtle residing in ponds, marshes, irrigation ditches, rivers, and streams with a high degree of aquatic vegetation. The species is omnivorous, feeding on plants, insects, aquatic invertebrates, fish, frogs, and carrion. Eggs are laid from April to early August (Stebbins 1985). Northwestern pond turtles have been observed in the channel between Montgomery Island and South Island, as well as at RM 209.7 and RM 206.5 (Beak 1993).

Table 3.5-2 - Terrestrial Species of Concern Potentially Occurring in the Project Area		
Resource	Common Name	Status Federal[a]/State[b]/CNPS[c]
Plants		
Astragalus tener var. *ferrisiae*	Ferris's milk vetch	SC/--/1B
Atriplex joaquiniana	Valley spearscale	SC/--/1B
Delphinium recurvatum	Recurved larkspur	SC/--/1B
Fritillaria pluriflora	Adobe lily	SC/--/1B
Hibiscus lasiocarpus	Rose-mallow	--/--/2
Paronychia ahartii	Ahart's paronychia	SC/--/1B
Sagittaria sanfordii	Sanford's arrowhead	SC/--/1B
Invertebrates		
Anthicus antiochensis	Antioch Dunes anthicid beetle	SC/--/--
Anthicus sacramento	Sacramento anthicid beetle	SC/--/--
Amphibians and Reptiles		
Scaphiopus hammondii	Western spadefoot toad	SC/CSC/--
Clemmys marmorata marmorata	Northwestern pond turtle	SC/CSC/--
Birds		
Athene cunicularia hypugea	Western burrowing owl	SC/CSC/--
Buteo regalis	Ferruginous hawk	SC/--/--
Dendroica petechia	Yellow warbler	--/CSC/--
Icteria virens	Yellow-breasted chat	--/CSC/--
Pandion haliaetus	Osprey	--/CSC/--
Plegadis chihi	White-faced ibis	SC/CSC/--
Mammals		
Myotis ciliolabrum	Small-footed myotis bat	SC/--/--
Myotis evotis	Long-eared myotis bat	SC/--/--
Myotis thysanodes	Fringed myotis bat	SC/--/--
Myotis volans	Long-legged myotis bat	SC/--/--
Myotis yumanensis	Yuma myotis bat	SC/--/--
Perognathus inoratus	San Joaquin pocket mouse	SC/CSC/--
Plecotus townsendii pallescens	Pale Townsend's big-eared bat	SC/CSC/--
Plecotus townsendii townsendii	Pacific western big-eared bat	SC/CSC/--

[a] Federal: SC = Species of Concern
[b] California: CSC = Species of Concern
[c] California Native Plant Society (CNPS): 1B = Rare, threatened, or endangered in California or elsewhere; 2 = Rare, threatened, or endangered in California, but more common elsewhere

C-085562

C-085562

Ferruginous hawk (*Buteo regalis*) (Federal Species of Concern) – This is a large, narrow winged buteo of broad plains and prairies. Ferruginous hawks prefer prairies and brushy open country where the primary food source is small mammals (Udvardy 1977). Although the ferruginous hawk has a fairly broad range overall, individuals tend to be very local. The range was formerly much more extensive for this species. Ferruginous hawks winter in the Central Valley (Peterson 1990).

Yellow warbler (*Dendroica petechia*) (State Species of Concern) – This small warbler is found most commonly among willows and alders in riparian habitats. It may also inhabit woodlands, gardens, and orchards. Within the warbler family, it has the most extensive yellow coloration. A yellow warbler was observed foraging at RM 209.4 near the project area (Beak 1993).

Yellow-breasted chat (*Icteria virens*) (State Species of Concern) – Looking rather wren-like with an upturned tail, this is the largest species in the warbler family. Yellow-breasted chat prefer dense shrubs or thickets along streams and rivers for nesting (Peterson 1990). This species was observed using habitat near the project area at RM 209.4 (Beak 1993).

Osprey (*Pandion haliaetus*) (State Species of Concern) – The osprey is a raptor which will nest in large snags, broken-top trees, or other open, tall structures near the water. Although the species preys primarily on fish, they have been seen to take rodents, birds and small invertebrates (Ehrlich et al. 1988). An active osprey nest was noted in the project area at RM 209.7 during surveys in 1992 (Beak 1992).

White-faced ibis (*Plegadis chihi*) (Federal and State Species of Concern) – The white-faced ibis is a wading bird in freshwater marshes, irrigated land, and tules. It has a long recurved bill for probing the soft bottom for prey items such as crayfish and also will feed on grasshoppers and frogs in wet fields (Udvardy 1977).

Long-eared myotis bat (*Myotis evotis*) (Federal Species of Concern) – The long-eared myotis bat inhabits thinly forested areas around either buildings or trees, and only occasionally in caves. These bats generally fly later in the evening. Colonies are generally relatively small (Burt and Grossenheider 1980).

Long-legged myotis bat (*Myotis volans*) (Federal Species of Concern) – This species of bat lives in trees, buildings, small pockets, and rock ledges. Flight is less erratic than most myotis (Burt and Grossenheider 1980). They commonly forage over water and in openings in the woods.

Yuma myotis bat (*Myotis yumanensis*) (Federal Species of Concern) – The Yuma myotis is a late-flying bat which forages close to the ground. This species is more closely associated with water than other North American bats. Although the Yuma myotis may be locally abundant, it may be absent from other areas which may appear to provide suitable foraging habitat. Night roosts are commonly in buildings. The availability of appropriate day roosts, therefore, may be an important factor in the distribution of this species (Barbour and Davis 1969).

C-085563

C-085563

San Joaquin pocket mouse (*Perognathus inoratus*) (Federal and State Species of Concern) – The San Joaquin pocket mouse is only found in the San Joaquin and Sacramento valleys. It is nocturnal and adapted for arid conditions. The species burrows into the ground for shelter and seed storage, preferring fine-textured soil (Burt and Grossenheider 1980). It is found in dry, open, grassy or weedy areas.

Pacific western big-eared bat (*Plecotus townsendii townsendii*) (Federal and State Species of Concern) – This race of *P. townsendii* is more commonly found in areas of the Pacific Northwest (Barbour and Davis 1969). Individuals can be found during the day in caves, mine shafts or in the attics of buildings. The species never roosts in crevices, but always hangs from the ceiling. It is colonial in nurseries and will often segregate during other portions of the year (Burt and Grossenheider 1980). The ears of the species are extremely large. These bats are extremely sensitive to disturbance by humans (Beak 1993).

3.5.7 Off-Site Mitigation Areas

Several off-site parcels have been preliminarily identified (Figure 2.4-6; Section 2.4.2.3, Screen Extension Mitigation) as having the physical and/or biological conditions (e.g., soils, proximity to the Sacramento River, restorable orchards) suitable for mitigation of impacts to terrestrial biological resources that could result from the fish screen improvement project.

The possibility exists at each parcel to restore orchards to riparian habitat. Portions of the shorelines of the larger parcels contain stretches of unarmoured, partially or totally unvegetated erodable bank habitat.

Revetted shoreline of the larger parcels could be improved through plantings, thus providing overhanging cover and increasing habitat values. Although the riprap would not be removed from these shorelines, the potential for increased riparian and Shaded Riverine Aquatic Cover habitat values are possible through planting within the riprap.

Of the off-site mitigation options, the lead agencies propose to acquire and improve aquatic/terrestrial habitat conditions on Parcel No. 037-100-002 south of and adjacent to the lower oxbow. The property is predominantly walnut orchard with the potential for riparian, SRA Cover and wetland habitat improvements. Section 2.4.2.3 (Screen Extension Mitigation) describes the proposed off-site mitigation plan for this property.

C—085564

C-085564

3.6 Visual Resources

3.6.1 Introduction

This section presents information on the existing visual setting and on sensitive visual receptors within the project area.

3.6.2 Regulatory Setting

There are no regulatory entities with jurisdiction over visual resources.

3.6.3 Regional Setting

The project area is located in a rural setting adjacent to the Sacramento River. Prominent visual features include the existing Hamilton City Pumping Plant (HCPP) facilities, the Sacramento River, the intake channel (upper oxbow) for the HCPP, surrounding agricultural fields, and local roads. Sensitive visual receptors include local residents and river recreationists.

3.6.4 Local Setting

The following sections provide background information for the project area relative to visual resources as presented in Section 2.6 (Issues Identified and Considered in EIR/EIS Process).

3.6.4.1 Sensitive Visual Receptors

Nearby residents and recreationists are the people most likely to use and be sensitive to views of the project area. The oxbow is posted as a private waterway, therefore the majority of the existing facility is within the viewshed of local residents.

The most common recreationists to use or pass through the project area are boaters, anglers, and hunters. These viewers are likely to be the most sensitive to, and appreciative of, the naturalistic setting of the project area (Section 3.4, Recreation and Navigation). Some nearby residents own small docks on the oxbow and Sacramento River within the project area. As these individuals travel to and from their destinations, they could pass through and view the project area. Portions of the project area can also be seen by residents from their homes and yards on the west side of the river channel adjacent to the upper oxbow channel. There are a total of approximately 7 residences within 1/4 mile and 20 residences within 1/2 mile of the potential project features.

The project area is not easily accessed from the land by the general public. The site is remote and cannot be generally characterized as a destination for travelers, with the exception of recreationists.

C-085565

C-085565

3.6.4.2 Visual Setting

Vegetation and Natural Setting

The Sacramento River is the largest and most naturalistic landscape component within the area and includes riparian vegetation, steep banks, rocky beaches, and gravel bars. The quality of vegetation along the river generally appears to be a mix of native riparian species, creating many visually interesting shoreline conditions. Although agricultural fields are within close proximity, the river's steep banks and riparian vegetation limit views from the river to these fields.

Within the project area, the Sacramento River flow splits around Montgomery Island and the upstream tip of the island serves as a landmark. The western banks of the oxbow channel are steep and are covered with dense vegetation. The eastern bank of the channel consists of a gravel berm of varying heights made up of dredge spoils. The gravel berm downstream of the fish screen includes riprap facing. The guide berms help to maintain flow velocities in the oxbow both upstream and downstream of the fish screens.

The eastern bank of Montgomery Island consists of flat lowlands and steep banks. The western bank (the bank adjacent to the oxbow channel) appears natural, but has been disturbed regularly by dredging equipment for the storage of spoils, for earthwork, and for access road use. The center of the island is covered with both dense riparian vegetation and large open grassland areas.

Presence of Riprap

Riprap is present within the project area (Figure 3.1-8) and includes sections along Montgomery Island across from the existing fish screen, around the existing internal fish bypass outfall, and along the lower oxbow channel to the Sacramento River.

Dredging

The upstream oxbow channel is the intake for HCPP diversions and, while of natural origins, is dredged frequently and has been extensively maintained over the last approximately 80 years. Currently, an approximately 24 by 60-foot barge is used to complete the dredging operations. This gravel and sediment removed from the oxbow channel are placed in a spoils stockpiling area on Montgomery Island. This stockpiling area reaches an approximate maximum height of 25 feet high (B. Pennock, pers. comm., 1997). Most dredge spoils were washed away during the January 1997 flood flows, considerably reducing the size of the spoil pile (Mussetter 1997).

HCPP Facilities

The HCPP facilities are located on the western side of the oxbow channel approximately 3,000 feet from the Sacramento River. The facilities consist of two prominent structures: a fish screen and a pumping plant. The pumping plant would not be affected by the project alternatives; therefore, its visual character is not described in detail. The fish screen (**Figure 3.6-1**) stands out in contrast to the riparian character of the oxbow channel and the surrounding rural landscape.

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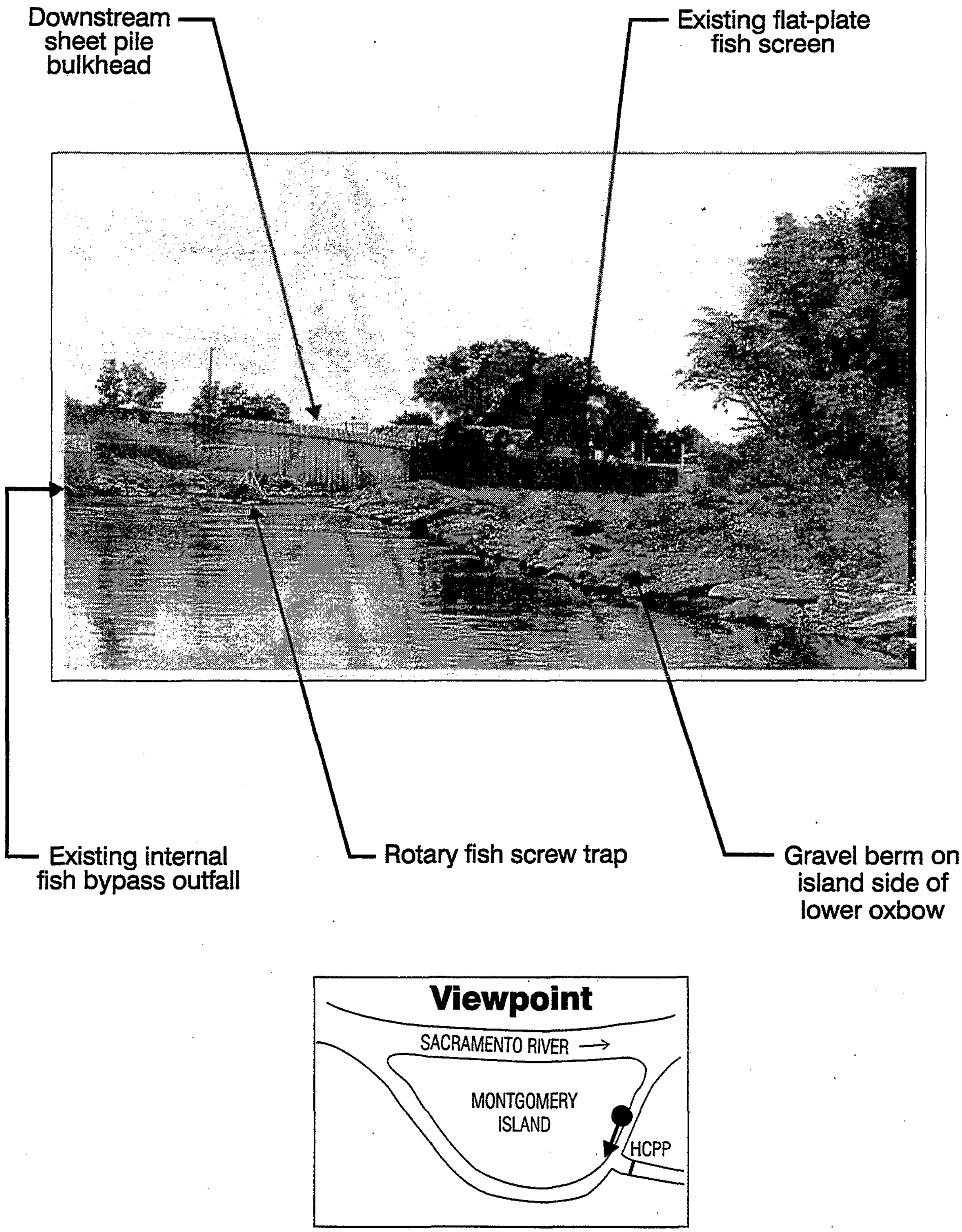
C-085566

FIGURE 3.6-1. VIEW OF HAMILTON CITY PUMPING PLANT FISH SCREEN



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This structure consists of two distinct structural elements: a primary screen structure and adjacent sheet pile bulkheads.

The primary screen structure is a 475-foot long concrete and steel-framed abutment divided evenly by intake bays. The deck of the structure, which includes a service road, light fixtures, and a safety fence, is approximately 26 feet above the oxbow invert. The invert is approximately 8 feet below the low water surface in the oxbow. From a distance, the structure appears to be a dark, solid wall or embankment. However, from a closer vantage point, the flat-plate screens and horizontally operating screen wipers can be seen. The screen structure is flanked upstream and downstream by two lightly colored sheet-pile bulkheads that are approximately 200 and 300 feet long and 20 feet tall. The upstream bulkhead is capped by a concrete wall that varies in height from approximately four to six feet. Because of their light color and height, the bulkheads are visually prominent, particularly on the west side of the screen. Cranes, heavy equipment, and small metal buildings and shops can be seen in this area from local public roads. Across from the service yard, at the intersection of First Avenue and Cutler Avenue, is a Glenn-Colusa Irrigation District (GCID) triangle-shaped parcel of land that has been used as a temporary storage area. The parcel is approximately 14 acres and is characterized by disturbed grassland with some large trees.

The service yard area has the general appearance of an industrial facility, with very few natural characteristics. The facility is in a remote location and is normally seen only by local residents, visitors to the fish screen, and anglers using the upper or lower oxbow.

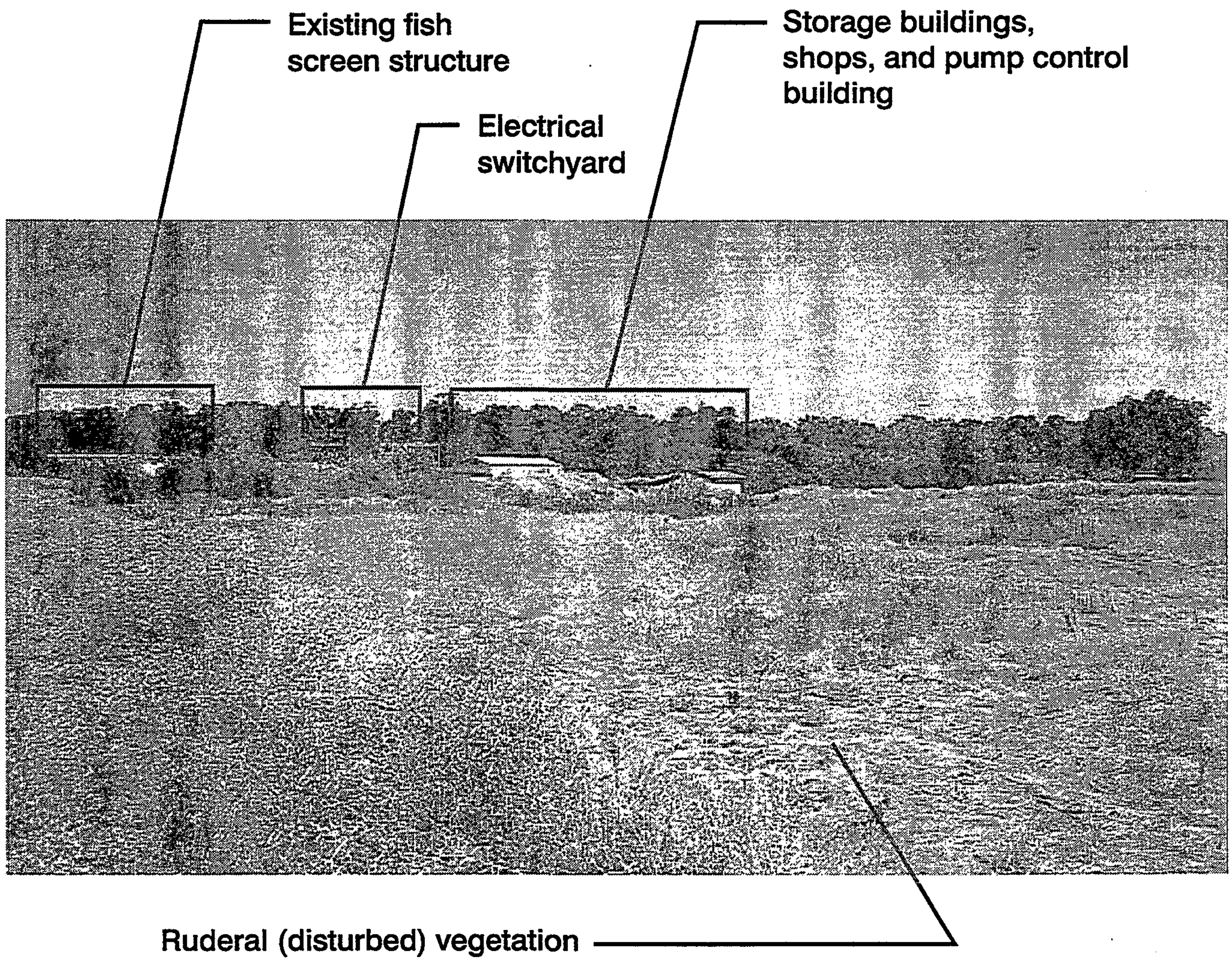
Figure 3.6-2 shows the HCPP service yard from a distance looking east across Parcel No. 037-090-007 near the intersection of First Avenue and Cutler Avenue. The parcel shown is GCID's land, which is proposed as a staging area (Section 2.4.1.1, No-Project Construction Activities and Schedule) and optional dredge spoil processing/stockpiling location (Section 2.4.1.2, No-Project Operations and Maintenance). This land is a disturbed site and is currently vacant.

3.6.5 Key Viewpoints

Three key viewpoints representing the views of sensitive visual receptors within the project area are presented on **Figure 3.6-3**, for further analysis in Chapter 4, Impact Analyses. Viewpoints #1 and #2 represent the views of boating recreationists on the Sacramento River within the project area. Viewpoint #3 represents the view of residents on the west side of the river channel near the upstream end of the upper oxbow channel.

Viewpoint #1 (Figure 3.6-3) is looking south just upstream of the divergence of the Sacramento River and the upper oxbow channel. From this viewpoint, the oxbow channel with its vegetative growth on the western banks can be clearly seen to the west, but the existing fish screens cannot be seen. The gravel tip of Montgomery Island is visible in the foreground to the south. Montgomery Island's dense riparian vegetation is visible in the background, as is evidence of unimproved gravel roads and spoils from dredging activities. The view to the east includes a

FIGURE 3.6-2. CONSTRUCTION STAGING AREA / ALTERNATIVE DREDGE SPOILS LOCATION ADJACENT TO THE HAMILTON CITY PUMPING PLANT



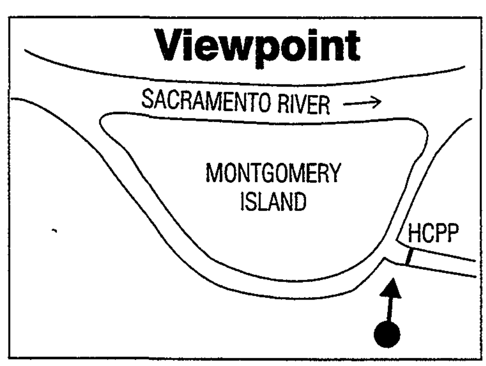


Photo taken from west side of 14-acre parcel (No. 037-090-007) looking east towards the Hamilton City Pumping Plant service yard.

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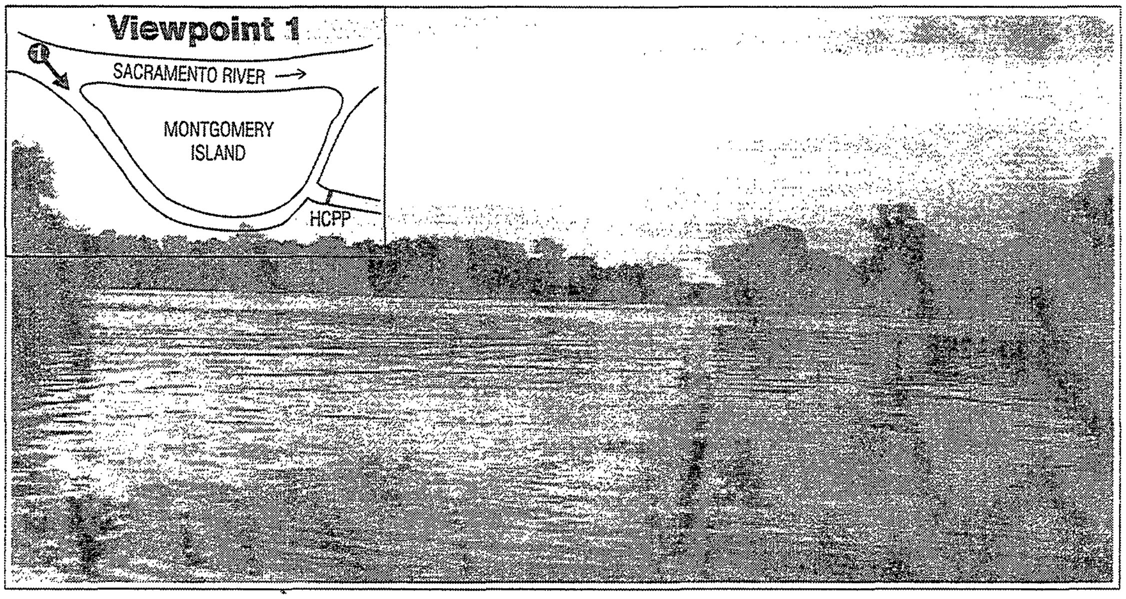
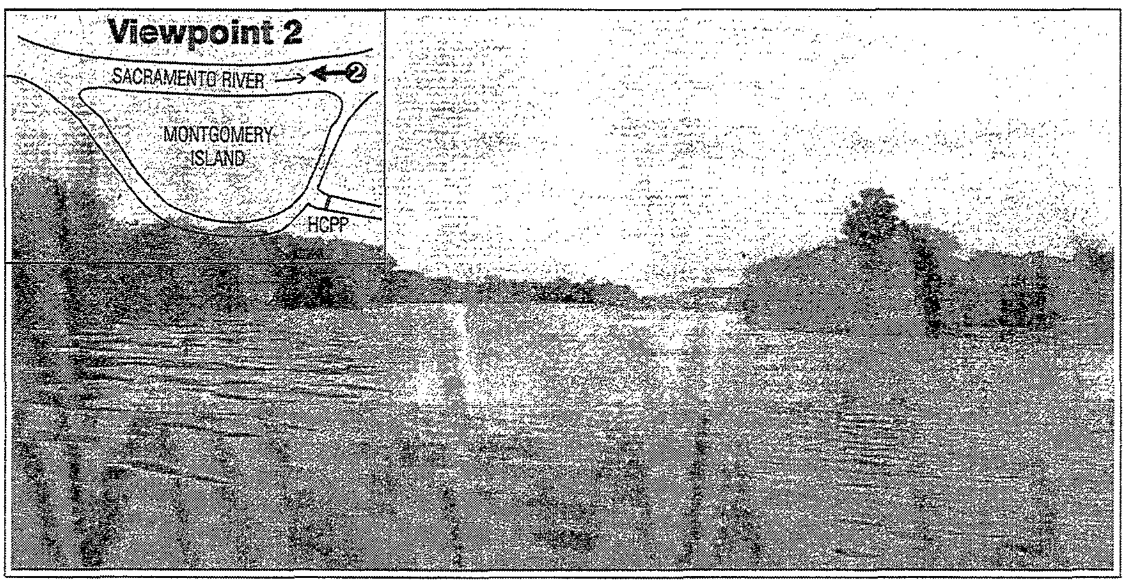
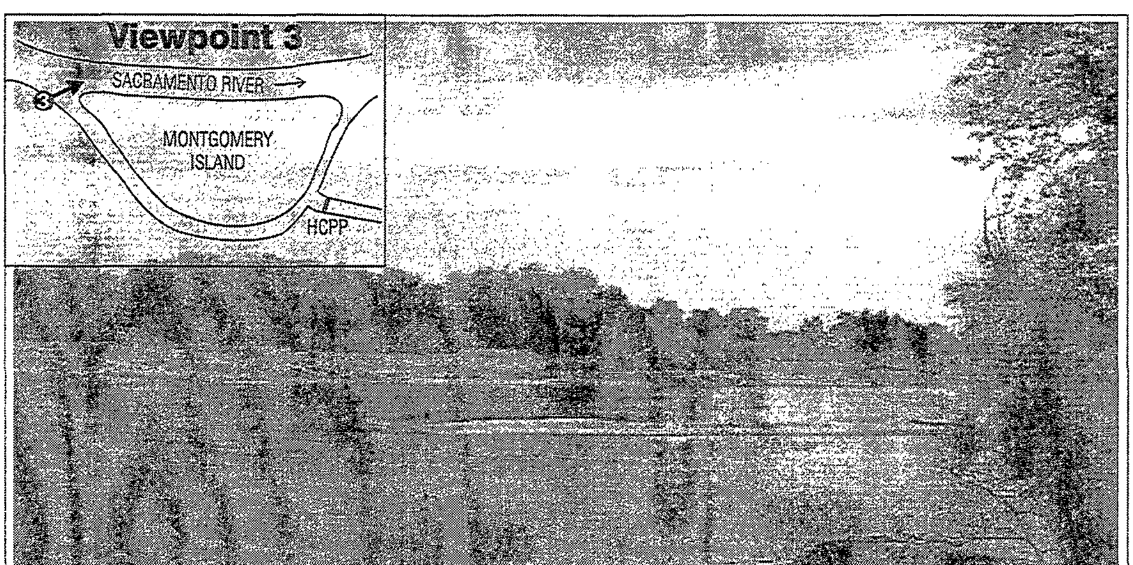
FIGURE 3.6-3. KEY VIEWPOINTS WITHIN THE PROJECT AREA







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sparsely vegetated gravel bar, which forms a portion of the riverbank, and a densely vegetated strip along the high water river bank parallel to the river.

Viewpoint #2, as shown in Figure 3.6-3, is looking north, just downstream of Montgomery Island, near the confluence of the lower oxbow and the Sacramento River. From this location, the view to the west is dominated by an opening in shoreline vegetation where the oxbow rejoins the Sacramento River. The area immediately adjacent to the channel and further to the north is overgrown with riparian vegetation. To the south, orchards grow near the water's edge.

Upstream, the overgrown eastern bank of the Sacramento River can be seen in the foreground, while in the background the southern portion of an upstream gravel bar is evident. Viewpoint #3, as shown in Figure 3.6-3, is looking southeast from the western bank of the Sacramento River (resident's backyard) near the upstream end of the upper oxbow channel. From this viewpoint, the Sacramento River and adjacent gravel bar and densely vegetated strip along the high water river bank can be seen to the east. To the south, views are dominated by the gravel tip and dense riparian vegetation of Montgomery Island. The upper oxbow channel is visible from this viewpoint, although the existing fish screens cannot be seen.

3.7 Land Use

3.7.1 Introduction

This section describes the regulatory, regional, and local land use setting, including local land use plans, ownership, and existing land uses. For purposes of addressing land use in this EIR/EIS, the project study area is generally defined as those lands or land uses that could experience a substantial change as a result of proposed facilities or mitigation actions, or changes in water supply availability or quality.

3.7.2 Regulatory Setting

The primary regulatory agencies concerned with land use in the project study area are Glenn, Butte, Tehama, and Colusa counties. In accordance with State law, each of these local governments have adopted general plans and zoning ordinances. The general plans provide policy direction regarding land use and the zoning codes provide specific mechanisms to implement general plan policies. Specific zoning and general plan land use designations for the project area are described below.

The State Lands Commission (SLC) may also exercise land use permit authority over lands in the project area. SLC authority is unclear at this time, because property boundaries have been made uncertain by movement of the Sacramento River channel.

3.7.3 Regional Setting

As described in Section 1.1, Project Location, the area potentially affected by construction, operation, and maintenance of the project would include irrigated lands to the west of the Sacramento River between the Red Bluff Diversion Dam (RBDD) and the Colusa Basin Drain (Figure 1.1-1). Included in this area are the service areas of Glenn-Colusa Irrigation District (GCID) and other water districts and the area serviced by the Tehama-Colusa Canal (TCC), a Central Valley Project facility. The GCID service area extends from approximately Hamilton City in the north to Williams in the south, and is generally bordered by the Sacramento River on the east and Interstate 5 on the west (Figure 3.1-2). Lands in the GCID service area and throughout the regional project area are typically in agricultural production and include a high proportion of prime and State-designated important farmlands (Glenn County 1993b; Colusa County 1989). These lands are designated primarily as Agricultural-Intensive and General Agriculture in the Glenn County and Colusa County general plans, respectively. Other notable land uses in the regional project area include the Sacramento, Delevan, and Colusa national wildlife refuges.

3.7.4 Local Setting

The Hamilton City Pumping Plant (HCPP) site is located near the intersection of boundaries for Glenn, Butte, and Tehama counties. Areas that could be affected by off-site mitigation requirements include sites both upstream and downstream of the HCPP, as shown in Figure 2.4.6.

3.7.4.1 Land Use Regulations

Glenn County

Project study area lands located in Glenn County are classified as Agricultural-Intensive in the Glenn County General Plan. The Agricultural-Intensive classification identifies areas suitable for commercial agriculture, which provides a major segment of the county's economic base. The classification is designed to encourage the preservation of agricultural land, both currently in production and potentially in production, which contain State-designated important farmlands. The zoning designation under the Agricultural-Intensive classification is Exclusive Agricultural, with a minimum parcel size of 40 acres.

Butte County

Project study area lands located in Butte County are classified Orchard and Field Crop in the Butte County General Plan. The Orchard and Field Crop classification is used to identify those areas where it is desirable to preserve agriculture as the primary land use. Two zoning designations apply: (1) Agricultural with a minimum parcel size of 160 acres, and (2) Agricultural with a minimum parcel size of 40 acres. Public facilities are considered permitted uses in this zoning designation (L. Painter, pers. comm., 1996).

Tehama County

Project study area lands located in Tehama County are classified as Cropland in the Tehama County General Plan. These lands are zoned Exclusive Agriculture, generally with a minimum parcel size of approximately 19 acres. Montgomery Island, in Tehama County, is classified as Habitat Resource. The purpose of this land use designation is to protect and maintain documented, significant wildlife habitats for their aesthetic and ecological values. According to the Tehama County General Plan, the land should remain in its natural state, yet may allow grazing, wilderness study, and passive recreational activities provided that these activities do not threaten the integrity of the habitat. The Habitat Resource land use is zoned Primary Floodplain. Uses allowed in this zone include agricultural and certain public facilities improvements (e.g., pipelines).

Off-Site Mitigation Areas

Potential off-site mitigation areas (as shown on Figure 2.4-6 and discussed in Section 2.4.2.3, Screen Extension Mitigation) are designated primarily for agricultural purposes in the general plans of Glenn, Butte, Tehama, and Colusa counties, with specific designations matching the categories described above. A review of zoning designations for specific properties indicates that zoning of these sites is also for agricultural purposes.

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3.7.4.2 Land Ownership/Existing Land Uses

HCPP Project Area

Existing land use in the project study area is primarily agricultural and associated rural residential. Ownership boundaries of lands adjacent to the HCPP are illustrated on **Figure 3.7-1.** Assessor parcel number and size information are listed in **Table 3.7-1.** Parcel boundaries adjoining the Sacramento River and the oxbow are unclear due to channel changes in the Sacramento River, and require detailed real estate investigations.

Table 3.7-1 - List of Property Owners

Reference Number	County	Assessor's Parcel Number	Acres
1	Tehama	091-250-30	1.12
2	Tehama	091-250-03	11.61
3	Tehama	091-250-04	2.00
4	Tehama	091-250-21	3.21
5	Tehama	091-250-22	2.10
6	Tehama	091-250-16	1.57
7	Tehama	091-250-08	3.76
8	Tehama	091-250-09	0.79
9	Tehama	091-250-27	0.77
10	Tehama	091-250-28	2.48
11	Tehama	091-250-24	0.3
12	Tehama	091-250-23	5.15
13	Tehama	091-250-31	2.99
14	Tehama	091-250-15	20.00
15	Tehama	091-250-32	2.00
16	Tehama	091-240-11	25.00
17	Tehama	091-240-12	15.60
18	Glenn	037-043-001	19.34
19	Glenn	037-043-002	7.6
20	Glenn	037-044-001	73.80
21	Glenn	037-043-003	33.19
22	Glenn	037-090-007	22.39
23	Glenn	037-090-003	6.80
24	Glenn	037-090-004	17.15
25	Glenn	037-090-005	16.05
26	Glenn	037-100-002	71.70
27	Glenn	037-090-008	44.23
28	Butte	047-400-002	532.00
29	Butte	047-400-003	993.10

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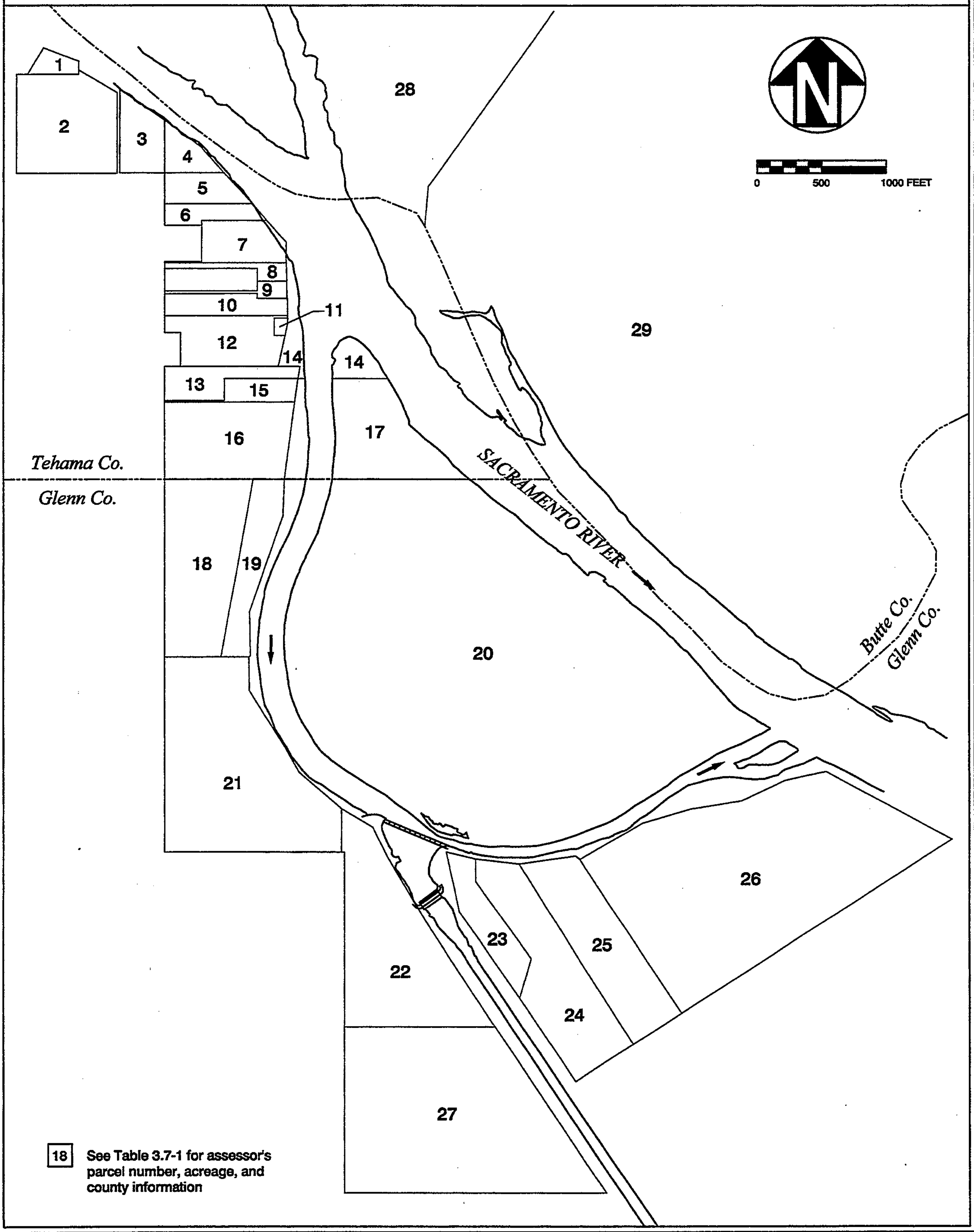
FIGURE 3.7-1. LAND OWNERSHIP IN VICINITY OF HAMILTON CITY PUMPING PLANT



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Parcels located near the HCPP in Glenn County range from about 7 to 70 acres in size, and appear to be used primarily for agricultural production. There are various on-site structures, including residences, on some of the parcels. Agricultural land uses abut the remainder of the oxbow, with the exception of the HCPP facilities. Montgomery Island in Glenn County is entirely passive open space. Lands to the east of the HCPP in Butte County are entirely agricultural, consisting of 2 large parcels totaling about 1,500 acres. Agricultural uses are buffered from the project area by riparian lands. Parcels to the north of the HCPP in Tehama County include rural residential uses; these residential uses are located near the west bank of the Sacramento River upstream of the north entrance to the oxbow. About 10 to 15 parcels are found in this area. Montgomery Island in Tehama County is passive open space.

Off-Site Mitigation Areas

The potential off-site mitigation areas discussed in Section 2.4.2.3 (Screen Extension Mitigation) and shown on Figure 2.4-6 are largely privately owned. Because of the location of these sites along the Sacramento River corridor, many of the sites remain undeveloped. Prevailing land uses are riparian forest, orchards, and row crops.

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3.8 Noise

3.8.1 Introduction

This section describes the affected environment with respect to noise, including existing noise sources and sensitive receptors (i.e., residential areas). For purposes of addressing noise in this EIR/EIS, the project study area is defined as the immediate vicinity of the Hamilton City Pumping Plant (HCPP) where construction activities may increase noise above ambient conditions.

3.8.2 Regulatory Setting

Glenn, Butte, and Tehama counties do not regulate construction noise in agriculturally zoned areas (C. Leighton, L. Painter, and J. Reed, respectively, pers. comm., 1996). In terms of average daily noise levels (generally not construction-related), the noise elements of the Butte, Glenn, and Tehama county general plans describe 60 decibels (dBA) as the noise level that is typically acceptable in residential areas.[2]

3.8.3 Regional Setting

Ambient noise levels are low in the region. Farming equipment and crop dusting activities are the principal contributors to daytime ambient noise levels. If peak noise levels and nighttime sensitivity are factored in, average daily noise levels are about 48-60 dBA (Glenn County 1993a). **Table 3.8-1** provides a basis for comparing typical noise sources to ambient conditions.

3.8.4 Local Setting

Ambient noise levels in the project area are estimated to be at the low end of the range described in the Glenn County General Plan, or about 48 dBA. Noise sources in the project study area include HCPP electric pumps, which emit buzzing sounds with a noise level of 60 dBA at 50 feet (ECOS 1991). Other sources of noise include vehicle traffic (Section 3.11, Transportation and Traffic Safety), dredging, and other HCPP operations. Table 3.8-1 includes selected noise measurements taken on August 12, 1997 in the project area.

Beyond Glenn-Colusa Irrigation District operator housing, the nearest residences to the HCPP are located about 1,350 feet to the southeast along Montgomery Avenue. This distance effectively attenuates noise from the pumps to an imperceptible level. Additional residences are located along the west bank of the upper oxbow in Tehama County in close proximity to Montgomery Island and the west bank of the Sacramento River. The proximity of these residences to potential project construction sites ranges from about 850 feet to over 1 mile. There are no residences along the east bank of the Sacramento River in the project vicinity.

[2] The 60 dBA standard described in the general plans is based on an average daily measurement.

Table 3.8-1 - Typical Noise Sources and Levels

Noise Source	Decibels, A-Weighted	Subjective Description
Civil Defense Siren at 100 Feet[a]	140	DEAFENING
Commercial Jet Takeoff at 200 Feet[a]	130	
Amplified Rock 'n Roll Band[a]	120	
Gas Lawn Mower at 3 Feet[a]	90	VERY LOUD
Garbage Disposal at 3 Feet[a]	80	
Freight Train at 100 Feet[a]	70	LOUD
Canal Road at Bridge (Mild Traffic)[b]	63	
Sacramento River at Confluence of Lower Oxbow (Boat About 50 Yards Distant)[b]	63	
First House on Right going North on Canal Road (Mild Traffic)[b]	62	
Sacramento River Between Residences and Northern Tip of Montgomery Island (No Boats In Area)[b]	61	
Normal Speech at 3 Feet[a]	60	
Corner of First Avenue and Cutler Avenue (No Traffic)[b]	59	MODERATE
House East of Canal Road Bridge Crossing of Canal (No Traffic)[b]	58	
Typical Business Office (Interior)[a]	50	
Small Theater[a]	40	
Soft Whisper at 5 Feet, Library[a]	30	FAINT
Rustling Leaves[a]	20	
Human Breathing[a]	10	VERY FAINT
Threshold of Hearing[a]	0	

a American Association of State Highway and Transportation Officials (1970).
b Ambient noise measurements in project vicinity taken on August 12, 1997.

In addition to typical ambient noise sources, dredging occurs in the oxbow about once a year in the springtime. Dredging typically takes place for 12 hours per day and can last up to two months, depending on river runoff conditions (B. Pennock, pers. comm., 1996). Noise level measurements from dredge activities are not available from the literature, but are expected to be roughly equivalent to stationary pump noise (75 dBA at 50 feet). For purposes of characterizing existing levels, noise from the annual dredging activities (which includes dredge equipment and earth-moving equipment) is roughly estimated at between 65 and 70 dBA at the residences that abut the upper oxbow in Tehama County. Some residences are located about 100 feet from the edge of the upper oxbow channel.

3.9 Cultural Resources

3.9.1 Introduction

This section discusses prehistoric, ethnographic, and historic background and context for the proposed project and its various components. Much of this data derives from anthropological, archaeological, and historic studies conducted over the past several decades. This section summarizes information concerning known prehistoric and historic sites and features located within the project's Area of Potential Effect (APE) **(Figure 3.9-1)** as defined for cultural resources discussions.

3.9.2 Regulatory Setting

The proposed project constitutes an "undertaking," according to Federal and State definitions, which needs to be evaluated to ensure that properties listed or eligible for listing on the National Register of Historic Places are not adversely affected. Since Federal jurisdiction is involved, evaluation of the potential impacts of the project to historic properties must be undertaken in conformity with Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations (36 CFR Part 800), Section 2(b) of Executive Order 11593, Section 101(b)(4) of the National Environmental Policy Act, the Archaeological Resources Protection Act, the Native American Grave Protection and Repatriation Act of 1990, and other rules and regulations. In addition, Public Resources Code Sections 21083.2 and 21084.1 and CEQA Guidelines Appendix K include provisions specific to the analysis, consideration, and mitigation of potential effects to cultural resources. Regulations include requirements to consult with native peoples and analyze ethnographic history as part of the process to determine if cultural resources are present in the project area.

There are no Historic District or other boundaries involving the APE which require assessment of cultural resources in relation to a Memorandum of Agreement, a Programmatic Agreement, or other special agreements or contracts.

3.9.3 Regional Setting

Several types of information were considered relevant to evaluating the types of archaeological sites which might be encountered within the project area. At the regional level, information considered relevant includes data on prehistory and ethnography, as well as previous archaeological survey reports involving the project area (Peak & Associates 1995); this data is useful in locating areas which might contain archaeological sites. Historic events and persons are considered relevant at the local level, and are discussed below in Section 3.9.4 (Local Setting).

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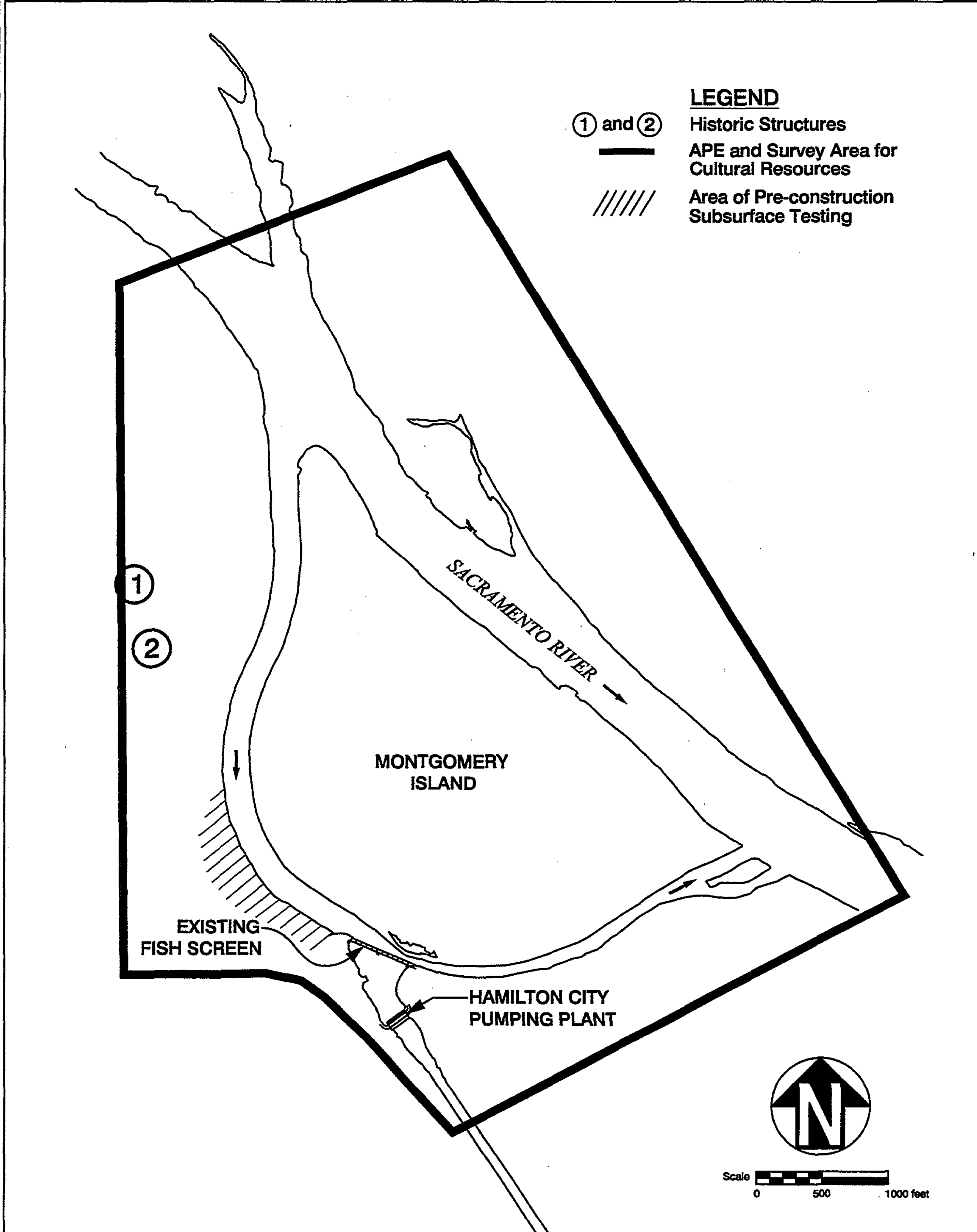
FIGURE 3.9-1. AREA OF POTENTIAL EFFECT FOR CULTURAL RESOURCE STUDIES AND SURVEY



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3.9.3.1 Prehistory

One of the earliest clearly dated contexts for human occupation in north central California is from site CA-SHA-475 located north of Redding on Squaw Creek, where a charcoal based C-14 date suggests initial Native American presence within this area around 6,500 years ago. Most of the artifactual material dating to this time period suggests cultural affiliation with the Borax Lake area -- the presence of large wide-stemmed projectile points, manos and metates being the most prominent and distinctive artifact types represented. Within the northern Sierra Nevada and the Oroville Locality, this early culture has been archaeologically defined as the Martis Complex, a wide-spread prehistoric culture which may first have entered the area around 2,000 to 3,000 years ago and possibly spoke a Hokan dialect.

Sometime around A.D. 200-400, the first major disruption of these Hokan-speaking peoples by Penutian immigrants occurred. Arriving ultimately from southern Oregon and the Columbia and Modoc Plateau region and proceeding down the major drainage systems (including the Feather, Yuba, American, and Sacramento rivers), these Penutian-speaking arrivals may have displaced the Martis populations, especially along the major river systems. Presumably introduced by these later arrivals were more extensive use of bulbs and other plant foods, animal and fishing products more intensively processed with mortars and pestles, and perhaps the bow and arrow and associated small stemmed- and corner-notched projectile points.

An even earlier arrival of Penutian-speaking peoples has been long suggested (Ragir 1972) on the basis of cultural materials at sites along the central and lower Sacramento River and the Delta. Referred to as the Windmiller Culture, these sites typically date to California's "Early Horizon", or to about 4,000 to 5,000 years ago. The connection with Penutian-speaking peoples is suggested on the basis of extended burials, large leaf-shaped and stemmed projectile points similar to points of the Stemmed Point Tradition in the Plateau and portions of the Great Basin, large villages established along major waterways, and elaborate material culture with a wide range of ornamental and other non-utilitarian artifact types being present. The continuation of this pattern through the "Middle Horizon", or from about 1,000 B.C. to A.D. 300, has also been documented at numerous riverine sites within the Sacramento Valley, including several sites excavated along the Sacramento River west of Chico in the general project area.

3.9.3.2 Ethnography

The general project area is located within territory which, at the time of Contact (circa A.D. 1850), may have been claimed by both the Maidu (east of the Sacramento River) and the Nomlaki (west of the river). Both groups were Penutian speakers, and for both groups the basic social unit was the family, although the village may also have functioned as a social, as well as a political and economic unit. Villages were usually located near water sources, with major villages inhabited mainly in the winter. During food gathering seasons (i.e., spring, summer and fall), it was necessary to go out into the hills and higher elevation zones to establish temporary camps. Villages typically consisted of a scattering of bark houses, numbering from four to five to several dozen in larger villages. Each house contained a single family or from three to seven people.

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As with all northern California Indian groups, economic life for the Maidu and the Nomlaki revolved around hunting, fishing, and the collecting of plant foods. Deer were an important meat source and were hunted by groups in community drives stalked and snared by individuals. Salmon and other food resources available along the Sacramento River also contributed significantly to local economies. While much of the fish protein was consumed immediately, a significant percentage, particularly during the fall runs, was prepared for storage and consumed during winter months. Acorns represented one of the most important vegetal foods and were particularly abundant within the project area and to the east along the margins of the northern Sacramento Valley.

3.9.4 Local Setting

To secure information concerning known sites within the APE, a number of contacts and field inspections were undertaken and sources consulted. These include the following:

- A search of records maintained by the Northeast Information Center of the California Historical Resources Information System, maintained at California State University, Chico;
- Field inspections and pedestrian archaeological survey of the project's APE;
- Review of the National Register of Historic Places (1979, 1989, Supplements to December 1995);
- Review of the California Inventory of Historic Resources (State of California 1976);
- Review of the California Historical Landmarks (State of California 1990); and
- Contacts with the following knowledgeable individuals and groups:
  - Mr. Richard Bjork, Tyme Maidu Tribe, 5 Tyme Way, Oroville, California.
  - The Chico Museum, Chico, California.
  - Ms. Delores McHenry, Chairperson, Chico Band of Mechoopda Indians.
  - Ms. Jessie M. Gilkey, Chairperson, Mooretown Rancheria of Maidu Indians.
  - The Tehama County Museum Foundation.

In addition to the above, the lead agencies undertook a subsurface testing program to assess the potential for unidentified, eligible resources in the vicinity of the proposed screen extension. The subsurface test area, shown in Figure 3.9-1, revealed no indications of the potential for subsurface resources.

3.9.4.1 Resource Considerations, Native American Sites

The discussion of regional prehistory and ethnography in Section 3.9.4 provides insight into the types of Native American cultural resources likely to be present within the project area. As noted in the discussion of Regional Setting, the Native American occupants of this region were very sophisticated in terms of their knowledge of the uses of local animals and plants, and of the availability of raw material sources which could be used in manufacturing an immense array of primary and secondary tools and implements. Unfortunately, only fragmentary evidence of their material culture remains, due in part to perishability and, in part, to the impacts to archaeological sites resulting from later (historic) land uses. Based on the results of previous archaeological survey work within the general and immediate project area, the expected range of Native American site types include the following:

- Large village sites located along the margins of the Sacramento River, and on old levee systems associated with prior alignments of the main river channel. Some of these sites were occupied into early historic time periods and could therefore contain historic artifacts or trade goods.
- Surface scatters of lithic artifacts and debitage without evidence of buried cultural deposits or substantial habitation, resulting from short-term occupation and/or specialized economic activities.
- Isolated finds of aboriginal artifacts and flakes.

3.9.4.2 Resource Considerations, Historic Resources

The project area lies on two former Mexican land grants, the Capay and the Bosquejo Ranchos. In the early 1840s, Maria Josefa Soto, later the wife of Dr. James Stokes of Monterey, received the Capay Grant from the Mexican government. In 1846, a man named Bryant built the first house on the land, and in 1848, after Marshall's gold discovery in Coloma and the resulting gold rush, the 44,388-acre land grant stretching along the west bank of the Sacramento River attracted more settlers including U.P. Monroe, Martin A. Reager, and John McIntosh (Rogers 1891; Hoover, Rensch, and Rensch 1970).

Small, independent companies and individual steamboat operators established shipping routes on the upper Sacramento River. This service was essential because many people who lived along the river were cut off for months from nearby towns by tule swamps or the distance from the railroad. These people relied on the boats that came up from San Francisco to bring supplies, and provide transportation along the river (McGowan 1961).

At its peak, river navigation on the upper Sacramento River reached Red Bluff, at least during high water. Although the 1871 completion of the railroad to Red Bluff eliminated the need for riverboat operations, some steam boats still traveled to the town. The Dover and the Weitchepec made the trip in 1911, and some people have claimed that a steamer reached Red Bluff in 1918 and Tehama in 1936. The practical head of navigation after 1871 was most likely Jacinto with only a few boats traveling higher upriver to Colby's landing above Chico (McGowan 1961).

The steamers opened the Capay Grant lands to settlement by providing easy access to Sacramento markets. Martin Reager and John McIntosh, two early settlers on the grant land, took advantage of the access by purchasing river front property.

Martin Reager's home, the first frame house constructed in Glenn County, is listed as a California Point of Historic Interest and lies within the boundaries of the project area (Parks and Recreation 1992). As early as 1850, Reager had opened a way-station in the northern part of the county, most likely near his home. Sitting on the banks of the river, this location was an ideal stopping point for travelers heading to the Northern mines.

John McIntosh built a hotel near the river across from Emery and Mitchell islands. This area, McIntosh Landing, was soon run by McIntosh's brother, Lewis. Lewis H. McIntosh was born in Bath County, Kentucky, in 1837. In 1852, he moved to Colusa County, California, where he worked for his brother. By 1890, Lewis McIntosh owned 3,000 acres of land, two-thirds of which he planted in wheat (Rogers 1891).

As more ranchers moved into the area, a need for irrigation water arose. In 1883, William S. Green posted the first water notice on an oak tree on the west bank of the Sacramento River. The notice, on the Capay Rancho within the project area, announced the diversion of 500,000 miners inches of water for the irrigation of lands on the west side of the Sacramento Valley. This spot is marked by State Registered Landmark 831 (Parks and Recreation 1990).

William Semple Green arrived in San Francisco, via the Panama route, on October 10, 1849. He traveled to Colusa County in 1850 where he lived until his death in 1905. Credited as the father of irrigation in Glenn and Colusa counties, Green worked as a ferryboat captain, mail carrier, surveyor, editor, writer, legislator, Surveyor General of the United States, California State Treasurer, and irrigationist during his life. Green's interest in an irrigation canal for the Colusa area began as early as 1866 when, as Colusa County Surveyor, he surveyed land for an irrigation canal that would pass through Colusa, Yolo, and Solano counties. Although this proposal, and a subsequent plan in 1875, failed, Green persisted in the quest for an irrigation system. His persistence paid off in 1883 with formation of the Stony Creek Canal Company, a company that had capital stock valued at $200,000, and proposed to begin by digging of a 50-foot wide canal that would, it was estimated, irrigate 190,000 acres of land. Although considerable work had been performed on this canal, the company failed to secure the right-of-way across private lands and, threatened by lawsuits from riparian owners, abandoned the project (Rogers 1891).

Green's second attempt at organizing an irrigation district, the Colusa Irrigation District, came late in 1887, after the passage of the Wright Irrigation Act. Signed into law on March 6, 1887, the Wright Irrigation Act authorized the creation of irrigation districts based on the approval of two-thirds of the property owners within the boundary of the proposed district. This law also stipulated that the electors could bond all the land in the proposed district to raise the necessary capital for rights-of-ways and construction costs. In addition to the bonds, district trustees could tax property owners for other expenses including compensation for the owners of the riparian rights to diverted water (McGowan 1961).

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In 1888, the Colusa Central Irrigation District issued bonds for $600,000 and construction began in 1889, when the first seven miles of the canal were contracted for $213,000. From its beginning, the district ran into problems. For example, several miles of the canal were dug through soil so porous that approximately one-third of the water in the canal was lost to seepage. Also, because the district contracted work on land prior to the signing of right-of-way agreements, they faced lawsuits, and in some cases, were forced to relocate entire segments of the canal (McGowan 1961).

By 1891, forty miles of the planned sixty-one mile canal had been constructed but the sections were useless because they were not continuous. In an attempt to complete the project, the district issued another $250,000 in bonds that did not sell. Faced with these continued financial and legal problems, the Colusa Central Irrigation District disbanded in 1893 (McGowan 1961).

Green's dream of irrigation districts in the Glenn-Colusa area finally materialized in 1908, when government reclamation engineers finished plans for irrigating 14,000 acres in the Orland vicinity. By 1918, farmers had organized the Glenn-Colusa Irrigation District that supplied water from Hamilton City south to Willows (Eubank 1948). The appearance of settlers on the Capay Grant in the 1850s and the continued arrival of additional farmers suggests that the Stokes family probably found it more profitable to sell parcels of their grant land rather than keep it for ranching, a trend that was common for most of the ranchos in the area, especially with the opening of the irrigation canals.

By 1911, most of the grant lands had been sold. In 1909, the Sacramento Valley Irrigation Company was purchasing rancho land in Glenn County and, in 1911, the Marysville Appeal noted that "land was booming in the west side" with the Willows area being the focus of interest (McGowan 1961).

On the east side of the Sacramento River was the Bosquejo Rancho, a 22,206-acre rancho granted to Peter Lassen in the 1840s. By 1850, Colonel C.L. Wilson had purchased most of the grant, including two miles of frontage along the river.

Colonel Charles Lincoln Wilson came to California in 1849. In 1856, he built the first railroad in California, the Sacramento Valley Railroad, which ran from Sacramento to Folsom. Later he expanded the railroad from Sacramento to Marysville, establishing the town of Lincoln. In 1865, he sold the railroad to the Central Pacific Company and concentrated on his ranch (McGowan 1961). By 1877, his ranch included a landing on the river, Wilson's Landing, and a warehouse adjacent to the California and Oregon railroad that crossed his property. In 1888, spurred by fruit tree development, Wilson subdivided 1,000 acres into 20-acre lots to sell directly to small farmers. By 1890, the area was planted to orange, olive, fig, almond, peach, pear, and prune trees by large corporate farmers who had purchased the lots (McGowan 1961).

3.9.4.3 Known Resources

Field work identified areas of extensive disturbance throughout much of the project area. This disturbance relates to historic uses and activities, ongoing agricultural activities, residential

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construction, and the effects of existing pumping station facilities, excavated ditches and segments of modified levee.

- ***Prehistoric***: Evidence of prehistoric presence was observed at the two locations previously recorded by Peak & Associates. The sites may be further described, as follows:

  - *PA-94-7*: This site consists of a diffuse scatter of approximately 10 metavolcanic debitage fragments, a core, and two crockery shards located in an almond orchard located on the first terrace above the floodplain of the Sacramento River.

  - *PA-94-8:* This site consists of approximately 100 primary and secondary reduction flakes located on the first terrace above the floodplain of the Sacramento River, adjacent to the west side of the Sacramento River north of the Glenn-Colusa Irrigation District's intake structure.

- ***Historic:*** Evidence of historic period structures (Figure 3.9-1) was observed at the two locations previously identified by Peak & Associates (1995). These may be further described, as follows:

  - *Historic Structure #1:* This structure consists of a single family home located at 4996 Second Avenue and corresponds to the site of the first framed house in Glenn County. The former location of this early residence has been designated California Point of Historical Interest, Number GLWE-016. A plaque identifying the historic significance of the structure is located directly west of the present structure along Second Avenue.

  - *Historic Structure #2:* This structure consists of a single family home located to the east of Second Avenue, on the boundary between Glenn and Tehama counties. The structure has not been formally evaluated by an architectural historian for National Register eligibility.

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3.10 Socioeconomics

3.10.1 Introduction

This section reviews recent changes to Glenn-Colusa Irrigation District (GCID) water delivery rates caused by restrictions imposed on Hamilton City Pumping Plant (HCPP) operations. While physical environmental effects have resulted from shifts in Sacramento River diversions from HCPP to Red Bluff Diversion Dam (RBDD) and reductions in GCID outflow to the lower Colusa Basin (Section 1.5, History of HCPP Diversions and Fish Screens and Section 3.1, Hydrology and Water Resources), no substantial environmental effects have been attributed to changes in delivery rates. Therefore, no significant environmental issues have been identified under socioeconomics for the project area.

3.10.2. Regulatory Setting

There are no social or economic regulations applicable to the scope of the proposed project.

3.10.3 Regional and Local Setting

Pumping restrictions imposed at the HCPP caused significant increases in water delivery costs to GCID's customers in the early 1990s. **Table 3.10-1** shows water delivery cost increases over this period. In 1992, a surcharge of $4.00 per deeded area was added to the delivery rates to contribute funding for the fish screen improvements as mandated by the Joint Stipulation of Parties (1993). Costs for planning, design, construction, and operation of the project will continue to be funded through water rate surcharges to satisfy GCID's 12.5 percent cost-share responsibility for the project. Final costs to the District for the project are not expected to substantially affect water delivery costs beyond the previous increases caused by the HCPP restrictions imposed in the early 1990s.

Table 3.10-1 - GCID Water Delivery Rates for Different Crop Types Over the Period 1985 - 1996 (Cost/Acre Crop)

Year	Rice	Sugar Beets/Tomatoes	Pasture - Clover - Ear Corn - Alfalfa - Orchard	General Crops (e.g., Grains, Vines, And Silage Corn)
1985 - 1989	$25.00	$18.00	$15.00	$10.00
1990	$30.00	$21.75	$18.00	$12.00
1991	$35.00	$25.00	$21.20	$14.00
1992[a,b]	$56.00	$40.75	$33.75	$22.50
1993[a,b]	$45.25	$32.75	$27.25	$18.25
1994[a,b]	$55.00	$40.00	$33.25	$22.25
1995[a,b]	$49.50	$36.00	$30.00	$20.00
1996[a,b]	$48.00	$35.00	$29.00	$19.50

[a] Effective in 1992, GCID established a dual rate schedule that provided a discount rate for participants in GCID's Water Conservation Program. Higher rates are charged to growers that have not implemented the GCID's Conservation Guidelines.

[b] An Endangered Species Act surcharge of $4.00 per deeded acre was instituted in 1992 to contribute to funding the fish screen improvements.

The substantial increases in water rates in the early 1990s were a result of direct and indirect changes in operations. Several new water delivery and on-farm water management programs and practices were implemented in the early 1990s (Section 3.1, Hydrology and Water Resources). These included new water conservation programs, increased agricultural runoff recapture and reuse, increased on-farm holding periods for irrigation where pesticides were used, and significant shifts in GCID and lower Colusa Basin water supply sources. Collectively, these programs and practices increased water delivery and management costs to GCID and its customers, as well as other water users throughout the Colusa Basin. In 1994, for example, the Groundwater Conjunctive Use Program cost the District approximately $1.5 million to implement (D. Mitchum, pers. comm., 1996). Furthermore, the $1.5 million is only the direct cost incurred by GCID for the purchase of groundwater from landowners. It does not include any of the indirect costs associated with GCID's administration of the program.

In addition to direct and indirect costs for water delivery and management, indirect costs were also realized by GCID and the growers in many parts of the Colusa Basin due to fallowed lands, delays in irrigations, and reductions in water quality. Increased recapture, reuse and groundwater pumping increased salinities for lower GCID service area customers and irrigators in the lower Colusa Basin (Section 3.1, Hydrology and Water Resources). Combined, these circumstances have significantly impacted growers' operations and production costs and indirectly impacted production yields and quality.

Continued use of increasingly saline water, especially in the southern end of the GCID service area and lower Colusa Basin, could lead growers to switch to more saline-tolerant and less water-intensive crops. Efforts to predict corresponding crop pattern changes and identify impact issues for the alternatives would be speculative since such changes would be a function of many variables, including market conditions, government farm programs, local infrastructure, regional farm management practices, and extra-regional changes in cropping patterns such as in the San Joaquin Valley. Potential changes in cropping patterns could have minor short-term effects, but would not be likely to have substantial long-term effects on the physical environment. Such short-term land fallowing occurred immediately following the early 1990s restrictions, but nearly all fallowed lands have been placed back into agricultural production.

GCID's share of fish screen improvement costs (12.5 percent) will be funded largely from reserves GCID established in the years immediately following the Joint Stipulation of Parties (1993) between NMFS, CDFG, and GCID. However, GCID was able to construct the interim screen improvements, in part, by using its reserved fund and also by deferring some of its annual operation and maintenance activities. GCID is now attempting to catch up on its deferred annual operation and maintenance to ensure the integrity of its water delivery and recapture system. As a result, continued elevated rates for water deliveries could be possible for the next several years until the fish screen improvements are completed and GCID recovers from delays to its annual operation and maintenance activities.

3.11 Transportation and Traffic Safety

3.11.1 Introduction

This section describes the affected environment with respect to the road network that provides access to the Hamilton City Pumping Plant (HCPP) and potential construction sites. For purposes of addressing traffic issues in this EIR/EIS, the project study area is defined as primary and secondary access roads to the eastern and western banks of the Sacramento River where construction activities could occur.

3.11.2 Regulatory Setting

Maintenance of State highways in the vicinity of the project (i.e., State Highway 32) is performed by the California Department of Transportation (CALTRANS). Local roads are maintained by the Glenn County Public Works Department (Canal Road) and the Butte County Public Works Department (Hamilton Nord Cana Highway and Wilson Landing Road).

3.11.3 Regional Setting

Primary north-south routes in the upper Sacramento Valley are Interstate 5, located approximately 8.5 miles west of the HCPP, and State Highway 99, located approximately 8.5 miles east. Smaller highways accommodate east-west traffic throughout the valley. In the vicinity of the HCPP is State Highway 32, a 2-lane road extending east from I-5, in Orland, to State Route 99 in Chico. As construction personnel, material, and equipment delivery traffic may originate from distant population centers (e.g., Chico), these regional arterials provide likely routes for access to the project area.

3.11.4 Local Setting

Local access to the project site is provided by two tiers of road systems: (1) primary county roads that provide access from regional arterials; and (2) smaller county and unpaved roads that link primary roads to the project area on the east and west sides of the Sacramento River. The primary county roads are described below, and are shown with regional arterials on **Figure 3.11-1.** Smaller county roads and unpaved access roads in the project area are shown on **Figure 3.11-2.**

3.11.4.1 Canal Road

Canal Road provides the primary access from Highway 32 to the HCPP, to construction sites on Montgomery Island, and to the west bank of the Sacramento River and oxbow. Canal Road is a 2-lane, north-south roadway that runs along the east side of the Glenn-Colusa Canal from Highway 32 to its northern terminus near the HCPP, 3 miles north of Hamilton City. Canal Road also provides access to residential properties and agricultural lands north of Hamilton City.

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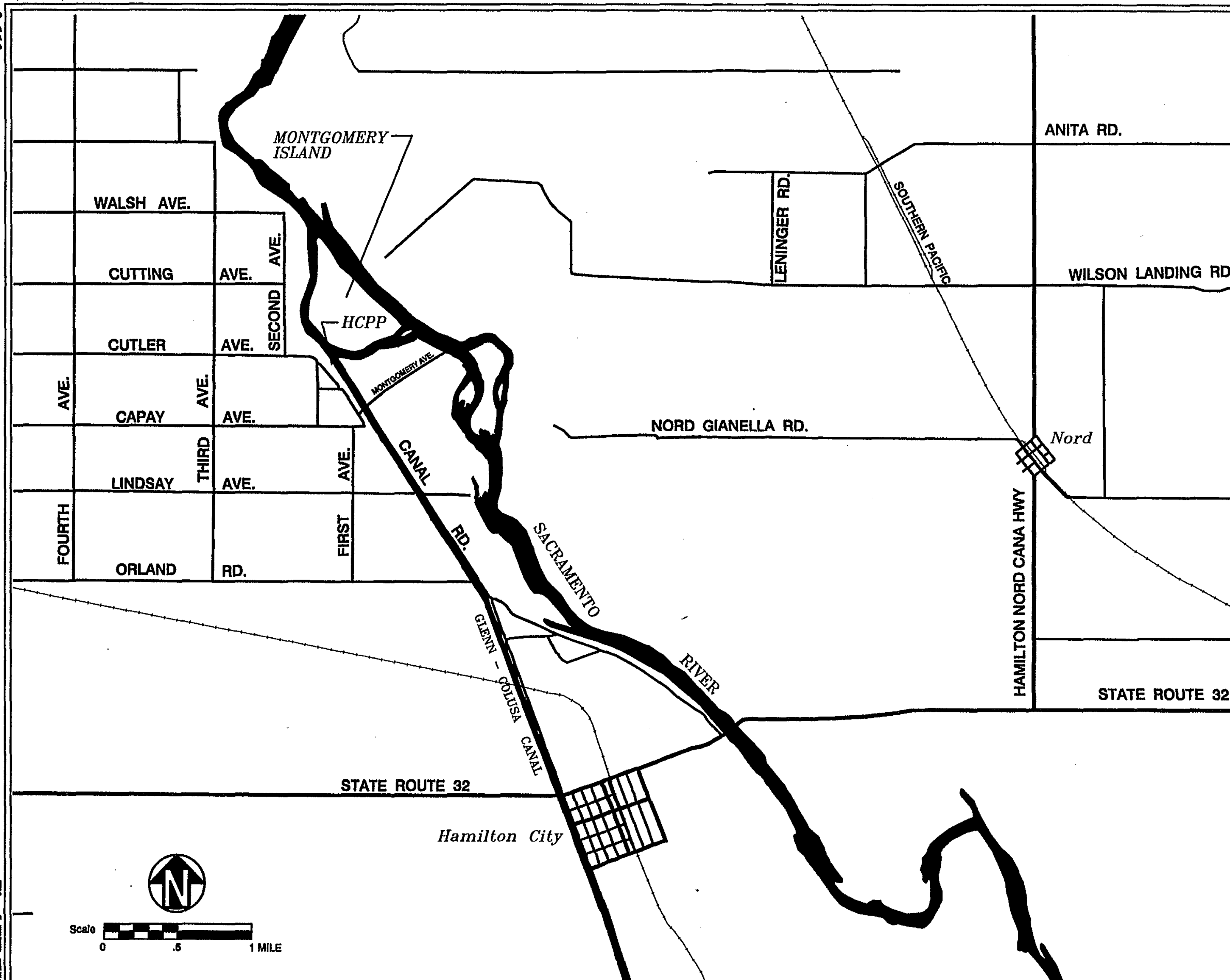

FIGURE 3.11-1. ARTERIAL ACCESS ROUTES TO PROJECT STUDY AREA

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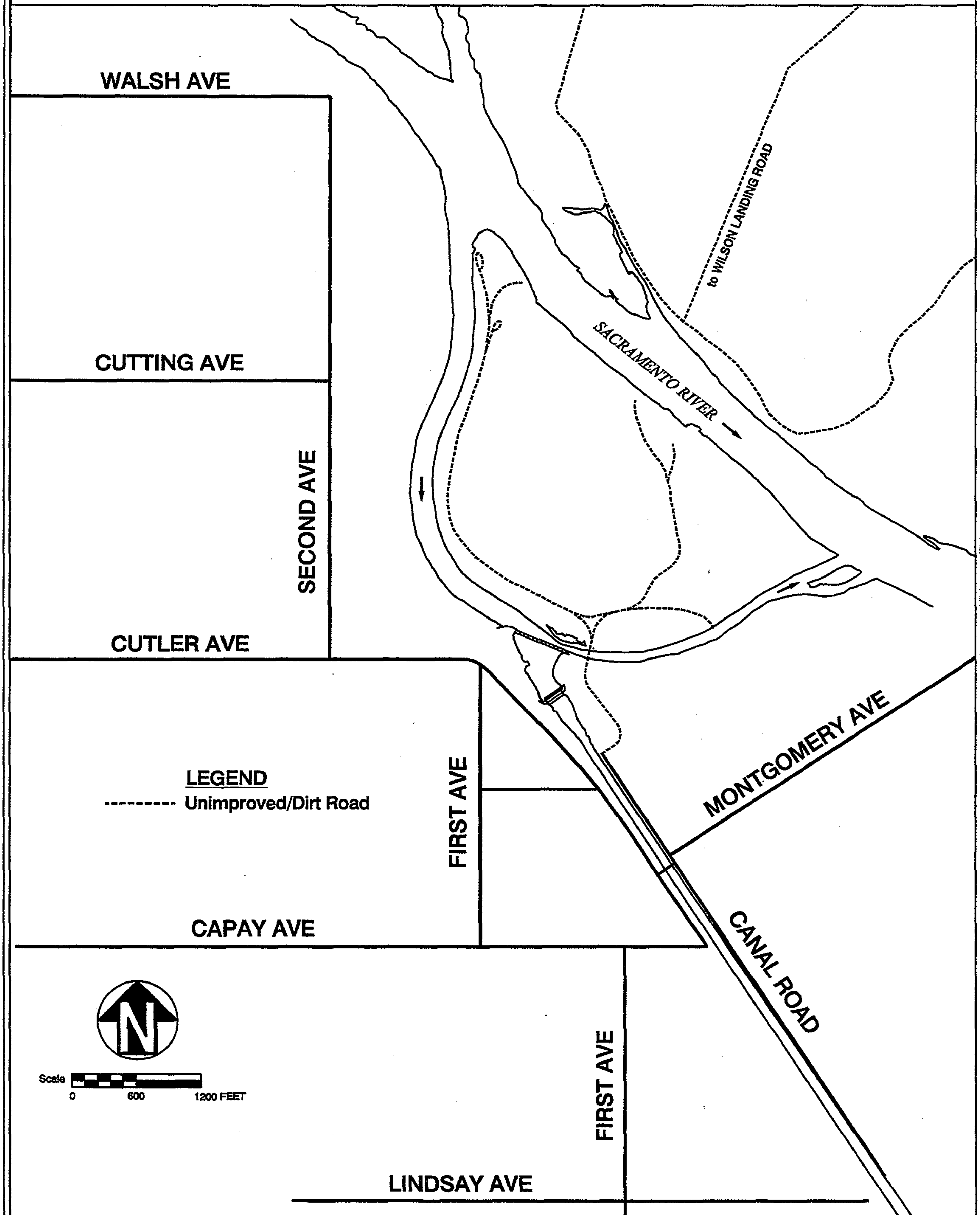
FIGURE 3.11-2. LOCAL ACCESS ROUTES IN PROJECT VICINITY



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C-085591

Average daily traffic on Canal Road is estimated to be about 1,380 vehicles per day (Glenn County Public Works Department 1990).

The intersection of Canal Road with Highway 32 is controlled by stop signs on the Canal Road approaches, with separate left turn lanes on the east and west approaches to the intersection. The posted speed on Highway 32 in this area of Hamilton City is 35 miles per hour (mph). Hamilton City High School is located at the northeast corner of this intersection. A primary parking area for the school is also located at this intersection on the west side of Canal Road, across the street from the school.

3.11.4.2 Hamilton Nord Cana Highway

Highway 32 is intersected approximately 3.5 miles east of Hamilton City by the Hamilton Nord Cana Highway. Hamilton Nord Cana Highway is a 2-lane, north-south roadway that extends north from Highway 32 approximately 8 miles to Highway 99. It serves agricultural properties, the community of Nord, and rural residences, and provides a link from Highway 32 to County roads that lead to the east bank of the Sacramento River at the project site. Hamilton Nord Cana Highway carries about 900 vehicles per day between Highway 32 and Nord and about 800 vehicles per day north of Nord (B. Jones, pers. comm., 1996).

The Hamilton Nord Cana roadway traverses three sharp curves in Nord. Each curve has a curve warning sign with posted advisory speeds of 15 or 20 mph. Rumble strips are provided on the approaches to the southernmost and northernmost curves. Lane widths are consistently 12 feet through the curves, and shoulders are unpaved and generally very narrow. There is an elementary school located about a block east of the Hamilton Nord Cana Highway in Nord.

3.11.4.3 Wilson Landing Road

Wilson Landing Road links Hamilton Nord Cana Highway to the project area on the east side of the Sacramento River. Wilson Landing Road is a 2-lane rural road extending west from Highway 99 to its terminus near the east bank of the Sacramento River. Wilson Landing Road carries about 400 vehicles per day between Highway 99 and Hamilton Nord Cana Highway, and about 380 vehicles per day between Hamilton Nord Cana Highway and its western terminus (B. Jones, pers. comm., 1996).

3.11.4.4 Other Roads

Secondary roads provide direct access to anticipated construction and staging areas. These areas are located along the west bank of the oxbow, on Montgomery Island, and along the east bank of the Sacramento River.

The west bank of the oxbow north of the HCPP is accessed from Canal Road to County Road 205. Access to the east side of the pumping plant forebay is via Canal Road past the HCPP operators' housing. Montgomery Island also is accessed from the end of Canal Road through the HCPP site and across a seasonal check dam. Unpaved access roads cross much of the island. The east bank

C-085592

of the Sacramento River can be accessed from the western terminus of Wilson Landing Road by unpaved, private roads on Butte County parcel 047-040-003 (Deseret Farms). The existing road system on this parcel appears to currently support heavy truck traffic associated with agricultural operations. However, the ability of the road system to support heavy traffic diminishes with proximity to the east bank of the Sacramento River. Road improvements could be necessary on portions of the existing road system, and access roads near and along the levee high water river bank would have to be widened.

C-085593

C-085593

3.12 Air Quality

3.12.1 Introduction

This section describes the general setting of the project with respect to air quality resources. Summary information on regional and local air quality is presented below, along with a discussion of Federal and State air quality standards for common air pollutants. Particular attention is given to particulate matter (PM_{10}) and ozone, since the region has on occasion exceeded State standards for these two pollutants.

3.12.2 Regulatory Setting

Air quality in California is regulated under both Federal and State clean air legislation. The Federal Clean Air Act of 1977 authorized the U.S. Environmental Protection Agency to set Federal air quality standards to protect public health. The California Clean Air Act of 1988 established State air quality standards, which are more stringent than Federal standards. Federal and State ambient air quality standards for common pollutants are presented in **Table 3.12-1.**

Air quality within California is regulated by the California Air Resources Board (CARB) and local Air Pollution Control Districts (APCD). The Butte, Glenn, and Tehama County APCDs manage the airshed within the vicinity of the project area. These APCDs are responsible for monitoring the attainment or non-attainment status of the area with respect to Federal and State standards.

In compliance with the California Clean Air Act of 1988, an Air Quality Attainment Plan for the Northern Sacramento Valley Air Basin (NSVAB) has been prepared and is updated every three years for submittal to the CARB. The NSVAB includes Butte, Colusa, Glenn, Shasta, Sutter, Tehama, and Yuba counties. The plan is designed to achieve a reduction in basin-wide emissions of each non-attainment pollutant or its precursors. The plan includes every feasible control measure for new or existing stationary sources of air pollution and a schedule of adoption for these measures.

The California Health and Safety Code, Section 41503(b) requires that emissions be reduced by five percent or more per year, averaged every three consecutive years, until State ambient air quality standards are attained. This five percent is calculated against the 1987 actual emission level of each non-attainment district (NSVAB 1994). Required emission reductions for the precursors reactive organic compound (ROG) and nitrous oxides (NO_x) for Glenn and Colusa counties are specified in **Table 3.12-2.**

C-085594

C-085594

Table 3.12-1 - Federal and State Ambient Air Quality Standards for Common Pollutants

Pollutant	Averaging Time	Federal Standards	California Standards
Carbon Monoxide (CO)	1 hour 8 hours	35.0 ppm 9.0 ppm	20.0 ppm 9.0 ppm
Nitrogen Dioxide (NO_2)	1 hour Annual	na 0.05 ppm	0.25 ppm na
Ozone (O_3)	1 hour	0.12 ppm	0.09 ppm
Particulate Matter (PM_{10})	24 hours Annual	150 g/m^3 50 g/m^3	50 g/m^3 30 g/m^3
Sulfur Dioxide (SO_2)	1 hour 24 hour Annual	na 0.14 ppm 0.03 ppm	0.25 ppm 0.04 ppm na

ppm Parts per million
g/m^3 Micrograms per cubic meter
na No standard exists
Source: CARB 1991

Table 3.12-2 - 1987 Emission Inventory Results and 1994, 1997 and 2000 Required Emission Reductions of ROG and NO_X for Colusa and Glenn Counties (NSVAB 1994)

	Colusa		Glenn	
Emissions (Tons Per Day)	**ROG**	**NO_X**	**ROG**	**NO_X**
1987 Baseline Emission Inventory	12.13	9.01	12.12	13.07
1994 Required Emission Reductions (5% x 7 years = 35%)	4.25	3.15	4.24	4.60
1997 Required Emission Reductions (5% x 10 years = 50%)	6.07	4.51	6.06	6.54
2000 Required Emission Reductions (5% x 13 years = 65%)	7.88	5.86	7.88	8.50

Agricultural burning is associated with significant emissions of PM_{10}, ozone and ozone precursors (NSVAB 1994). The Rice Straw Burning Reduction Act of 1991 (AB-1378) mandates a reduction in rice straw acreage burning by the year 2000 using the following schedule:

Year	Rice Acreage That Can Be Burned
1992	90%
1993	80%
1994	70%
1995	60%
1996	50%
1997	38%
1998	25%
1999	25%

During the year 2000 and thereafter, burning is limited to the lesser of 25 percent of the planted acreage, or 125,000 acres in the Sacramento Valley. However, burning of any acreage after 1999 is subject to the county agricultural commissioner's finding that the existence of a pathogen during the growing season caused a significant, quantifiable reduction in yield. (NSVAB 1994; L. Hrytnchuk, pers. comm., 1997).

3.12.3 Regional Setting

The project area is located in the northern portion of the Sacramento Valley Air Basin within the Central Valley of California. The climate within the region is Mediterranean, with average maximum/minimum temperatures of 97°/58°, annual sunshine hours of approximately 75 percent of the hours possible, and average annual precipitation ranging from approximately 15 inches in the northwest to 60 inches in the northeast. Prevailing winds flow from the coast through the Carquinez Straits and north through the Sacramento Valley, blowing air pollutants north from the Sacramento metropolitan area. The major topographical features of the region include the broad Central Valley floor, with elevations ranging from 60 to 500 feet mean sea level (msl), and mountain ranges with peaks of 10,000 or more feet above msl, which enclose the Valley to the east, north, and west within the region.

These climatic and topographic features result in an air basin with a relatively high potential for air inversions (i.e., when air of one temperature is trapped beneath a layer of air of another temperature and circulation is impeded). Inversions occur frequently in the region in all seasons. The most stable of these inversions occurs in the late summer and early fall, when cool coastal air is trapped beneath a warm air mass. Photochemical smog (i.e., ozone) trapped in this inversion is enhanced by relatively high temperatures and a large number of sunny days. In the late fall and winter, temperature inversions at ground level occur and tule fog develops when Central Valley air is trapped and little mixing with coastal air occurs. Levels of CO, NO_x, and PM_{10} are highest during this season.

C-085596

C-085596

3.12.4 Local Setting

The following section provides background information for the project area relative to air quality issues as presented in Section 2.6 (Issues Identified and Considered in EIR/EIS Process).

3.12.4.1 Pollutant Emissions

Air pollution levels within the vicinity of the project do not exceed Federal or State standards for CO, NO_2, and SO_2; however, the area is considered a "non-attainment" area for ozone and PM_{10} under State standards.

Air pollution levels within the vicinity of the project do not exceed Federal standards for NO_2, ozone, PM_{10}, and SO_2 or State standards for NO_2 and SO_2. CO levels are not expected to exceed either Federal or State standards and are not monitored within the area, because CO is a highly localized pollutant, found primarily at busy intersections in metropolitan areas (K. Tokunaga, pers. comm., 1996). Under State standards, however, the area is considered a "non-attainment" area for both ozone and PM_{10} (Glenn County 1993a; K. Tokunaga, pers. comm., 1996).

Ozone is produced in the atmosphere by a series of photochemical reactions involving its precursors: NO_X and ROG. In high concentrations, ozone can cause respiratory irritation and can inhibit vegetative growth. Ozone levels are highest in the area during the summer, because of the long sunny days. Many sources of NO_X and ROG emissions exist within the vicinity of the project; no one source is known to be primarily responsible for the emission of these precursors to ozone.

PM_{10} can produce haze, reduce visibility and result in respiratory irritation. The major sources of PM_{10} within the vicinity of the project area are agriculture, burning, construction, and the entrainment of dust in the air by motor vehicles. Rice straw is currently burned in fields throughout the Colusa Basin.

The findings of recent air pollutant inventories in the vicinity of the project area are presented on **Table 3.12-3.**

C-085597

C-085597

Table 3.12-3 - Air Pollutant Data Summary
Willows, Red Bluff and Colusa, California
1992-1994

Pollutant	1992			1993			1994		
	Willows	Red Bluff	Colusa	Willows	Red Bluff	Colusa	Willows	Red Bluff	Colusa
Ozone (O_3)									
Highest 1-hour	0.11	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.11
Days >0.09 ppm[a]	6	9	8	1	5	3	3	2	4
Days >0.12 ppm	0	0	0	0	0	0	0	0	0
Particulate Matter (PM_{10})									
Highest 24-hour	111	75	84	75	67	70	80	74	57
Days >50 g/m[a]	9	5	8	4	3	4	4	6	5
Days >150 g/m[b]	0	0	0	0	0	0	0	0	0

a State standard
b Federal standard
> Greater than
Source: CARB 1993, 1994, 1995

C-085598

C-085598

3.13 Indian Trust Assets

3.13.1 Introduction

This section presents information regarding potential Indian Trust Assets (ITA) in the project area. For purposes of evaluating ITAs, the project study area is defined as those Native American resources or practices that may be directly or indirectly affected by changing water supply conditions within the Colusa Basin.

3.13.2 Regulatory Setting

The United States has a trust responsibility to protect and maintain rights reserved by or granted to American Indian tribes or Indian individuals by treaties, statues, and executive orders. Indian trust assets are legal interests in property held in trust (on behalf of a beneficiary) by the United States for Indian Tribes or individuals, or property that the United States is otherwise charged by law to protect. These assets are anything owned that has monetary value. The asset could be some property interest, such as a lease or a right to use something. Assets can be real property, physical assets or intangible property rights. Most Indian trust assets are located on the reservation, but they can be located off-reservation. Examples of resources that could be Indian trust assets are lands, minerals, hunting and fishing rights, water rights, and instream flows. The Federal Government has a responsibility to protect ITAs from adverse impacts of its programs and activities.

3.13.3 Regional and Local Setting

The Bureau of Indian Affairs (BIA) was contacted to identify ITAs within the project area. Two rancherias, Colusa and Grindstone, are near the project but do not receive water supplies from the HCPP or other sources that would likely be affected by the alternatives. The rights of recognized Native American groups to fishery resources of the Sacramento River would not be adversely affected by the alternatives; selection of any project alternative is anticipated to result in net benefits to Sacramento River fisheries.

The following areas were identified in or near the potentially affected area:

Glenn County

- Grindstone Rancheria: 100.03 acres on Stony Creek

Colusa County

- Colusa Rancheria: 273.22 acres on the Sacramento River north of Colusa
- Cortina Rancheria: 640 acres west of Williams
- Individual Indian Public Domain Allotment: 80 acres (Santiago McDaniel, Section 25, R7W, T18N)

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Tehama County

- Paskenta Rancheria: No trust lands
- Individual Indian Public Domain Allotments: 90.29 acres: (1) 85.0 acres Lorinda Gravier Hulsman, Section 23, T27N, R2E; (2) 5.0 acres Lorinda Gravier Hulsman, Section 23, T27N, R2E; and (3) .29 acre Gertrude Patterson, Section 18, T25N, R2W

C-085600

C-085600

3.14 Environmental Justice

3.14.1 Introduction

This section presents information regarding potential Environmental Justice in the project area. For purposes of evaluating Environmental Justice, all communities and social and economic groups were considered.

3.14.2 Regulatory Setting

Executive Order 12898 (1994) on Environmental Justice requires that environmental analyses of proposed Federal actions address any disproportionately high and adverse human health or environmental effects on minority and low-income communities. Federal agencies' responsibility under this order shall also apply equally to Native American programs. In addition, each Federal agency must ensure that public documents, notices, and hearings are readily accessible to the public.

3.14.3 Regional and Local Setting

No significant issues have been identified (Section 2.6, Issues Identified and Considered in EIR/EIS Process) concerning Environmental Justice. No disproportionately high or adverse human health or environmental effects on minority and low-income communities have been identified; impacts of the alternatives would affect the farming community and those economically linked to farming, equally.

The mailing distribution list for this EIR/EIS was initiated when the proposed project was first noticed in 1992, and has been continually updated during the EIR/EIS process. This mailing list includes property owners and potentially affected persons and institutions without any distinction based on minority or income status.

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3.15 International Considerations

Under Executive Order 12114 (January 4, 1979), Federal agencies are required to consider the effects of their actions when they may have a significant effect on the environment outside national jurisdiction, on the environment of an uninvolved foreign nation, upon the environment of a foreign nation that may benefit from the action, and on global resources protected by treaty or designated by the President. No comments have been identified that would indicate the potential for the alternatives to have substantial effects, beneficial or otherwise, on international interests.

Chapter 4
Impact Analyses

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4.0 IMPACT ANALYSES

This chapter describes the methods and results of analyses of the potential environmental impacts of the no-project and project alternatives. The reader should note that the scope and general order of impact topics correspond to the issues identified in Table 2.6-2, Issues Carried Forward for Further Analysis.

Each resource section in this chapter presents impact significance criteria, methods of analyses, and the results of analyses. Impact levels are compared to significance thresholds. Where impacts to resources would have the potential to exceed significance thresholds, the analysis concludes with mitigation recommendations (where feasible) and the significance of impacts remaining after mitigation (residual impacts). Mitigation recommendations are not provided for potentially significant impacts under the no-project alternative, except where mitigation is identified for actions included under the project alternatives. Mitigation for the no-project alternative would be subject to planning, design, and separate environmental review if one of the project alternatives is not selected for implementation.

The analysis of impacts includes: direct, indirect, cumulative, short-term, long-term, beneficial, and adverse impacts. In general, construction of the no-project and project alternatives would result in short-term environmental impacts while the long-term impacts of the alternatives would result from operation and maintenance activities throughout the 50-year life of the project. Construction impacts are measured from existing conditions and no-project conditions (e.g., hydrology and water resources). Operational impacts are also evaluated from predicted conditions of the resources over the 50-year life of the project.

For most resources, future conditions are not expected to differ substantially from existing conditions. For hydrology and water resources, information was available indicating reasonably foreseeable changes in the future regardless of decisions on this project. Reclamation (1996i), as described in Appendix B (Hydrology and Water Resources Technical Report), provides information regarding projected river flows and water demands in 2020. This is the furthest point into the future to reasonably predict changes and was used to evaluate impacts over the 50-year project life. Unless otherwise stated in the Methods sections of this chapter, impacts from implementing the alternatives under future conditions would be substantially the same as impacts under existing conditions.

The impact analyses results for each alternative in this chapter are compared to each other in Chapter 5 (Comparison of Alternatives). The purpose of the Chapter 5 comparison is to provide the reviewer with a focused presentation on the major differences in anticipated environmental effects among the alternatives.

C-085604

C-085604

4.1 Hydrology and Water Resources

4.1.1 Introduction

This section presents the analyses of impacts on hydrology and water resources. It includes criteria for determining the significance of the impacts, the methods for determining the impacts, and the results of the impact analyses. The analyses address the issues identified in Table 2.6-2, Issues Carried Forward for Further Analysis: Glenn-Colusa Irrigation District (GCID) deliveries, Sacramento River flows, water quality, river channel stability, sedimentation and dredging, and flooding.

Hamilton City Pumping Plant (HCPP) operations affect the quantity, quality, and timing of water flows through the regional study area. Impacts to hydrology and water resources could result from physical changes due to construction activities and from long-term HCPP operational changes. For hydrology and water resources, operational changes were identified using modeling techniques as described in Appendix B, Hydrology and Water Resources Technical Report. An analysis of the changes is presented at the beginning of Section 4.1.4, Impacts.

4.1.2 Impact Significance Criteria

Because hydrology and water resource changes directly impact both water resource characteristics, such as temperature and water quality, and aquatic resources, the hydrology and water resources analysis (Section 4.1.4) is presented before the aquatic analysis (Section 4.2). The hydrologic and water resources information is pertinent to an understanding of the water-dependent resource impact analyses such as aquatic resources.

California Environmental Quality Act (CEQA) guidelines specifically state that a project would normally have a significant impact on hydrology and water resources if it would:

- substantially degrade water quality;
- substantially degrade or deplete groundwater resources; or
- cause substantial flooding, erosion, or siltation.

In addition to the above criteria, impacts to Sacramento River hydraulic conditions would be considered significant if:

- floodplain characteristics would substantially change; or
- channel geometry or gradients would be altered to substantially affect bank erosion, aggradation, degradation, or the meander process.

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Impacts to water quality would be considered significant if the objectives contained in the Central Valley Basin Water Quality Control Plan (WQCP) (CVRWQCB 1994) would be exceeded; specifically, temperature, electrical conductivity, and pesticide objectives.

Temperature

The WQCP states that Sacramento River water temperatures between Shasta Dam and Hamilton City shall not exceed 56°F during periods when temperature increases will be detrimental to fisheries. *[Note: Only changes in temperature are presented in this section. Fish impacts as a result of these changes are described in Section 4.2, Aquatic Resources.]*

Electrical Conductivity

The electrical conductivity objectives for the Sacramento River, as described in the WQCP, are 0.230 deci-Siemens per meter (dS/m) and 0.235 dS/m. Electrical conductivity is used as an indicator of salinity in evaluating water quality conditions for beneficial uses such as agriculture. Salinity levels are generally correlated with electrical conductivity levels.

While no specific electrical conductivity objectives are identified for the Colusa Basin Drain, the WQCP states that Colusa Basin Drain water has beneficial use as irrigation water. As irrigation water, Colusa Basin Drain water should have electrical conductivity levels below the sensitivity levels required by crops farmed in the region. Approximately 90 percent of the irrigation water from Colusa Basin Drain is used for rice. Rice is specified as sensitive to saline waters (Hanson et al. 1993). Ayres and Westcot (1985 in Hanson et al. 1993) suggest severely restricting the use of water with electrical conductivity levels between 0.7 - 3.0 dS/m on sensitive crops and Scardaci et al. (1995) have shown that rice yields decline as a function of increasing electrical conductivity. Thresholds for rice establishment and yield decline were observed at 2.0 dS/m (Scardaci et al. 1995).

Pesticides

The California Department of Pesticide Regulation (CDPR) and the State Water Resources Control Board (SWRCB) have a Memorandum of Understanding which requires the CDPR to regulate pesticide discharges into surface waterways, including the Sacramento River and the Colusa Basin Drain. In 1990, control efforts were clarified and expanded, following adoption of the WQCP. This plan established performance goals for molinate and thiobencarb, beginning in 1990, and for the pesticides carbofuran, methyl parathion, and malathion beginning in 1991. Agricultural management practices are specified yearly by CDPR to meet performance goals. Pesticide concentrations in surface waters are monitored throughout the growing season (Gorder and Lee 1995).

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Performance goals for the pesticides are:

- 10 parts per billion (ppb) for molinate;
- 1.5 ppb for thiobencarb;
- 0.4 ppb for carbofuran;
- 0.13 ppb for methyl parathion; and
- 0.1 ppb for malathion.

4.1.3 Methods

Methods used to evaluate impacts to hydrology and water resources included: use of mathematical models of the Sacramento River to simulate flows, diversions, and temperature; evaluation of geomorphic, sedimentation, and water quality data with respect to project and WQCP objectives; and applicable regulations.

Diversions, Flows, and Temperature

Because the current screen approach velocity (V_a = 0.33 feet per second (ft/s)) would be applied to the no-project alternative year-round, rather than from August 1 through November 30, GCID diversions would be reduced from existing conditions (**Figure 4.1-1**). This results in a substantial change from existing conditions to the no-project alternative.

Hydrologic models were used to simulate the monthly water operations in the Sacramento River and in the GCID service area. To ensure that a variety of hydrologic conditions were represented, including extreme and more normal conditions, the 1922-1991 hydrologic trace was modeled under existing and future (2020) operating conditions. A complete description of the hydrologic modeling process is contained in Appendix B, Hydrology and Water Resources Technical Report.

The modeling tools used included:

- Project Simulation Model (PROSIM) - a Bureau of Reclamation (Reclamation) hydrologic model that simulates average monthly Central Valley Project (CVP) operations;

- a Reclamation Sacramento River average monthly temperature simulation model; and

- an average weekly operations model that disaggregated GCID deliveries from PROSIM results.

PROSIM was used to derive average monthly Sacramento River flows downstream of Red Bluff Diversion Dam (RBDD) for the 70-year period of record (1922-1991). Average weekly GCID diversions were simulated using the Sacramento River flow at the HCPP (derived from

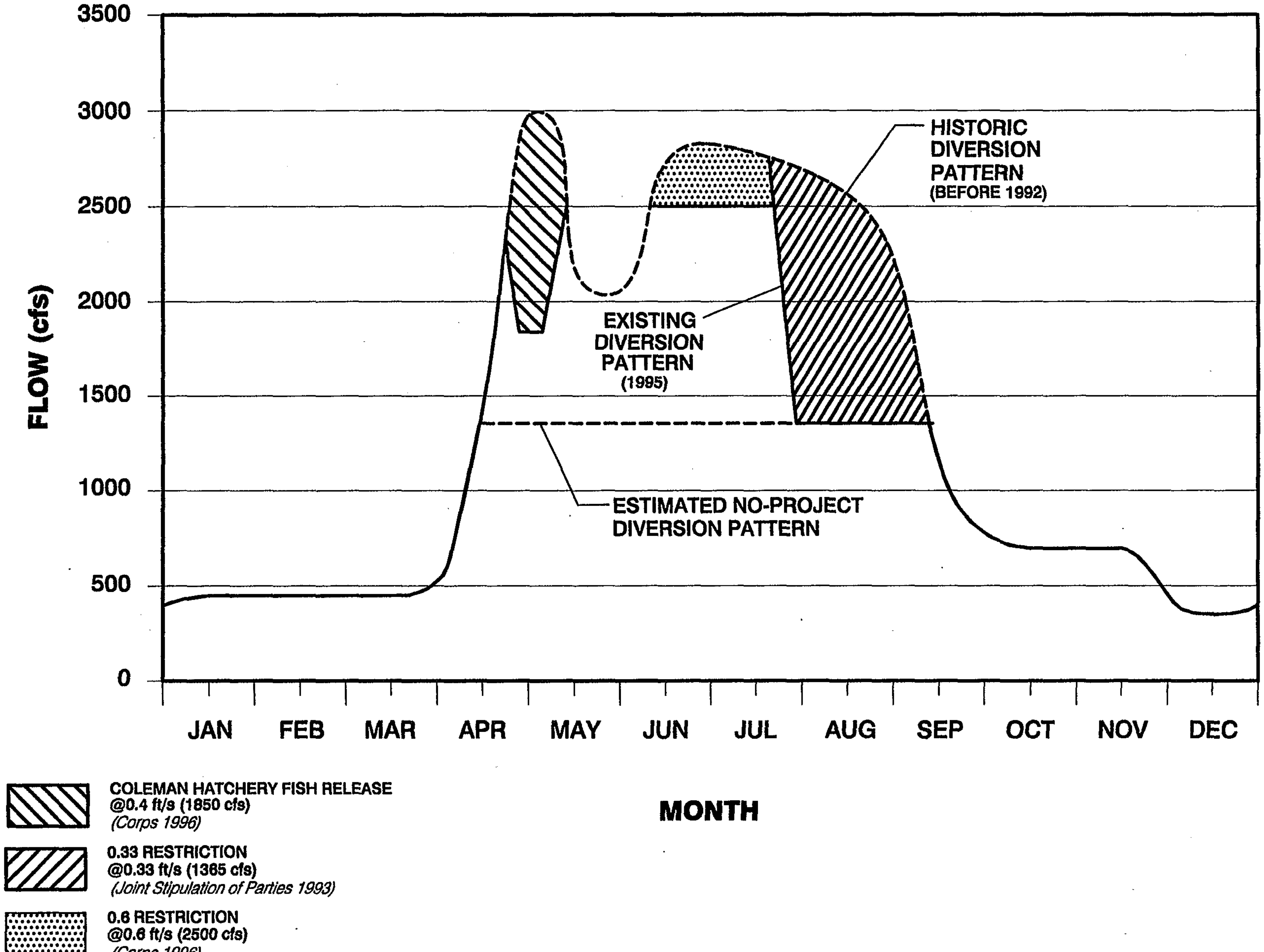

FIGURE 4.1-1. CHANGES TO EXISTING GCID DIVERSION PATTERNS FROM THE NO-PROJECT ALTERNATIVE [a,b]

Sources: GCID (1995a and 1996a) and CH2M Hill (1989)

a) Based upon a water surface elevation of 137 feet at the fish screen.

b) Assumes existing river gradient conditions.

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PROSIM) as input, in addition to projected availability of water from Stony Creek, the Tehama-Colusa Canal (TCC), recapture, and groundwater. Deliveries from each source were determined on a cost-based priority described in Section 3.1.4.1, GCID Deliveries. Output from PROSIM and calculated diversions were input into Reclamation's temperature model to simulate average and seasonal variability in monthly temperatures at Vina and Butte City for the period of record.

The GCID diversions, river flows, and temperature analyses involved two hydrologic conditions: existing conditions and future (2020) conditions. The existing conditions analysis was conducted to determine hydrologic changes attributable to implementing the alternatives compared to existing operating conditions. The future (2020) analysis was conducted to determine long-term changes attributable to the project alternatives within the framework of Reclamation's (1996i) modeling assumptions for the year 2020. For the future level analysis, the no-project condition under a 2020 hydrology served as the baseline for assessing changes in GCID diversions, flow, and temperature. 2020 conditions represent the best available information for estimating long-term effects over the 50-year project life.

Water Quality

Future effects of the project and no-project alternatives on water quality were based upon trends observed since the restricted operations at HCPP. The electrical conductivity analysis was based upon previous trends in the GCID service area, as reported in water measurement reports. Changes in pesticide concentrations were evaluated considering dilution potential under the different alternatives.

River Channel Stability

The analysis of Sacramento River channel stability in the vicinity of the project was based upon ~~an~~ evaluations prepared by Ayres (1996d) and Mussetter Engineering (Mussetter 1997). The evaluations included a literature and field review of historical and existing conditions between River Mile (RM) 201 and RM 210 to determine areas with ongoing erosion and the effects of the January 1997 flood. The evaluation also considered the locations of existing revetments and geologic formations to determine the potential for meander upstream and downstream of the project site, and an analysis of potential changes in riffles controlling the hydraulic gradient in the project area.

Sedimentation

Sedimentation potential in the oxbow resulting from the gradient facility was evaluated in studies by Reclamation (1996a, 1997c). The results of the most recent study by Reclamation (1997c) indicate the gradient facility would have little effect on sedimentation in the oxbow (Table 2.6-1, Issues Considered and Eliminated From Further Analysis). However, sedimentation may occur in the main portion of the river and gradient facility, as discussed in Section 4.1.4, Impacts.

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Flooding Potential During Operation

Flooding potential following construction of the gradient facility was analyzed and eliminated (Table 2.6-1, Issues Considered and Eliminated From Further Analysis). The analysis of flooding potential during construction of the gradient facility is based upon analyses conducted by Ayres (1996d and 1997a). The analyses involved two-dimensional modeling to evaluate the flow split at the head of Montgomery Island.

Groundwater

The analysis of groundwater impacts is based on DWR 1994b, 1994c, and 1996b and assumed future use of groundwater as an alternate source to HCPP diversions.

4.1.4 Impacts

As noted in Section 4.1.1 (Introduction), impacts to hydrology and water resources are dependent on changes in the amount, timing, quality, and distribution of water throughout the conveyance system. Such impacts could occur from construction and operation of the no-project and project alternatives.

Provided below is an analysis of the environmental impacts of the no-project and project alternatives on water resources that would occur in the near-term and throughout the 50-year life of the project. Additional analysis of operational impacts is presented in Appendix B, Hydrology and Water Resources Technical Report. Following in Section 4.1.4.1 through Section 4.1.4.4 are alternative-by-alternative impact determinations.

No-Project Hydrology and Water Resources Analysis

Under the no-project alternative (Section 2.4.1), existing HCPP operating conditions would change. The current screen approach velocity (V_a = 0.33 ft/s) would be applied to the no-project alternative year-round, rather than from August 1 through November 30, resulting in reduced pumping capability at HCPP (Figure 4.1-1). The reduction in pumping would impact GCID deliveries, groundwater, Sacramento River flows, and water quality. However, the long-term viability of this alternative (Section 2.4.1, No-Project Alternative) is uncertain depending upon future changes in river gradient.

GCID Deliveries

Table 4.1-1 compares the existing average monthly deliveries to GCID by supply source over the 70-year hydrologic period of record (1922-1991) to the no-project alternative HCPP operating conditions. Under the no-project alternative, GCID diversions at the HCPP would decrease an average of 137,000 acre-feet (ac-ft) per year and reduce GCID's ability to meet peak demands during the irrigation season. This reduction in diversion at the HCPP would result in increased use of Stony Creek, TCC, recaptured water, and groundwater.

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Table 4.1-1 - Comparison of Existing Conditions to the No-Project Alternative for Simulated Average Monthly Deliveries to GCID by Supply Source (in thousands of acre-feet)

	Hamilton City Pumping Plant			Stony Creek			Recapture			Tehama-Colusa Canal			Groundwater		
Month	Ex	NP	Ch	Ex	NP	Ch	Ex	NP	Ch	Ex	NP	Ch	Ex	NP	Ch
Oct.	16	15	**-1**	1	2	**+1**	2	2	**0**	0	0	**0**	0	0	**0**
Nov.	10	10	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Dec.	6	6	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Jan.	3	3	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Feb.	3	3	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Mar.	6	6	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Apr.	86	65	**-21**	3	10	**+7**	4	6	**+2**	0	0	**0**	9	23	**+14**
May	116	82	**-34**	2	8	**+6**	22	25	**+3**	3	18	**+15**	1	10	**+9**
Jun.	121	79	**-42**	4	4	**0**	22	23	**+1**	18	58	**+40**	0	0	**0**
Jul.	122	83	**-39**	1	1	**0**	34	40	**+6**	7	41	**+34**	0	0	**0**
Aug.	77	77	**0**	1	1	**0**	34	40	**+6**	38	32	**-6**	0	0	**0**
Sep.	23	23	**0**	0	0	**0**	9	9	**0**	0	0	**0**	0	0	**0**
Total	589	452	**-137**	12	26	**+14**	127	145	**+18**	65	149	**+83**	10	33	**+23**

Ex Existing Conditions
NP No-Project Alternative
Ch Change From Existing Conditions
Note: The increases and decreases in water use do not balance due to rounding of output.

GCID could not rely on the TCC as a long-term reliable diversion point. The ability to divert GCID's water at RBDD would be based upon available capacity after deliveries were made to TCC Authority (TCCA) water contractors. Future capacity of the canal is contractually committed, and available capacity would depend upon actual deliveries to TCCA contractors. Also, the gates at RBDD must currently be raised from September 15 to May 15 of each year to allow for fish passage (NMFS 1993), making the TCC capacity unavailable during critical irrigation periods. Consequently, the future reliability of the TCC as a water delivery source is uncertain.

GCID has prior rights under the Angle Decree to natural streamflow in Stony Creek. GCID has indicated that it would increase the use of this water from Stony Creek as a substitution of water diverted at HCPP. The diversion from Stony Creek would potentially impact other Stony Creek water users, including TCCA. Possible indirect effects to the TCCA are speculative, but could include greater reliance on groundwater, shifting of crop patterns, and/or land fallowing to reduce demand.

Reduced pumping at HCPP would lead to increased use of groundwater, which could lead to localized declines in the groundwater table. The magnitude of the decline would depend upon a number of factors, including the recharge rate of the aquifers, quantity and rate of local withdrawal, and location of new wells.

Sacramento River Flows

Table 4.1-2 compares the modeled existing average monthly Sacramento River flows downstream of RBDD for the 1922-1991 hydrologic period to no-project alternative hydrologic conditions. Tables summarizing the flow by month for each year are contained in Appendix B, Hydrology and Water Resources Technical Report.

Table 4.1-2 - Comparison of Existing Conditions to the No-Project Alternative for Simulated Average Monthly Flows in the Sacramento River Downstream of RBDD for the 70-year Hydrologic Period of Record (1922-1991)

Existing Hydrologic Conditions			
Month	**Existing Operations [a] (cfs)**	**No-Project Alternative [b] (cfs)**	**Differences Between Existing Operations and No-Project Alternative (cfs)**
Oct.	7,089	7,089	**0**
Nov.	8,401	8,401	**0**
Dec.	13,152	13,152	**0**
Jan.	15,119	15,119	**0**
Feb.	18,150	18,150	**0**
Mar.	14,139	14,139	**0**
Apr.	10,913	10,913	**0**
May	10,158	9,896	**-262**
Jun.	10,063	9,414	**-649**
Jul.	11,462	10,879	**-583**
Aug.	9,185	9,285	**+100**
Sep.	7,821	7,821	**0**

a River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with existing HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

b River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 no-project alternative HCPP operating criteria. No-project assumes, beginning in 1998, increased restrictions at the HCPP, and increased recapture and use of groundwater; see Chapter 2, Project Description and Development of Alternatives. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

cfs Cubic feet per second.

The no-project alternative would decrease flows in the Sacramento River downstream of RBDD during the months of May through July. This change would be due to decreases in GCID diversions at HCPP, while increasing GCID's deliveries via the TCC, resulting in diminished river flows between RBDD and Hamilton City. The no-project alternative would increase flows in the Sacramento River downstream of RBDD during August. This increase in August would be due to expected increases in use of recaptured water (expanded capacity of irrigation recapture facilities) and corresponding decreases in diversions to GCID through the TCC (Table 4.1-1).

Water Quality

Temperature

Tables 4.1-3 and **4.1-4** compare the existing average monthly temperatures in the Sacramento River at Vina and Butte City (Figure 3.1-1) during the period of record (1922-1991) to the no-project alternative. Temperatures at Vina represent conditions between RBDD and the HCPP. Temperatures at Butte City represent conditions downstream of the HCPP. Tables summarizing the temperature by month for the period of record are contained in Appendix B, Hydrology and Water Resources Technical Report.

On average, under the no-project alternative, small temperature changes would occur at Vina and Butte City due to the reduced flows downstream of RBDD. Temperature changes would vary slightly more from the average during individual years. In the driest years the temperature changes would be similar to the average temperature changes shown in the tables. However, in normal years the temperature at Vina and Butte City could increase as much as 0.4°F in June and 0.3°F in July.

The temperature criteria of 56°F is exceeded under existing conditions. The tables are included to show the changes between the no-project alternative and existing conditions. The impacts of these changes are discussed in Section 4.2, Aquatic Resources.

Electrical Conductivity (Salinity)

Increased use of recaptured water would be expected under this alternative, as shown previously in Table 4.1-1 with the 10 new or modified recapture stations. Increased electrical conductivity (salinity) levels would also be expected with the increased use of recaptured water. This assumption is based on information that salinity levels have roughly doubled during the irrigation season in the lower GCID service area since 1986 (refer to Table 3.1-9) with the increased use of recaptured water. Salinity changes depend upon potential changes in cropping patterns, the quantity of water recaptured during a particular season, and other factors such as drought, groundwater conjunctive use, and conservation. There is agreement in the farming community that salinity levels in Colusa Basin Drain water have been increasing and may be high enough to adversely affect rice crops (B. Wallace, pers. comm., 1996; Spyers 1992; Scardaci et al. 1995).

Pesticides

Increased use of recaptured water would be expected under this alternative, as shown previously in Table 4.1-1, with the 10 new or modified recapture stations. Increased recapture could lead to reduced outflow in the Colusa Basin Drain, thus potentially less dilution (Section 3.1.4.5, Water Quality) and increased concentrations of pesticides. Quantifying this is difficult because the potential increase in pesticide concentrations would be speculative and depend upon application and release time, location, and quantity of recapture used during the season. Therefore, the

Table 4.1-3 - Comparison of Existing Conditions to the No-Project Alternative for Simulated Average Monthly Temperatures in the Sacramento River - Vina			
Existing Hydrologic Conditions			
Month	**Existing Operations [a] (°F)**	**No-Project Alternative [b] (°F)**	**Differences Between Existing Operations and No-Project Alternative (°F)**
Oct.	55.7	55.7	**0.0**
Nov.	51.4	51.4	**0.0**
Dec.	46.7	46.7	**0.0**
Jan.	44.5	44.5	**0.0**
Feb.	47.9	47.9	**0.0**
Mar.	51.8	51.8	**0.0**
Apr.	55.6	55.6	**0.0**
May	58.2	58.3	**+0.1**
Jun.	60.4	60.6	**+0.2**
Jul.	60.9	61.1	**+0.2**
Aug.	61.4	61.4	**0.0**
Sep.	58.7	58.7	**0.0**

[a] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with existing HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[b] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 no-project alternative HCPP operating criteria. No-project assumes, beginning in 1998, increased restrictions at the HCPP, and increased recapture and use of groundwater; see Chapter 2, Project Description and Development of Alternatives. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

Table 4.1-4 - Comparison of Existing Conditions to the No-Project Alternative for Simulated Average Monthly Temperatures in the Sacramento River - Butte City			
Existing Hydrologic Conditions			
Month	**Existing Operations [a] (°F)**	**No-Project Alternative [b] (°F)**	**Differences Between Existing Operations and No-Project Alternative (°F)**
Oct.	57.3	57.3	**0.0**
Nov.	51.3	51.3	**0.0**
Dec.	46.0	46.0	**0.0**
Jan.	44.1	44.1	**0.0**
Feb.	48.2	48.2	**0.0**
Mar.	52.5	52.5	**0.0**
Apr.	57.6	57.6	**0.0**
May	61.8	61.8	**0.0**
Jun.	65.8	66.0	**+0.2**
Jul.	67.2	67.3	**+0.1**
Aug.	67.0	66.9	**-0.1**
Sep.	62.8	62.8	**0.0**

[a] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with existing HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[b] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 no-project alternative HCPP operating criteria. No-project assumes, beginning in 1998, increased restrictions at the HCPP, and increased recapture and use of groundwater; see Chapter 2, Project Description and Development of Alternatives. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

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C-085614

analysis of the no-project alternative cannot be quantitatively related to the significance criteria in Section 4.1.2.

Groundwater

Decreased diversions at the HCPP under the no-project alternative would decrease the surface water supply available for GCID to satisfy demands and increase reliance on groundwater, compared to the existing condition.

River Channel Stability

This section discusses the potential for the Sacramento River alignment and water elevation to change in the project vicinity through the 50-year analysis period. Because the no-project alternative does not include construction in the river, there are no construction-related impacts to river channel stability. Also, there are no long-term operational impacts to river channel stability because changes in flows downstream of RBDD are not significant (Table 4.1-2) and occur during the annual low flow period.

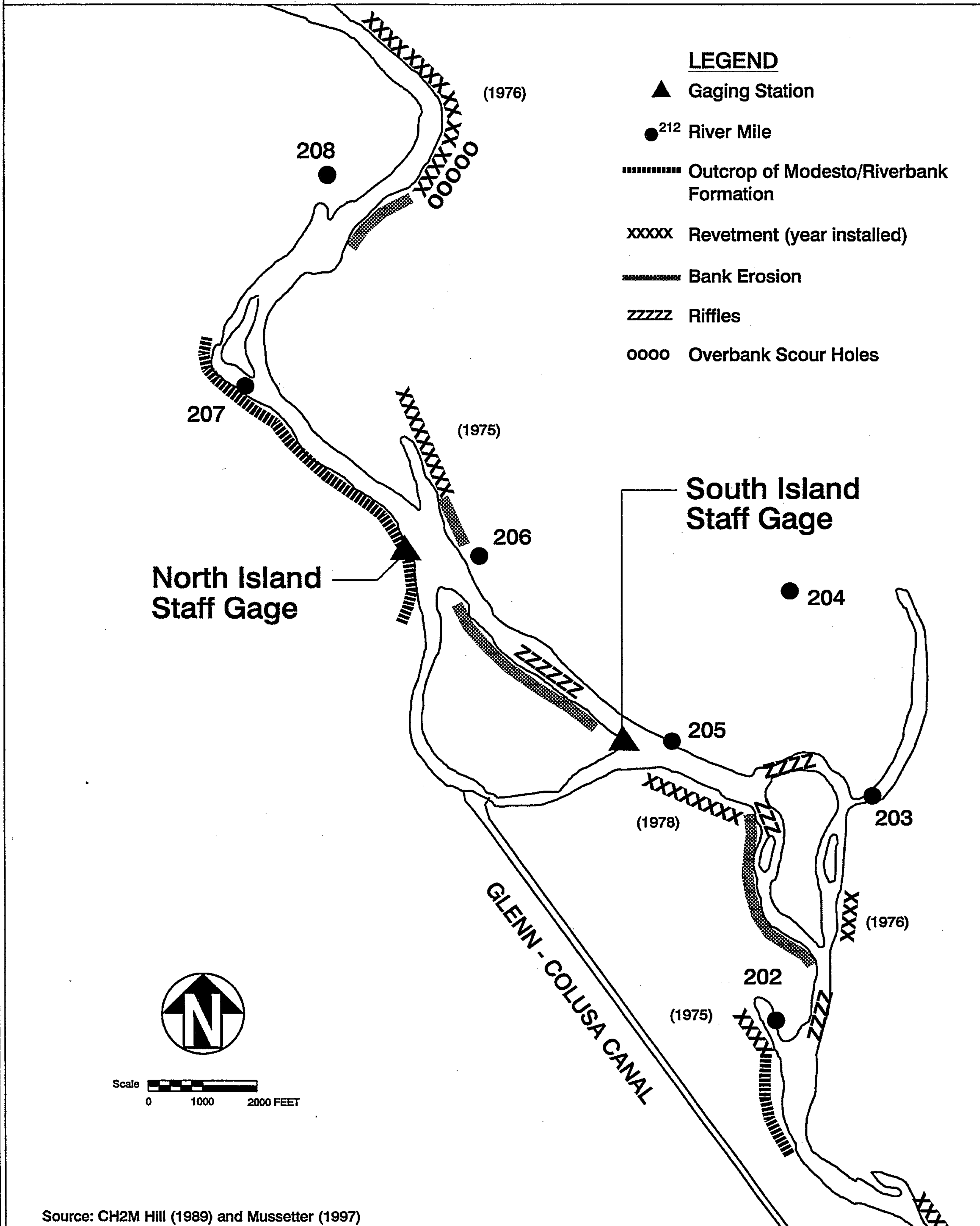
However, the following sections provide the baseline of changes in channel stability from which to measure impacts due to the other alternatives during the analysis period. Also, changes in river stability present certain risks to the operations at the HCPP under the no-project alternative, which would have to be taken into account.

Riffle Stability

Section 3.1.4.6, River Channel Stability, provides a description of the riffles influencing the hydraulic gradient and water surface elevations at the HCPP. These riffles are at RM 205.6 (also known as Picnic Riffle), RM 203.2, and RM 202.5 (**Figure 4.1-2**).

Picnic Riffle at RM 205.6 has been in place since the mid-1970s, and has varied in elevation since its formation (Ayres 1996d), affecting the North Island Gage and hydraulic gradient across the fish screen system (Figure 2.3-1). For example, a Reclamation channel survey conducted in 1996 indicated the riffle at RM 205.6 had degraded about 3.0 feet since 1995, reducing the head differential between the upstream and downstream ends of Montgomery Island to approximately 1.3 feet. Aggradation at RM 202.5 could have also contributed to the decline in the river gradient. Following the January 1997 floods, the riffle aggraded vertically and extended downstream to form a low-relief, mid-channel bar. The source of the sediments was the dredge spoils at the head of Montgomery Island. The riffle is expected to remain into the future as long as the sediment is supplied from the dredge spoils at the head of Montgomery Island (Mussetter 1997). However, its configuration is expected to continue changing. Under the no-project alternative, without a "hard point" in the river to maintain a minimum bed elevation, the water surface elevation and head differential could be further reduced in the future (as in 1996), thereby reducing the effective (wetted) area of the fish screen, fish bypass performance, and HCPP's diversion potential.

FIGURE 4.1-2. APPROXIMATE SACRAMENTO RIVER ALIGNMENT IN PROJECT VICINITY



Source: CH2M Hill (1989) and Mussetter (1997)

Deposition of dredge spoils on the island under existing conditions and the no-project alternative would continue to make material available to build the mid-channel bar that formed in 1997. This could continue to erode the east bank of Montgomery Island. There would be no substantial difference in erosion on Montgomery Island between the existing conditions and the no-project alternative.

The riffle in the easterly branch of the river at RM 203.2 may also continue to vary in elevation, with some potential to affecting the water surface elevation at the location of the South Island Gage (Figure 4.1-23.1-8). The riffle is in an area where sediment is deposited as a result of backwater during high flows. The riffle is protected from meandering by the revetments located at RM 205. As a result of these revetments, it is unlikely that major changes in channel alignment would occur. It is likely that sediment deposition will would impact the riffle (Mussetter 1997) and an increase in elevation at the riffle at RM 203.2 wcould result in an increase of water surface elevation at the South Island Gage and a decrease in head differential across the fish screen. However, the dominant factor expected to continue to control water surface elevation in the lower project reach is the riffle at about RM 202.5 that extends up to about RM 203.

River Meander

The river channel alignment is controlled at several points upstream and downstream of the project vicinity by existing revetments and the Modesto/Riverbank Formation (Section 3.1.4.6, River Channel Stability and Figure 3.1-8). The existing pattern of the Modesto/Riverbank Formation at RM 218, 213, and 206 to 207, and the revetments at RM 211, 209.5, 209, and 206.3 are expected to maintain the channel alignment upstream of the HCPP. Between RM 218 and 206 there are no bends in the channel that would likely be cut-off suddenly during a flood event (Mussetter 1997).

At RM 207, the river has changed alignment in a series of chute cutoffs that moved the channel to the east, followed by periods of westerly migration back to the Modesto/Riverbank Formation outcrop. From 1969 to 1981, the channel occupied an easterly course. Since that time, the channel has been moving progressively westward. If past behavior is repeated, the channel should switch back to an easterly course. Revetment installed in 1975 along the west side of Snaden Island, when the river had the easterly alignment, is still in place and would prevent channel migration to the east of the current alignment (Mussetter 1997).

At RM 206.1, a small amount of bank erosion occurred during the January 1997 flood. Any channel movement upstream of the HCPP would likely be gradual, such that preventative measures could be taken at locations demonstrating a threat of channel movement (Mussetter 1997).

The most probable future change in channel alignment would occur downstream of the riffles at RM 203.2 and 202.5. As described in Section 3.1.4.6, River Channel Stability, the channel is currently eroding to the west, and is projected to do so until the river comes in contact with the Modesto/Riverbank Formation. The increase in channel length would be approximately 1,000 feet, resulting in a decrease in bed slope of approximately 20 percent. Under relatively low flow conditions, the decrease in bed slope and increased sinuosity of the channel would result in energy losses, and hence, increased water surface elevation at the riffles and the South Island Gage. The increased water surface elevation at the South Island Gage would reduce the head differential at the fish screen (Mussetter 1997), reducing the ability of GCID to meet fish passage criteria while diverting water under the no-project alternative.

Sedimentation

The no-project alternative would not significantly change sediment deposition or dredging requirements from the existing condition (Reclamation 1995).

Flooding Potential During Construction

There would be no construction occurring in the mainstem river under this alternative, and therefore, no changes in flooding potential are expected.

Screen Extension Hydrology and Water Resources Analysis

HCPP operations would change under the screen extension alternative (Section 2.4.2). The extended screen would increase the amount of water GCID would be able to divert, while increasing fish protection. However, as with the no-project alternative (Section 2.4.1, No-Project Alternative), the long-term viability of this alternative is uncertain depending upon future changes in river gradient.

GCID Deliveries

Under the screen extension alternative, GCID's historic ability to meet its instantaneous demands through diversions at the HCPP would largely be restored; however, pumping may be restricted at river flows less than 7,000 cubic feet per second (cfs). Table 2.4-2 shows the HCPP capacity for the range of Sacramento River flows during GCID's highest demand period (i.e., the irrigation season from April through October). However, during low flow conditions or when the hydraulic gradient across the screens is low, sweeping velocity, bypass or other fish protection criteria would not be met. Table 2.4-2 pumping rates and the analyses below assume existing river gradient conditions.

The following hydrologic analysis of GCID deliveries was performed for the screen extension alternative:

- **Table 4.1-5** shows changes to GCID deliveries that would result from the screen extension alternative compared to existing conditions and no-project conditions using 1995 hydrologic conditions. **Table 4.1-6** shows changes to GCID deliveries that would result from the screen extension alternative compared to future no-project (2020 hydrologic) conditions.

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Table 4.1-5 - Comparison of Screen Extension Alternative with Existing Conditions and No-Project Conditions
Simulated Average Monthly Deliveries to GCID by Supply Source
(in thousands of acre-feet)

	Hamilton City Pumping Plant					Stony Creek					Recapture					Tehama-Colusa Canal					Groundwater				
Mo	Ex	NP	PA	Ch Ex	Ch NP	Ex	NP	PA	Ch Ex	Ch NP	Ex	NP	PA	Ch Ex	Ch NP	Ex	NP	PA	Ch Ex	Ch NP	Ex	NP	PA	Ch Ex	Ch NP
Oct	16	15	16	**0**	**+1**	1	2	1	**0**	**-1**	2	2	2	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Nov	10	10	10	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Dec	6	6	6	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Jan	3	3	3	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Feb	3	3	3	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Mar	6	6	6	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Apr	86	65	99	**+13**	**+34**	3	10	3	**0**	**-7**	4	6	2	**-2**	**-4**	0	0	0	**0**	**0**	9	23	0	**-9**	**-23**
May	116	82	120	**+4**	**+38**	2	8	2	**0**	**-6**	22	25	21	**-1**	**-4**	3	18	0	**-3**	**-18**	1	10	0	**-1**	**-10**
Jun	121	79	139	**+18**	**+60**	4	4	4	**0**	**0**	22	23	22	**0**	**-1**	18	58	0	**-18**	**-58**	0	0	0	**0**	**0**
Jul	122	83	129	**+7**	**+46**	1	1	1	**0**	**0**	34	40	34	**0**	**-6**	07	41	0	**-7**	**-41**	0	0	0	**0**	**0**
Aug	77	77	115	**+38**	**+38**	1	1	1	**0**	**0**	34	40	34	**0**	**-6**	37	32	0	**-37**	**-32**	0	0	0	**0**	**0**
Sep	23	23	23	**0**	**0**	0	0	0	**0**	**0**	9	9	9	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Total	589	452	669	**+80**	**+217**	12	26	12	**0**	**-14**	127	145	124	**-3**	**-21**	65	149	0	**-65**	**-149**	10	33	0	**-10**	**-33**

Ex Existing Hydrologic Conditions
NP No-Project Alternative
PA Project Alternative - Screen Extension
Ch Ex Change From Existing Hydrologic Conditions
Ch NP Change From No-Project Alternative
Note: The increases and decreases in water use do not balance due to rounding of output.

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Table 4.1-6 - Comparison of Screen Extension Alternative with No-Project Alternative
Simulated Average Monthly Deliveries to GCID by Supply Source
with 2020 Hydrologic Conditions
(in thousands of acre-feet)

Month	Hamilton City Pumping Plant			Stony Creek			Recapture			Tehama-Colusa Canal			Groundwater		
Month	NP	PA	Ch	NP	PA	Ch	NP	PA	Ch	NP	PA	Ch	NP	PA	Ch
Oct.	14	16	**+2**	2	1	**-1**	2	2	**0**	0	0	**0**	0	0	**0**
Nov.	8	8	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Dec.	5	5	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Jan.	2	2	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Feb.	2	2	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Mar.	5	5	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Apr.	63	94	**+31**	10	3	**-7**	6	2	**-4**	0	0	**0**	20	0	**-20**
May	81	120	**+39**	8	2	**-6**	25	21	**-4**	19	0	**-19**	10	0	**-10**
Jun.	79	140	**+61**	4	4	**0**	23	22	**-1**	59	0	**-59**	1	0	**-1**
Jul.	84	131	**+47**	1	1	**0**	40	34	**-6**	41	0	**-41**	0	0	**0**
Aug.	79	118	**+39**	1	1	**0**	40	34	**-6**	33	0	**-33**	0	0	**0**
Sep.	28	29	**+1**	0	0	**0**	9	9	**0**	0	0	**0**	0	0	**0**
Total	450	670	**+220**	26	12	**-14**	145	124	**-21**	152	0	**-152**	31	0	**-31**

NP No-Project Alternative
PA Project Alternative - Screen Extension
Ch Change From No-Project Under 2020 Hydrologic Conditions
Note: The increases and decreases in water use do not balance due to rounding of output.

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HCPP

Under the screen extension alternative, GCID would be able to divert an average of 80,000 ac-ft more water during April through August at the HCPP relative to existing conditions, and 217,000 ac-ft more water relative to the no-project alternative, with existing hydrological conditions. This would decrease the need to use alternative sources of water to meet demands. GCID would be able to divert an average of 220,000 ac-ft more water above the future no-project condition at the HCPP, further decreasing the need for TCC diversions, recaptured water, and groundwater.

Stony Creek

Although the screen extension alternative would not change the demand of Stony Creek water compared to existing conditions, it would decrease the use of Stony Creek water compared to the no-project condition by 14,000 ac-ft per year throughout the 50-year analysis period, because of the additional diversion capacity at HCPP due to the screen extension.

Recapture Water

The screen extension alternative would slightly decrease use of recapture water compared to the existing condition. Compared to the no-project alternative, under existing hydrological conditions, the screen extension alternative would decrease the use of recapture water by about 21,000 ac-ft per year and would continue this same effect under future (2020) hydrological assumptions. This would be due to the increased diversion capacity provided by the screen extension alternative.

TCC Capacity

Based on the assumptions used for this analysis, use of the TCC would not occur with the screen extension alternative. This means that compared to the existing condition and the no-project conditions, about 65,000 ac-ft and 149,000 ac-ft, respectively, of TCC capacity would not be needed, assuming current hydrological conditions. This effect would increase under future hydrological assumptions to 152,000 ac-ft per year of TCC capacity not needed relative to the no-project condition.

Groundwater

Under the screen extension alternative, no substantial changes in groundwater use are expected compared to the existing conditions. However, starting in 1998, compared to the no-project condition, the screen extension alternative would result in a net decrease in groundwater use of 33,000 ac-ft per year. In the future, the screen extension alternative would reduce groundwater use by 31,000 ac-ft per year, compared to the no-project condition.

Sacramento River Flows

Table 4.1-7 compares the existing conditions and the no-project alternative to the screen extension alternative for the average monthly Sacramento River flows downstream of RBDD during the period of record (1922-1991) under existing and 2020 hydrologic conditions. Tables summarizing the flow by month for the period of record are contained in Appendix B, Hydrology and Water Resources Technical Report.

The screen extension alternative would increase flows between RBDD and HCPP compared to existing hydrologic conditions, and compared to future (2020) hydrologic conditions would further increase flows in this reach during the months of May through August. This is attributable to a decrease of diversions at the TCC and corresponding increases at HCPP to meet current and future demands.

Water Quality

Temperature

Tables 4.1-8 and **4.1-9** compare the effects of the screen extension alternative with existing conditions and no-project alternative on the average monthly temperatures in the Sacramento River at Vina and Butte City (Figure 3.1-1) during the period of record (1922-1991) under 1995 and 2020 hydrologic conditions. Temperatures at Vina represent conditions between RBDD and the HCPP. Temperatures at Butte City represent conditions downstream of the HCPP. Tables summarizing the temperature by month for the period of record are contained in Appendix B, Hydrology and Water Resources Technical Report.

On average, small temperature changes would occur with the screen extension alternative. Temperature changes would vary slightly more than the average monthly figures during individual years. In critical years, the temperature changes with the screen extension would be similar to the average temperatures shown in the tables. However, in normal years the temperature at Vina could decrease as much as 0.5°F in June and July with the screen extension alternative. The temperature increases at Butte City in April and May are attributable to restored diversion capability at the HCPP and, thereby, reduced flows downstream of the HCPP.

The temperature criteria of 56°F degrees is exceeded under the existing conditions and screen extension alternative. The tables are included to show the changes between the existing conditions and the screen extension alternative. The impacts of these changes are discussed in Section 4.2, Aquatic Resources.

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Table 4.1-7 - Comparison of Screen Extension Alternative with Existing Conditions and No-Project Alternative Simulated Average Monthly Flows in the Sacramento River Downstream of RBDD for 70-Year Hydrologic Period of Record (1922-1991)

Existing Hydrologic Conditions

Month	Existing Operations [a] (cfs)	No-Project Alternative[b] (cfs)	Screen Extension Alternative [c] (cfs)	Differences Between Existing Operations and Screen Extension Alternative (cfs)	Differences Between No-Project Operations and Screen Extension Alternative (cfs)
Oct.	7,089	7,089	7,089	**0**	**0**
Nov.	8,401	8,401	8,401	**0**	**0**
Dec.	13,152	13,152	13,152	**0**	**0**
Jan.	15,119	15,119	15,119	**0**	**0**
Feb.	18,150	18,150	18,150	**0**	**0**
Mar.	14,139	14,139	14,139	**0**	**0**
Apr.	10,913	10,913	10,913	**0**	**0**
May	10,158	9,896	10,236	**+78**	**+340**
Jun.	10,063	9,414	10,449	**+386**	**+1,035**
Jul.	11,462	10,879	11,667	**+205**	**+788**
Aug.	9,185	9,285	9,946	**+761**	**+661**
Sep.	7,821	7,821	7,821	**0**	**0**

2020 Hydrologic Conditions

	No-Project Alternative[d] (cfs)	Screen Extension Alternative[e] (cfs)	Differences Between No-Project and Screen Extension Alternative (cfs)
Oct.	6,059	6,059	**0**
Nov.	8,278	8,278	**0**
Dec.	12,947	12,947	**0**
Jan.	15,224	15,224	**0**
Feb.	18,537	18,537	**0**
Mar.	14,413	14,413	**0**
Apr.	11,023	11,023	**0**
May	9,773	10,129	**+356**
Jun.	9,436	10,477	**+1041**
Jul.	11,765	12,553	**+788**
Aug.	9,976	10,667	**+691**
Sep.	6,531	6,531	**0**

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Footnotes to Table 4.1-7 - Comparison of Screen Extension Alternative with Existing Conditions and No-Project Alternative Simulated Average Monthly Flows in the Sacramento River Downstream of RBDD

[a] River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with existing HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[b] River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 no-project alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[c] River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 screen extension alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[d] River flows of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with no-project alternative HCPP operating criteria, effective 1998. No-project assumes increased restrictions at the HCPP, and increased recapture and use of groundwater beginning in 1998; see Chapter 2, Project Description and Development of Alternatives. This scenario serves as the 2020 baseline hydrologic conditions. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[e] River flows of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with screen extension alternative HCPP operating criteria, effective 1998. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

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Table 4.1-8 - Comparison of Screen Extension Alternative with Existing Conditions and No-Project Alternative Simulated Average Temperatures in the Sacramento River - Vina

Existing Hydrologic Conditions

Month	Existing Operations[a] (°F)	No-Project Alternative[b] (°F)	Screen Extension Alternative[c] (°F)	Differences Between Existing Operations and Screen Extension Alternative (°F)	Differences Between No-Project Operations and Screen Extension Alternative (cfs)
Oct.	55.7	55.7	55.7	0.0	0.0
Nov.	51.4	51.4	51.4	0.0	0.0
Dec.	46.7	46.7	46.7	0.0	0.0
Jan.	44.5	44.5	44.5	0.0	0.0
Feb.	47.9	47.9	47.9	0.0	0.0
Mar.	51.8	51.8	51.8	0.0	0.0
Apr.	55.6	55.6	55.6	0.0	0.0
May	58.2	58.3	58.2	0.0	-0.1
Jun.	60.4	60.6	60.3	-0.1	-0.3
Jul.	60.9	61.1	60.9	0.0	-0.2
Aug.	61.4	61.4	61.2	-0.2	-0.2
Sep.	58.7	58.7	58.7	0.0	0.0

2020 Hydrologic Conditions

Month	No-Project Alternative[d] (°F)	Screen Extension Alternative[e] (°F)	Differences Between No-Project and Screen Extension Alternative (°F)
Oct.	56.2	56.2	0
Nov.	51.3	51.3	0
Dec.	46.6	46.6	0
Jan.	44.5	44.5	0
Feb.	47.8	47.8	0
Mar.	51.8	51.8	0
Apr.	55.6	55.6	0
May	58.3	58.3	0
Jun.	60.7	60.3	-0.4
Jul.	60.4	60.2	-0.2
Aug.	60.9	60.7	-0.2
Sep.	60.0	60.0	0

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Footnotes to Table 4.1-8 - Comparison of Screen Extension Alternative with Existing Conditions and No-Project Alternative Simulated Average Monthly Temperatures in the Sacramento River - Vina

[a] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with existing HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[b] River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 no-project alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[c] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 screen extension alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[d] Temperatures of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with no-project alternative HCPP operating criteria, effective 1998. No-project assumes increased restrictions at the HCPP, and increased recapture and use of groundwater beginning in 1998; see Chapter 2, Project Description and Development of Alternatives. This scenario serves as the 2020 baseline hydrologic conditions. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[e] Temperatures of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with screen extension alternative HCPP operating criteria, effective 1998. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

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Table 4.1-9 - Comparison of Screen Extension Alternative with Existing Conditions and No-Project Alternative
Simulated Average Temperatures in the Sacramento River - Butte City

Existing Hydrologic Conditions

Month	Existing Operations[a] (°F)	No-Project Alternative[b] (°F)	Screen Extension Alternative[c] (°F)	Differences Between Existing Operations and Screen Extension Alternative (°F)	Differences Between No-Project Operations and Screen Extension Alternative (cfs)
Oct.	57.3	57.3	57.3	**0.0**	**0.0**
Nov.	51.3	51.3	51.3	**0.0**	**0.0**
Dec.	46.0	46.0	46.0	**0.0**	**0.0**
Jan.	44.1	44.1	44.1	**0.0**	**0.0**
Feb.	48.2	48.2	48.2	**0.0**	**0.0**
Mar.	52.5	52.5	52.5	**0.0**	**0.0**
Apr.	57.6	57.6	57.7	**+0.1**	**+0.1**
May	61.8	61.8	61.8	**0.0**	**0.0**
Jun.	65.8	66.0	65.8	**0.0**	**-0.2**
Jul.	67.2	67.3	67.1	**-0.1**	**-0.2**
Aug.	67.0	66.9	66.8	**-0.2**	**-0.1**
Sep.	62.8	62.8	62.8	**0.0**	**0.0**

2020 Hydrologic Conditions

Month	No-Project Alternative[d] (°F)	Screen Extension Alternative[e] (°F)	Differences Between No-Project and Screen Extension Alternative (°F)
Oct.	57.8	57.8	**0**
Nov.	51.2	51.2	**0**
Dec.	46.0	46.0	**0**
Jan.	44.2	44.2	**0**
Feb.	48.2	48.2	**0**
Mar.	52.5	52.5	**0**
Apr.	57.5	57.6	**+0.1**
May	61.9	62.0	**+0.1**
Jun.	66.1	65.9	**-0.2**
Jul.	66.6	66.4	**-0.2**
Aug.	66.5	66.3	**-0.2**
Sep.	64.2	64.2	**0**

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Footnotes to Table 4.1-9 - Comparison of Screen Extension Alternative with Existing Conditions and No-Project Alternative Simulated Average Monthly Temperatures in the Sacramento River - Butte City

[a] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with existing HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[b] River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 no-project alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[c] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 screen extension alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[d] Temperatures of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with no-project alternative HCPP operating criteria, effective 1998. No-project assumes increased restrictions at the HCPP, and increased recapture and use of groundwater beginning in 1998; see Chapter 2, Project Description and Development of Alternatives. This scenario serves as the 2020 baseline hydrologic conditions. Refer to Appendix B (Hydrology and Water Resources) for specific assumptions.

[e] Temperatures of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with screen extension alternative HCPP operating criteria, effective 1998. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

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Electrical Conductivity (Salinity)

As indicated by Tables 4.1-5 and 4.1-6, under the screen extension alternative, GCID would rely less on recaptured water compared to the no-project alternative (21,000 ac-ft less) throughout the analysis period. Reduced reliance on this water source could mean reduced salinity levels in the drain water, helping to stabilize and potentially improve the quality of the water for farming. The degree of improvement to water quality, relative to the existing or no-project conditions, would be very difficult to quantify.

Pesticides

As indicated by Tables 4.1-5 and 4.1-6, under the screen extension alternative, GCID would rely less on recaptured water in the Colusa Basin Drain, thus, there could be more water in the Colusa Basin Drain which could dilute, and potentially decrease, pesticide concentrations.

River Channel Stability

The river channel stability discussion for the no-project alternative applies to the screen extension alternative because this alternative does not include any stabilization of the river channel. Continued risks of changes in alignment and gradient would also be expected to occur with the screen extension alternative and HCPP operations could be adversely affected, as described previously.

Sedimentation

Under the screen extension alternative, no substantial changes in sedimentation are expected (Reclamation 1985). It is expected that sedimentation and associated dredging operations would be similar to historic operations.

Flooding Potential During Construction

There would be no construction occurring in the main river channel that could lead to increased water surface elevations upstream of Montgomery Island under this alternative, and therefore, no changes in flooding potential would be expected during construction. The effects of construction in the oxbow channel would be negligible because they would take place during the non-flood season.

Screen Extension with Gradient Facility Hydrology and Water Resources Analysis

Existing HCPP operations would change under the screen extension with gradient facility alternative (Section 2.4.3). The alternative would provide GCID with increased diversion capability (Table 2.4.2) while protecting fish. Unlike the no-project and screen extension alternatives, however, the risk of future major changes in river gradient would be minimized with this alternative (Section 2.4.3, Screen Extension with Gradient Facility Alternative).

GCID Deliveries

Construction of the fish screen extension with gradient facility would largely restore GCID's historic ability to meet its instantaneous demands through HCPP diversions. For Sacramento River flows as low as 7,000 cfs, the existing HCPP pumping capacity of 3,000 cfs could be achieved (Table 2.4-2).

Table 4.1-10 compares the screen extension with gradient facility alternative to existing conditions and no-project alternative for the average monthly deliveries to GCID by supply source over the 70-year hydrologic period of record (1922-1991) under existing hydrologic conditions. With the screen extension with gradient facility alternative, GCID would be able to divert an average of 80,000 ac-ft more water during April through August at the HCPP relative to existing conditions, and 217,000 ac-ft more water relative to the no-project alternative, decreasing TCC diversions, recaptured water, and groundwater, and restoring GCID's ability to meet instantaneous demands during the peak irrigation season from the HCPP.

Table 4.1-11 compares the no-project alternative to the screen extension with gradient facility alternative for the average monthly deliveries to GCID by supply source over the 70-year hydrologic period of record (1922-1991) under future conditions (2020 hydrology). The results show that for the screen extension with gradient facility alternative, diversions from April to September would increase relative to the future conditions. GCID would be able to divert an average of 220,000 ac-ft more water than the future no-project alternative at the HCPP, decreasing TCC diversions, recaptured water, and groundwater. Also, for the no-project alternative, a comparison of Table 4.1-1 with 4.1-11 shows a slight decline in the future.

Sacramento River Flows

Table 4.1-12 compares both the existing condition and the no-project alternative to the screen extension with gradient facility alternative for the average monthly Sacramento River flows downstream of RBDD during the 70-year hydrologic period of record under existing and 2020 hydrologic conditions. The results are similar to those with the screen extension alternative. Tables summarizing the flow by month for the 70-year period of record are contained in Appendix B, Hydrology and Water Resources Technical Report.

The effect of the screen extension with gradient facility alternative would be to increase flows between RBDD and HCPP under existing hydrologic conditions and, in the future, further increase flows in this reach during the months of May through August. This is attributable to a decrease of diversions at the TCC and corresponding increases at HCPP to meet current and future demands, compared to the no-project and existing conditions.

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Table 4.1-10 - Comparison of Screen Extension with Gradient Facility Alternative with Existing Conditions and No-Project Alternative Simulated Average Monthly Deliveries to GCID by Supply Source (in thousands of acre-feet)

	Hamilton City Pumping Plant					Stony Creek					Recapture					Tehama-Colusa Canal					Groundwater				
Mo	Ex	NP	PA	Ch Ex	Ch NP	Ex	NP	PA	Ch Ex	Ch NP	Ex	NP	PA	Ch Ex	Ch NP	Ex	NP	PA	Ch Ex	Ch NP	Ex	NP	PA	Ch Ex	Ch NP
Oct	16	15	16	**0**	**+1**	1	2	1	**0**	**-1**	2	2	2	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Nov	10	10	10	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Dec	6	6	6	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Jan	3	3	3	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Feb	3	3	3	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Mar	6	6	6	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Apr	86	65	100	**+13**	**+35**	3	10	3	**0**	**-7**	4	6	2	**-2**	**-4**	0	0	0	**0**	**0**	9	23	0	**-9**	**-23**
May	116	82	120	**+4**	**+38**	2	8	2	**0**	**-6**	22	25	21	**-1**	**-4**	3	18	0	**-3**	**-18**	1	10	0	**-1**	**-10**
Jun	121	79	139	**+18**	**+60**	4	4	4	**0**	**0**	22	23	22	**0**	**-1**	18	58	0	**-18**	**-58**	0	0	0	**0**	**0**
Jul	122	83	129	**+7**	**+46**	1	1	1	**0**	**0**	34	40	34	**0**	**-6**	7	41	0	**-7**	**-41**	0	0	0	**0**	**0**
Aug	77	77	115	**+38**	**+38**	1	1	1	**0**	**0**	34	40	34	**0**	**-6**	37	32	0	**-37**	**-32**	0	0	0	**0**	**0**
Sep	23	23	23	**0**	**0**	0	0	0	**0**	**0**	9	9	9	**0**	**0**	0	0	0	**0**	**0**	0	0	0	**0**	**0**
Total	589	452	669	**+80**	**+217**	12	26	12	**0**	**-14**	127	145	124	**-3**	**-21**	65	149	0	**-65**	**-149**	10	33	0	**-10**	**-33**

Ex Existing Hydrologic Conditions
NP No-Project Alternative
PA Project Alternative - Screen Extension with Gradient Facility
Ch Ex Change From Existing Hydrologic Conditions
Ch NP Change From No-Project Alternative
Note: The increases and decreases in water use do not balance due to rounding of output.

Table 4.1-11 - Comparison of Screen Extension with Gradient Facility Alternative With No-Project Alternative
Simulated Average Monthly Deliveries to GCID by Supply Source with 2020 Hydrologic Conditions
(in thousands of acre-feet)

	Hamilton City Pumping Plant			Stony Creek			Recapture			Tehama-Colusa Canal			Groundwater		
Month	NP	PA	**Ch**	NP	PA	**Ch**	NP	PA	**Ch**	NP	PA	**Ch**	NP	PA	**Ch**
Oct.	14	16	**+2**	2	1	**-1**	2	2	**0**	0	0	**0**	0	0	**0**
Nov.	8	8	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Dec.	5	5	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Jan.	2	2	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Feb.	2	2	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Mar.	5	5	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Apr.	63	94	**+31**	10	3	**-7**	6	2	**-4**	0	0	**0**	20	0	**-20**
May	81	120	**+39**	8	2	**-6**	25	21	**-4**	19	0	**-19**	10	0	**-10**
Jun.	79	140	**+61**	4	4	**0**	23	22	**-1**	59	0	**-59**	1	0	**-1**
Jul.	84	131	**+47**	1	1	**0**	40	34	**-6**	41	0	**-41**	0	0	**0**
Aug.	79	118	**+39**	1	1	**0**	40	34	**-6**	33	0	**-33**	0	0	**0**
Sep.	28	29	**+1**	0	0	**0**	9	9	**0**	0	0	**0**	0	0	**0**
Total	450	670	**+220**	26	12	**-14**	145	124	**-21**	152	0	**-152**	31	0	**-31**

NP No-Project Alternative
PA Project Alternative - Screen Extension with Gradient Facility
Ch Change From No-Project Under 2020 Hydrologic Conditions
Note: The increases and decreases in water use do not balance due to rounding of output.

C-085633

Table 4.1-12 - Comparison of Screen Extension with Gradient Facility Alternative With Existing Conditions and No-Project Alternative Simulated Average Monthly Flows in the Sacramento River Downstream of RBDD

Existing Hydrologic Conditions

Month	Existing Operations[a] (cfs)	No-Project Alternative[b] (cfs)	Screen Extension with Gradient Facility Alternative[c] (cfs)	Differences Between Existing Operations and Screen Extension with Gradient Facility Alternative (cfs)	Differences Between No-Project Operations and Screen Extension with Gradient Facility Alternative (cfs)
Oct.	7,089	7,089	7,089	**0**	**0**
Nov.	8,401	8,401	8,401	**0**	**0**
Dec.	13,152	13,152	13,152	**0**	**0**
Jan.	15,119	15,119	15,119	**0**	**0**
Feb.	18,150	18,150	18,150	**0**	**0**
Mar.	14,139	14,139	14,139	**0**	**0**
Apr.	10,913	10,913	10,913	**0**	**0**
May	10,158	9,896	10,237	**+79**	**+341**
Jun.	10,063	9,414	10,450	**+387**	**+1,036**
Jul.	11,462	10,879	11,667	**+205**	**+788**
Aug.	9,185	9,285	9,950	**+765**	**+665**
Sep.	7,821	7,821	7,821	**0**	**0**

2020 Hydrologic Conditions

Month	No-Project Alternative[d] (cfs)	Screen Extension with Gradient Facility Alternative[e] (cfs)	Differences Between No-Project and Screen Extension with Gradient Facility Alternative (cfs)
Oct.	6,059	6,059	**0**
Nov.	8,278	8,278	**0**
Dec.	12,947	12,947	**0**
Jan.	15,224	15,224	**0**
Feb.	18,537	18,537	**0**
Mar.	14,413	14,413	**0**
Apr.	11,023	11,023	**0**
May	9,773	10,129	**+356**
Jun.	9,436	10,483	**+1047**
Jul.	11765	12,553	**+788**
Aug.	9,976	10,670	**+694**
Sep.	6,531	6,531	**0**

C-085634

Footnotes to Table 4.1-12 - Comparison of Screen Extension with Gradient Facility Alternative with Existing Conditions and No-Project Alternative
Simulated Average Monthly Flows in the Sacramento River Downstream of RBDD

[a] River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with existing HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[b] River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 no-project alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[c] River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 screen extension with gradient facility alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[d] River flows of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with no-project alternative HCPP operating criteria, effective 1998. No-Project assumes increased restrictions at the HCPP, and increased recapture and use of groundwater beginning in 1998; see Chapter 2, Project Description and Development of Alternatives. This scenario serves as the 2020 baseline hydrologic conditions. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[e] River flows of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with screen extension with gradient facility alternative HCPP operating criteria, effective 1998. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

C-085634

Groundwater

Under the screen extension with gradient facility alternative, there would be less use of groundwater, compared to the existing condition. Groundwater use would decline for the 50-year life of the project due to increased ability to meet demands through HCPP. Compared to the no-project alternative, the screen extension with gradient facility alternative shows an even greater decline in use of groundwater for the 50-year project life.

Water Quality

Temperature

Tables 4.1-13 and **4.1-14** compare the screen extension with gradient facility alternative existing conditions and the no-project alternative for the average monthly temperatures in the Sacramento River during the period of record (1922-1991) under existing and 2020 hydrologic conditions at Vina and Butte City (Figure 3.1-1). Temperatures at Vina represent conditions between RBDD and the HCPP. Temperatures at Butte City represent conditions downstream of the HCPP. Tables summarizing the temperatures by month for the period of record are contained in Appendix B, Hydrology and Water Resources Technical Report.

The results are similar to those shown for the screen extension alternative. Small temperature changes are expected. The temperature increases at Butte City in April and May are attributable to restored diversion capability at HCPP and, thereby, reduced flows downstream of the HCPP.

Electrical Conductivity (Salinity)

As indicated by Table 4.1-11, under the screen extension with gradient facility alternative, GCID would rely less on recaptured water compared to the no-project alternative. Reduced reliance on this water source could mean relatively reduced salinity levels in the drain water, helping to stabilize and potentially improve the quality of the water for farming. The degree of improvement to water quality, relative to the existing or no-project conditions, would be very difficult to quantify.

Pesticides

As indicated by Table 4.1-6, under the screen extension with gradient facility alternative, GCID would rely less on recaptured water in the Colusa Basin Drain, thus, there could be more water in the Colusa Basin Drain that could dilute and potentially reduce pesticide concentrations.

River Channel Stability

The gradient facility would provide a "hard point" and local river channel stability at RM 205.6 (Picnic Riffle). The gradient facility would stabilize the flow versus water surface elevation relationship at North Island Gage, increasing water surface elevation and hydraulic gradient for the screen and providing a predictable range in hydraulic gradient across the fish screen and

C-085636

Table 4.1-13 - Comparison of Screen Extension with Gradient Facility Alternative with Existing Conditions and No-Project Alternative Simulated Average Monthly Temperatures in the Sacramento River - Vina

Existing Hydrologic Conditions

Month	Existing Operations[a] (°F)	No-Project Alternative[b] (°F)	Screen Extension with Gradient Facility Alternative[c] (°F)	Differences Between Existing Operations and Screen Extension with Gradient Facility Alternative (°F)	Differences Between No-Project Operations and Screen Extension with Gradient Facility Alternative (cfs)
Oct.	55.7	55.7	55.7	0.0	0.0
Nov.	51.4	51.4	51.4	0.0	0.0
Dec.	46.7	46.7	46.7	0.0	0.0
Jan.	44.5	44.5	44.5	0.0	0.0
Feb.	47.9	47.9	47.9	0.0	0.0
Mar.	51.8	51.8	51.8	0.0	0.0
Apr.	55.6	55.6	55.6	0.0	0.0
May	58.2	58.3	58.2	0.0	-0.1
Jun.	60.4	60.6	60.3	-0.1	-0.3
Jul.	60.9	61.1	60.9	0.0	-0.2
Aug.	61.4	61.4	61.2	-0.2	-0.2
Sep.	58.7	58.7	58.7	0.0	0.0

2020 Hydrologic Conditions

Month	No-Project Alternative[d] (°F)	Screen Extension with Gradient Facility Alternative[e] (°F)	Differences Between No-Project and Screen Extension with Gradient Facility Alternative (°F)
Oct.	56.2	56.2	0
Nov.	51.3	51.3	0
Dec.	46.6	46.6	0
Jan.	44.5	44.5	0
Feb.	47.8	47.8	0
Mar.	51.8	51.8	0
Apr.	55.6	55.6	0
May	58.3	58.3	0
Jun.	60.7	60.3	-0.4
Jul.	60.4	60.2	-0.2
Aug.	60.9	60.7	-0.2
Sep.	60.0	60.0	0

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C-085637

Footnotes to Table 4.1-13 - Comparison of Screen Extension with Gradient Facility Alternative with Existing Conditions and No-Project Alternative
Simulated Average Monthly Temperatures in the Sacramento River - Vina

[a] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with existing HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[b] River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 no-project alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[c] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 screen extension with gradient facility alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[d] Temperatures of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with no-project alternative HCPP operating criteria, effective 1998. No-project assumes increased restrictions at the HCPP, and increased recapture and use of groundwater beginning in 1998; see Chapter 2, Project Description and Development of Alternatives. This scenario serves as the 2020 baseline hydrologic conditions. Refer to Appendix B for specific assumptions.

[e] Temperatures of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with screen extension alternative HCPP operating criteria, effective 1998. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

C-085637

C-085638

Table 4.1-14 - Comparison of Screen Extension with Gradient Facility Alternative with Existing Conditions and No-Project Alternative Simulated Average Monthly Temperatures in the Sacramento River - Butte City

Existing Hydrologic Conditions

Month	Existing Operations[a] (°F)	No-Project Alternative[b] (°F)	Screen Extension with Gradient Facility Alternative[c] (°F)	Differences Between Existing Operations and Screen Extension with Gradient Facility Alternative (°F)	Differences Between No-Project Operations and Screen Extension with Gradient Facility Alternative (cfs)
Oct.	57.3	57.3	57.3	0.0	0.0
Nov.	51.3	51.3	51.3	0.0	0.0
Dec.	46.0	46.0	46.0	0.0	0.0
Jan.	44.1	44.1	44.1	0.0	0.0
Feb.	48.2	48.2	48.2	0.0	0.0
Mar.	52.5	52.5	52.5	0.0	0.0
Apr.	57.6	57.6	57.7	+0.1	+0.1
May	61.8	61.8	61.8	0.0	0.0
Jun.	65.8	66.0	65.8	0.0	-0.2
Jul.	67.2	67.3	67.1	-0.1	-0.2
Aug.	67.0	66.9	66.8	-0.2	-0.1
Sep.	62.8	62.8	62.8	0.0	0.0

2020 Hydrologic Conditions

	No-Project Alternative[d] (°F)	Screen Extension with Gradient Facility Alternative[e] (°F)	Differences Between No-Project and Screen Extension with Gradient Facility Alternative (°F)
Oct.	57.8	57.8	0.0
Nov.	51.2	51.2	0.0
Dec.	46.0	46.0	0.0
Jan.	44.2	44.2	0.0
Feb.	48.2	48.2	0.0
Mar.	52.5	52.5	0.0
Apr.	57.5	57.6	+0.1
May	61.9	62.0	+0.1
Jun.	66.1	65.9	-0.2
Jul.	66.6	66.4	-0.2
Aug.	66.5	66.3	-0.2
Sep.	64.2	64.2	0.0

C—085638

C-085639

Footnotes to Table 4.1-14 - Comparison of Screen Extension with Gradient Facility Alternative with Existing Conditions and No-Project Alternative
Simulated Average Monthly Temperatures in the Sacramento River - Butte City

[a] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with existing HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[b] River flows of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 no-project alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[c] Temperatures of hydrologic period of record (1922-1991) modeled under 1995 CVP operating criteria with 1998 screen extension with gradient facility alternative HCPP operating criteria. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[d] Temperatures of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with no-project alternative HCPP operating criteria, effective 1998. No-Project assumes increased restrictions at the HCPP, and increased recapture and use of groundwater beginning in 1998; see Chapter 2, Project Description and Development of Alternatives. This scenario serves as the 2020 baseline hydrologic conditions. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

[e] Temperatures of hydrologic period of record (1922-1991) modeled under 2020 CVP operating criteria with screen extension with gradient facility alternative HCPP operating criteria, effective 1998. Refer to Appendix B (Hydrology and Water Resources Technical Report) for specific assumptions.

C-085639

through the oxbow. The in-river portion of the gradient facility would consist of approximately 1,000 feet of bed improvements to maintain a minimum bed elevation at the riffle (Section 2.4.3, Screen Extension with Gradient Facility Alternative).

The potential impacts of this alternative that are different from the screen extension alternative fall into two categories: the effect of the gradient facility on the Sacramento River alignment and meander processes and the effect of the gradient facility on upstream flooding. The meander issue includes effects on upstream meandering and downstream meandering, including the risk of the gradient facility being outflanked.

Potential for Gradient Facility to Affect Upstream and Downstream River Meandering

Because the gradient facility would only be hydraulically active at low flows (the range of flows that are less than those required to initiate movement of bed material), it is unlikely that it would have any significant effect on channel meandering downstream. If the gradient facility causes some sediment deposition in the immediate reach upstream of the structure near RM 206, this could reduce the sediment supply to the downstream reach and lead to somewhat accelerated bank erosion in the already eroding reach centered on RM 202.5, relative to the no-project alternative. In addition, the low water and high water bank protection portions of the gradient facility would reduce sediment recruitment areas slightly and could have the same effect. The extent of recruitment and erosion changes would not be substantial.

The current alignment of the Sacramento River upstream of the gradient facility is controlled by the revetment at RM 208, left bank, and the River Bank formation outcrop that extends from about RM 206, right bank to RM 207, right bank. Revetment installed in 1975 along the west side of Snaden Island is still in place and would prevent channel migration to the east of the proposed gradient facility location (Mussetter 1997). Because the hydraulic effects of the gradient facility are negligible at higher flows, when sediment transport and morphologic changes tend to occur, it will have no effect on upstream channel meandering, relative to the no-project alternative. The gradient facility is not expected to cause the local (RM 206 to RM 207) river alignment to meander outside of its current range of the Modesto/Riverbank Formation and Snaden Island revetment (Mussetter 1997) (Figure 4.1-2).

Concern has been expressed by a landowner ~~adjacent~~ on the west side of ~~to~~ the river at RM 206 that increased ~~low~~ water surface elevations ~~river levels~~ upstream of the gradient facility could accelerate bank erosion and retreat. Bank erosion throughout the project area occurs both naturally from river flows and as a result of wave action caused by boat wakes. Rock and riprap have been placed at the base of the bank at RM 206 to slow this process. Depending upon final gradient facility design, increased low water river levels could contribute to increased boat wake erosion of the bank. However, potential increases in bank erosion would not be expected to be substantial. ~~because of~~ River water surface elevations would continue to be in the range of average flows, plans to post boat speed limits in the area of the gradient facility would reduce potential wave erosion, and ~~because of~~ the presence of the erosion-resistant Modesto/Riverbank Formation (Figure 4.1-2) would further serve to minimize erosion potential in this area.

Sedimentation

Reclamation (1997c) sedimentation studies concluded the gradient facility would cause a small (1%-2%) increase in dredge volume in the oxbow (refer to Table 2.6-1, Issues Considered and Eliminated from Further Analysis). The effects of the gradient facility on sediment transport and deposition are difficult to predict. As a result, there could be a potential need for dredging the river upstream and within the gradient facility to remove sediment deposited during high river flows. However, the need for and amount of dredging that could be required in the river and gradient facility is unknown at this time. The amount of deposition could vary from year-to-year, depending on the magnitude of flows and the deposition characteristics of the gradient facility. Current modeling of gradient facility prototypes at Colorado State University is expected to provide additional information on this issue.

Flooding Potential During Construction

Flooding is an issue under this alternative because the proposed construction methods (dry construction involving cofferdams) include blocking portions of the Sacramento River to construct the gradient facility. The proposed construction methods include constructing the gradient facility in four phases (Section 2.4.3, Screen Extension with Gradient Facility). During each phase, one half of the channel width would be blocked, causing an upstream rise in water elevation depth and redirection of more water through the oxbow.

Analyses conducted by Ayres (1996d, 1997a) indicate the upstream increase in water elevation would depend upon when the improvements to the oxbow were completed relative to gradient facility construction. Lower oxbow improvements would be completed after the gradient facility construction. Therefore, the flood capacity of the lower oxbow channel would continue to be available in the oxbow. The rise in water levels upstream would not put adjacent lands at risk of flooding (Ayres 1996d).

Screen Extension with Gradient Facility and Internal Fish Bypass Hydrology and Water Resources Analysis

The results and discussion of the changes to Sacramento River flows and temperatures, GCID diversions, and sedimentation issues presented for the screen extension with gradient facility alternative also would apply to this alternative. No additional substantial changes would be expected.

4.1.4.1 No-Project Impacts

Construction

No potentially significant environmental impacts to hydrology and water resources have been identified due to construction activities (lower oxbow channel improvements and new/modified groundwater wells and recapture stations) associated with the no-project alternative.

Operation

Impact 4.1-1 *Localized declines in the groundwater table.*

A potentially significant impact. Increased pumping restrictions at the HCPP under the no-project alternative would decrease the surface water supply available for GCID to satisfy demands, and would increase reliance on alternative sources, including groundwater. Increased groundwater pumping to satisfy demands could lead to local declines in the groundwater table, resulting in a potentially significant impact.

Impact 4.1-2 *– Increased electrical conductivity and pesticide levels in irrigation water.*

A potentially significant impact. Decreased diversion capability at the HCPP due to increased pumping restrictions would result in increased use of recaptured water, including the possible construction of 10 new or modified recapture stations. There is agreement within the farming community that salinity in Colusa Basin Drain water has been increasing and may be high enough to adversely affect rice crops (B. Wallace, pers. comm., 1996; Spyers 1992; Scardaci et al. 1995). Increased HCPP restrictions under the no-project alternative could cause further adverse effects to agricultural practices in the lower GCID service area and the lower Colusa Basin. Less water in the Colusa Basin Drain could also mean less water to dilute drainage water pesticides levels. This could be a potentially significant impact.

4.1.4.2 Screen Extension Impacts

Construction

No potentially significant environmental effects to hydrology and water resources have been identified for construction activities from the screen extension alternative.

Operation

Impact 4.1-3 *– Reduced electrical conductivity levels in irrigation water.*

A beneficial impact. Increased HCPP diversion rate, up to 3,000 cfs depending on the stage of the Sacramento River, could result in better water quality for agricultural users. There is agreement within the farming community that salinity in Colusa Basin Drain water has been increasing and may be high enough to adversely affect rice crops (B. Wallace, pers. comm., 1996; Scardaci et al.

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C-085642

1995). Return of HCPP capacity would provide opportunity to improve and possibly stabilize electrical conductivity levels in the lower GCID service area and lower Colusa Basin.

4.1.4.3 Screen Extension with Gradient Facility Impacts

The screen extension with gradient facility alternative would have similar construction and operation impacts as the screen extension alternative. This alternative would also have potential effects to flooding and turbidity levels during gradient facility construction.

The extent of the potential turbidity effects are dependent upon the construction method to be used. No potentially significant effects are anticipated with the proposed four-phase construction method. A discussion of turbidity-related issues for alternative gradient facility construction methods are described below.

***Impact 4.1-4** – Flooding potential during construction.*

A less than significant impact. Cofferdams to be used in the mainstem river for gradient facility construction would cause temporary increases in upstream river water surface elevations (Carly 1997). However, construction would occur only during normal low flow periods (April through November) when flood flows in the river are unlikely. Therefore, the increased potential for flooding during construction would be considered less than significant.

Alternative Gradient Facility Construction Methods

The scope of activities that would be anticipated with alternative gradient facility construction methods is presented in Section 2.4.3 (Screen Extension with Gradient Facility Alternative).

In-River (Wet) Construction of the Gradient Facility

This alternative would involve in-water construction using barges, pipeline dredges, hydraulic excavators, and large draglines to construct the gradient facility. Cofferdams would not be utilized. In-river construction would reduce flooding potential; however, as described earlier, the risk of flooding with dry construction methods (i.e., use of cofferdams) would be low. Any manipulation of the bed under this method would likely increase ~~result in~~ turbidity, particularly during the summer and fall low river flow months when there is little sediment movement ~~plumes~~; however, measures would be included in project design (i.e., Reclamation and Corps specifications for construction, conformance with permits, monitoring) to minimize turbidity increases associated with this construction method. Therefore, no potentially significant effects would be expected with this construction method alternative.

One-Phase (Dry) Construction of the Gradient Facility

This alternative would involve using cofferdams to block the Sacramento River upstream of the gradient facility construction site, thus channeling all river flows through the oxbow for the one-phase duration of gradient facility construction. The period of time anticipated for gradient

C-085643

C-085643

facility construction under this alternative would be approximately three months, possibly up to six months. The additional flows in the oxbow would likely increase scouring in the oxbow and thus, increase suspended sediment and turbidity downstream of the construction area. The magnitude of the increase relative to potential increases under the other construction methods is not known.

Measures would be included in project design (i.e., Reclamation and Corps specifications for construction, conformance with permits, monitoring) to minimize turbidity increases associated with this construction method. Therefore, the potential exists for significant impacts from turbidity.

Two-Phase (Dry) Construction of the Gradient Facility

This alternative would involve the installation and removal of cofferdams in two phases. The first would facilitate the construction of the west side of the gradient facility, and the second would facilitate construction of the east side. The entire gradient facility would be constructed in one ~~six-month~~ season, similar to the proposed four-phase, one-year approach. Measures would be included in project design (i.e., Reclamation and Corps specifications for construction, conformance with permits, monitoring) to minimize turbidity increases associated with this construction method. Therefore, no potentially significant impacts from turbidity would be expected with this construction method alternative.

Two-Year Construction Schedule

The construction methods would be similar to those described for the four-phase, one-year alternative, with the exception that the timeline would be extended to two years. During the first year, the downstream half of the gradient facility would be constructed with the upstream portion constructed during the following year. Extending the construction schedule over a two-year period would still require measures to be included in project design (i.e., Reclamation and Corps specifications for construction, conformance with permits, monitoring) to minimize turbidity increases associated with placement of the cofferdams. No potentially significant impacts would be expected with this construction method alternative.

4.1.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass Impacts

No additional impacts beyond those described for the screen extension with gradient facility alternative would be expected for this alternative.

4.1.5 Mitigation

No potentially significant adverse impacts to hydrology and water resources have been identified for the project alternatives. Therefore, no mitigation is recommended. Potentially significant adverse impacts could result from the no-project alternative. Such potentially significant effects would be addressed as part of a separate environmental review process if none of the project alternatives are implemented.

4.2 Aquatic Resources

4.2.1 Introduction

This section presents significance criteria used for assessing potential impacts to aquatic resources, impact assessment methodologies, the significance of anticipated impacts, and proposed measures to mitigate significant or potentially significant impacts.

4.2.2 Impact Significance Criteria

The significance criteria identified in **Table 4.2-1** have been developed for use in assessing impacts to aquatic resources in the project area, and are based upon the California Environmental Quality Act (CEQA) Guidelines.

Impacts to aquatic resources would be considered significant if:

- The habitat of a State or Federal special-status species, including habitat designated as critical habitat, would be reduced or degraded, thereby potentially resulting in a reduction in species abundance.
- Substantial interference with or prevention of the migration of any fish species.
- Substantial reductions in aquatic habitat, either from direct impacts or from secondary impacts that result in substantial loss of aquatic habitat, such as geomorphologic changes in the Sacramento River or decreased water quality in the project study area.
- Substantial change in fish abundance due to changes in factors affecting abundance such as predation, impingement, entrainment, injury, or disease. Any change in the abundance of listed fish species or species proposed for listing would be considered significant.

Table 4.2-1 is organized by issues, design considerations, and significance criteria. The design considerations are consistent with California Department of Fish and Game (CDFG), National Marine Fisheries Service (NMFS), and U.S. Fish and Wildlife Service (USFWS) guidelines for screening projects that were used to design the project alternatives. These guidelines are incorporated into the Fish Protection Evaluation and Monitoring Program (FPEMP) performance criteria (Chapter 6, Environmental Commitments and Mitigation and Monitoring). The significance criteria are used for making impact significance determinations in Section 4.2.4 (Impacts). Each of the project alternatives were designed in cooperation with staff from the USFWS, CDFG, and NMFS.

Table 4.2-1 - Aquatic Resources Significance Criteria		
Issue	**Design Considerations**	**Significance Criteria**
Impingement and Entrainment		
• Impingement of Juvenile Fish on Screen	♦ Approach velocity (≤0.33 feet per second (ft/s)). ♦ Sweeping velocity of at least twice the approach velocity. ♦ Uniform approach and sweeping velocities. ♦ Duration of exposure to the screen.	Substantial change in the potential for fish mortality due to impingement as assessed by: (1) compliance with performance criteria; (2) uniformity of approach and sweeping velocities at the screen face; (3) change in the relative number of fish exposed to the screen; (4) duration of exposure to screen; and (5) high ratio of sweeping velocities/ approach velocities.
• Entrainment of Fish at Early Life Stages at Screen	♦ During pre-design phase, state-of-the-art screen design criteria (3/32 in) were applied.	Substantial change in the potential for fish entrainment at the screen. Substantial change in the potential for early life stages of fish measuring less than 30 millimeters (mm) to be entrained at the screens as assessed by: (1) timing of occurrence; (2) proportion of river flow diverted; and (3) approach and sweeping velocities.
Bypass System Performance		
	♦ Effective attraction or entrance into the bypass system. ♦ Effective conveyance of fish entering bypass system with minimal fish losses due to: (1) direct mortality; (2) latent mortality; and (3) predation (flow greater than 2.0 ft/s).	Substantial change in the potential for fish losses due to: (1) direct mortality in the bypass system; (2) latent mortality outside of the bypass system due to stress or physical injury and subsequent mortality (e.g., disease and/or predation); and (3) disorientation and subsequent predation.
Fish Predation Within the Project Vicinity		
• Upper Oxbow	♦ Lack of predator holding areas (e.g., hydraulic roughness elements, shear zones, and eddy fences creating areas with current velocity less than 2.0 ft/s).	Substantial change in the amount of predator holding areas (i.e., areas with flows less than 2.0 ft/s).
• At Facility: ♦ Screen Face ♦ Oxbow Flow Control Structure ♦ Hydraulic "Hot Spots"	♦ Lack of predator holding areas (e.g., hydraulic roughness elements, shear zones, and eddy fences creating areas with current velocity less than 2.0 ft/s).	Substantial change in the amount of predator holding areas (i.e., areas with flows less than 2.0 ft/s).

C—085646

C-085646

Table 4.2-1 - Aquatic Resources Significance Criteria (Continued)

Issue	Design Considerations	Significance Criteria
Fish Predation With the Project Vicinity(Continued)		
• In Bypass: ◆ Lower Oxbow (Open Channel Bypass) ◆ Internal Bypass	◆ Lack of predator holding areas (e.g., hydraulic roughness elements, shear zones, and eddy fences creating areas with current velocity less than 2.0 ft/s).	Substantial change in the amount of predator holding areas (i.e., areas with flows less than 2.0 ft/s).
• At outfall to Sacramento River	◆ Lack of predator holding areas (e.g., hydraulic roughness elements, shear zones, and eddy fences creating areas with current velocity less than 2.0 ft/s).	Substantial change in the amount of predator holding areas (i.e., areas with flows less than 2.0 ft/s).
• In Sacramento River at Gradient Facility	◆ Lack of predator holding areas (e.g., hydraulic roughness elements, shear zones, and eddy fences creating areas with current velocity less than 2.0 ft/s).	Significantly greater potential for predation at gradient facility than would be expected to occur at a natural riffle within the project vicinity.
Disruption (i.e., Prevention and/or Delay) of Fish Migration Through the Project Vicinity		
• Immigration of Adult Fish ◆ Sacramento River	◆ Ability of the gradient facility to mimic the hydraulics of a natural riffle.	Significant difference in amount or continuity of depths and velocities from those that occur in natural riffles within the project vicinity.
◆ Oxbow	◆ Configuration of oxbow and associated project features not to cause additional disruption (i.e., prevention or delay) of fish immigration.	Substantial change in the degree to which the oxbow disrupts (i.e., prevents or delays) fish immigration.
• Downstream Emigration of Juvenile Fish ◆ Sacramento River ◆ Oxbow	◆ Configuration of oxbow and associated project features not to cause additional disruption (i.e., prevention or delay) of fish emigration. ◆ Timing of project construction activities relative to seasonality of emigration.	Substantial change in the degree to which juvenile fish emigration through the project vicinity is disrupted (i.e., prevented or delayed).

C—085647

C-085647

Table 4.2-1 - Aquatic Resources Significance Criteria (Continued)		
Issue	**Design Considerations**	**Significance Criteria**
Alteration of Aquatic Habitat		
• Oxbow ♦ Channelization of Oxbow	♦ Elimination of hydraulic roughness elements and construction of a trapezoidal channel configuration.	Substantial loss of fish spawning and/or rearing habitat within the Sacramento River system.
• Sacramento River	♦ Not applicable.	Substantial loss of Sacramento River fish spawning and/or rearing habitat at or upstream of the gradient facility location.
• Shaded Riverine Aquatic Cover (SRA Cover)	♦ Protection of existing amount (i.e., acreage) of SRA Cover.	Decrease in SRA Cover.
Degradation of Water Quality Within the Project Area		
• Temperature	♦ Not applicable.	Substantial change in seasonal water temperatures that would affect fish spawning, incubation, rearing and/or migration within the project area.
• Turbidity/Sedimentation ♦ Oxbow	♦ Minimize turbidity and sedimentation during construction.	Change in turbidity/sedimentation levels to a degree that would: (1) affect fishery and benthic macroinvertebrate resources (short-term); (2) affect performance of fish screen (long-term); (3) affect bioavailability of contaminants to aquatic life (short-term).
♦ Sacramento River	♦ Not applicable.	Change in turbidity/sedimentation levels to a degree that would: (1) affect fishery and benthic macroinvertebrate resources (short-term); (2) affect performance of gradient facility (long-term); (3) affect bioavailability of contaminants to aquatic life (short-term).

4.2.3 Methods

Hydrologic modeling of the Central Valley Project was performed under the existing (1995) and future (2020) levels of demand and operations. For a detailed description of the methods employed for hydrologic modeling using Reclamation's PROSIM model, see Section 4.1, Hydrology and Water Resources and Appendix B, Hydrology and Water Resources Technical Report. In addition to hydrologic evaluations, specific analyses were performed to assess project-related impacts to fish resulting from: (1) impingement and entrainment at the screen; (2) bypass system performance; (3) predation; (4) disruption of migration; (5) alteration of aquatic habitat; and (6) degradation of water quality. For each project alternative, both short-term, construction-related impacts and long-term operation and maintenance related impacts to aquatic

C-085648

C-085648

resources were assessed. For all assessments, impacts that would be expected to occur under each project alternative were compared to the existing condition. The existing condition (1995) is considered to be the same as the future condition (2020), because any determination of differences in the future condition would be highly speculative. An exception is for temperature and flow impacts, which were assessed using hydrologic modeling. In these cases, the impacts are discussed for both 1995 and 2020 conditions. Specific methodologies for assessing impacts associated with the above six issues are discussed below.

More than 30 species of fish are known to use the Sacramento River (Table 3.2-3). Although each species in the river fulfills an ecological role, impact analyses focused on the following fish species of management concern:

- chinook salmon (all four runs);
- steelhead;
- green sturgeon; and
- Sacramento splittail.

These species were evaluated because they are indicator species for the upper Sacramento River fish community, have recreational or economic importance, and/or have protected status under the State Endangered Species Act (CESA) and/or the Endangered Species Act of 1973 as amended (ESA). Additional discussion of species having protected status under State CESA or Federal ESA is presented in Appendix A, Biological Assessment. Evaluation of impacts to these species is assumed to encompass the potential impacts that would occur to other fish species utilizing the upper Sacramento River, including species of special concern, such as the river lamprey and hardhead. Thus, the evaluation of impacts to upper Sacramento River fishery resources focuses primarily on the above four species.

As part of assessing various impacts to fishery resources within the oxbow, changes in the relative proportion of river flow diverted into the oxbow was considered. As the proportion of Sacramento River flow diverted increases, the potential exists to divert more fish into the oxbow. The actual relationship that defines changes in the relative number of fish diverted into the oxbow as the proportion of Sacramento River flow diverted increases is not definitively known at this time for either larval or juvenile fish life stages. The actual relationship would likely be both species- and size-specific, because factors such as swimming ability, uniformity of distribution across the river channel, and microhabitat preferences during emigration would all affect this relationship. In addition, the relationship may change with changes in river flow rates. Consequently, for the purposes of impact assessment for aquatic resources, it was assumed that changes in the relative number of fish diverted into the oxbow would be directly proportionate to changes in the proportion of river flow diverted into the oxbow.

Recent studies conducted at Reclamation District (RD) 1004, Princeton, and RD 108 Wilkins Slough water diversions indicate that, at least for the relatively low proportion of river flow diverted (about 250 cubic feet per second (cfs) at RD 1004 and 500 cfs at RD 108), juvenile chinook salmon were diverted (entrained) at rates much lower than would be expected based on the proportion of Sacramento River flow diverted (C. Hanson, pers. comm., 1996). Conversely,

C-085649

C-085649

investigations of juvenile salmonids entering Georgiana Slough have indicated that the relative number of young fish entering the slough was found to be related to the relative proportion of Sacramento River flow entering the slough (C. Hanson, pers. comm., 1997). Similarly, a study of fish passage at Red Bluff Diversion Dam (RBDD) (Vogel and Marine 1988) concluded that juvenile salmon migrating downstream were diverted into the Tehama Colusa Canal (TCC) at a rate proportional to the amount of flow diverted. In both of the latter studies, the proportion of river flow diverted (either into Georgiana Slough or TCC) was relatively large, whereas in the RD 1004 and RD 108 studies, the proportion of river flow diverted was small. Hence, changes in the relative numbers of young fish diverted from the Sacramento River may be approximately proportional to changes in the proportion of river flow diverted when the diversion constitutes a relatively large proportion of total river flow (e.g., TCC and Georgiana Slough), but may not be proportional when the diversion constitutes a relatively small proportion of the total river flow (e.g., RD 1004 and RD 108).

Because numerous site-specific factors and fish behaviors can affect the relative proportionality at which various fish species are diverted at different diversion rates, definitively determining such proportionality for any given diversion and fish species would require extensive site-specific field investigations over a variety of river flow and diversion rates. Based on available information, a conservative approach to be used for this EIR/EIS is to assume that fish are diverted from the main channel relative to the proportion of river flow diverted. Hence, if the proportion of river flow being diverted were to increase by 10%, it also will be assumed that the relative number of fish diverted into the oxbow would increase by approximately 10%. Conversely, if the proportion of river flow diverted into the oxbow were to decrease, the relative number of fish diverted into the oxbow will be assumed to decrease proportionately.

Screen Impacts

Impacts to Sacramento River fishery resources resulting from impingement and/or entrainment (of fish less than 30 millimeters (mm); the screens would exclude juvenile salmonids and other fish larger than 30 mm) at the fish screen were assessed based on the proportion of river flow diverted into the oxbow, estimated maximum screen exposure times, and the uniformity of screen approach and sweeping velocities under river flow/HCPP pumping rate conditions ranging from 5,000/1,000 cfs to 60,000/3,000 cfs. Screen approach and sweeping velocity data used for assessing these impacts were developed by Reclamation (1996e).

Bypass-Related Impacts

Impacts to fishery resources due to latent mortality caused by physical injury, stress, and/or predation following transport through the internal bypass system were assessed based on anticipated bypass hydraulics (i.e., at the bypass bays, within the pipes, and at the outfall) and time of transport in the internal bypass pipes (estimated from length of bypass pipes and anticipated bypass velocities). In addition to assessing the overall effectiveness of the bypass system based on design criteria, time of transport coupled with the relative potential for predator holding areas near the bypass outfall was used to assess the potential for latent mortality of

C-085650

C-085650

bypassed fish due to predation. Finally, latent mortality due to both physical injury and predation was assumed to increase with increasing time of transport in the internal bypass system.

Predation Impacts

To assess the overall potential for predation impacts under each alternative, changes in the availability of potential predator holding habitat was assessed at all areas where a project alternative could alter the existing amount of predator holding habitat, including: (1) the upper oxbow; (2) screen face; (3) lower oxbow; (4) confluence of lower oxbow with the Sacramento River's main channel; and (5) at internal bypass outfalls. Because a project alternative could increase the potential for predation in some areas within the project vicinity while decreasing it in others, the assessment included whether the overall potential for fish losses due to predation within the entire project vicinity would be expected to increase or decrease under any given alternative.

The primary fish species in the project area that prey upon juvenile salmonids and other juvenile emigrant anadromous species include Sacramento squawfish, American shad, and striped bass. These predatory fish species are referred to as "sit-and-wait" or "ambush" predators, which means they hold their position in the water column and wait for opportunities to ambush and consume prey as they (the prey) move past the predator. For this foraging strategy to be energetically beneficial to the predator, the waiting or holding must occur in areas where the predator is not expending large amounts of energy to simply hold its position. In other words, these predatory fish require areas with relatively low current velocities.

Back eddies, shear zones, and other hydraulic irregularities that occur around hydraulic roughness elements within a river channel can create areas where current velocities are less than 2.0 feet per second (ft/s). It is important to note, however, that current velocity is only one of several important factors that collectively dictate whether a predator will use an area as a feeding site. Other important factors include, but are not limited to: (1) water depth; (2) water quality; (3) channel morphology and adjacent hydraulics; (4) abundance of prey; and (5) competition with other predatory fish. Hence, areas characterized by low turbidity and low current velocities adjacent to areas containing relatively high densities of juvenile fish (e.g., along the fish screen structure and at fish bypass outfalls) can serve as ideal predator holding areas. Predation rates could become even higher if the juvenile fish are disoriented when they pass predatory ambush sites (e.g., below dams and bypass outfalls).

The fact that numerous and diverse factors affect predation losses of juvenile fish emigrating through the oxbow may explain why some past studies of the predation issue at the HCPP have reported conflicting conclusions. In studies intended to evaluate the extent of predation by squawfish at the HCPP, Cramer & Associates (1993) concluded that squawfish predation on juvenile chinook salmon was low during the period when the study was conducted. However, the CDFG and others have questioned these conclusions on the basis of sampling problems and insufficient data. Based on their respective investigations of the issue, CDFG (P. Ward, pers. comm., 1996) and Vogel and Marine (1995) concluded that predation in the oxbow was potentially significant under the conditions that existed when the studies were conducted. Hence, the relative impact of predation on juvenile anadromous fish emigrating through the oxbow remains uncertain, and may indeed vary widely by season and year as a result of varying hydraulic conditions within the oxbow, and behavioral manifestations by predator species.

Predation impacts were assessed based on the relative availability of potential predator holding habitat within the project area. In addition to prey availability, current velocity is believed to be among the most important factors that dictate preferred predator feeding areas in aquatic environments. All other factors remaining constant, the relative utility of a given area as predator holding habitat would decrease as current velocities increase, until a critical velocity is exceeded that would prohibit predators from using the area for holding. A study conducted by Faler et al. (1988) found that northern squawfish (a close relative of the Sacramento squawfish—the predatory fish species of greatest concern regarding predation impacts to emigrating salmonids in the project area) did not hold in areas having current velocities greater than approximately 2.3 ft/s. However, Shively et al. (1996) identified current velocities of 3.3 ft/s or greater as necessary to reduce northern squawfish use of habitats. Based on available literature and observations of habitat used for holding by Sacramento squawfish, it was determined that areas having current velocities of approximately 2.0 ft/s or greater would be less likely to be used for holding. Therefore, for the purposes of this EIR/EIS, 2.0 ft/s is used as the critical velocity above which holding by Sacramento squawfish and other predators would be expected to be reduced.

By importing depth-averaged velocity contour data generated from two-dimensional (2-D) model output (Ayres 1997b) into AutoCad, potential predation impacts to young fish emigrating through the oxbow were analyzed by calculating the percentage of the upper and lower oxbow having sufficiently high current velocities (i.e., 2.0 ft/s or greater) to minimize predator holding. Hence, the percentage of total upper and lower oxbow area expected to hold few predators, based on depth-averaged current velocities, was used as an "index" to assess potential predation impacts under the base condition and each project alternative.

Migration Impacts

Project-related factors that could disrupt (i.e., delay and/or block) immigration of adult fish to upstream spawning habitats include physical structures within the oxbow, elevated current velocities in the Sacramento River at the gradient facility during and following its construction, and underwater sound pressures resulting from in-channel construction activities. The significance of physical structures (e.g., road culverts, oxbow flow control structure) with regard to blocking adult immigration were assessed based on the conditions along the probable fish migration route past the structure.

Using depth-averaged velocity contour plots developed from 2-D model output (Ayres 1996d), current velocities anticipated to occur within the gradient facility and oxbow channel during construction (at river flows of 9,500 cfs, 12,000 cfs, 15,000 cfs, and 20,000 cfs) were compared to swimming speeds for chinook salmon, steelhead, and sturgeon to determine whether these species could immigrate past the gradient facility during the construction period. Velocity contour plots were evaluated to determine whether fish migration routes comparable to those of a natural riffle would be available. Fish migration routes were defined as areas greater than 1 foot

C—085652

C-085652

deep and with velocities 2.0-4.0 ft/s. Depth-averaged velocities within the gradient facility during operation of the project were compared to those measured for the natural riffle located at RM 202.5 to determine whether hydraulic conditions within the gradient facility would differ substantially from those that occur in this natural riffle under various flow conditions.

Potential impacts to adult immigration due to underwater sound pressures created by the construction of project features within the oxbow and gradient facility were assessed by comparing the level of sound pressures expected to occur in specific project areas to levels documented in the literature to adversely affect fish. Because a great range of amplitude in sound pressure levels is encountered in nature, it has become conventional to express sound levels in terms of a logarithmic measure, the decibel (dB), relative to a reference pressure, normally taken as one micro-pascal (1 μPa) for water. Hence, the units assigned to sound pressure levels are typically dB (re. μPa), which were used for this quantitative assessment.

In addition to changes in predation risks, project-related factors that could disrupt (i.e., delay and/or block) the emigration of juvenile fish past the project area include underwater sound pressures, degraded water quality, and stranding behind cofferdams within the oxbow and river that could occur during construction of various project features. Disruption of emigration from underwater sound pressures was assessed in the same manner described above for impacts to adult immigration. Potential impacts to juvenile fish emigration resulting from degraded water quality are discussed separately below. Mortality of emigrating fish stranded behind cofferdams that would occur upon removing water from the enclosed areas for construction were evaluated for each alternative based on: (1) the relative amount of cofferdam installation required; and (2) the timing of cofferdam installation relative to species-specific timing of emigration.

Habitat Impacts

Impacts to Shaded Riverine Aquatic Cover (SRA Cover) were assessed using AutoCad to overlay the footprint of the project features on maps of the project area depicting locations having high-value SRA Cover. For the purposes of calculating affected acreage, the width of SRA Cover was defined to be 10 feet (according to guidelines defined by the U.S. Fish and Wildlife Service (USFWS)) along shorelines where this habitat was present. All non-SRA Cover along shoreline within the project footprint was included in the calculations for assessing impacts to non-vegetated, erodible shoreline habitat.

The habitat impact acreages for the project alternatives described in this Draft EIR/EIS are slightly different than those shown in the Fish and Wildlife Coordination Act Report (CAR) (Appendix C). The differences are a result of slightly different assumptions for project design. The differences are not substantial for any of the habitats, and are expected to change again in the future with final design and final habitat surveys.

Impacts to riverine habitat were evaluated in terms of potential impacts to warm-water fish species and benthic macroinvertebrates, consistent with the Fish and Wildlife Coordination Act Report and Habitat Evaluation Procedures. Although the project would be located within the federally-listed critical habitat of the winter-run chinook salmon, winter-run use this area for migration, rather than spawning or rearing. The proposed project would not adversely affect the critical habitat.

The relative change in chinook salmon rearing habitat availability for a given change in flow was evaluated using habitat-discharge relationships (i.e., weighted usable area (WUA) curves) developed by DWR (1993) for the Sacramento River between RBDD and Hamilton City. Although WUA values were only determined for fall-run chinook in this reach of the river, the change in rearing habitat for late-fall-run and winter-run chinook salmon is estimated from the data developed for fall-run, assuming equivalent juvenile rearing habitat-discharge relationships among all three runs. Conversely, spring-run chinook salmon were not included in this analysis because the spring-run juveniles would not be rearing in this portion of the Sacramento River from May through August, when changes in flow would result in changes in WUA. The WUA analysis was restricted to the period May through August because it includes all months when Sacramento River flows downstream of RBDD would be affected by the project.

Water Quality Impacts

For both existing (1995) and future (2020) conditions, Reclamation's PROSIM model was used to simulate Sacramento River flows downstream of RBDD, for the 70-year hydrologic period of record, under the base condition and each project alternative. PROSIM output was input into Reclamation's Sacramento River Water Temperature Model to simulate changes in river temperatures that would be expected to occur at Vina and Butte City, based on expected changes in river flows. Changes in river water temperatures were used to assess potential thermal impacts to Sacramento River fishery resources. For all four runs of chinook salmon, water temperature modeling output was input into Reclamation's Sacramento River Salmon Mortality Model to simulate annual early-life-stage losses (of emergent fry from egg potential) that would be expected to occur based on changes in water temperatures throughout the upper Sacramento River.

Impacts to aquatic resources resulting from increases in sedimentation and turbidity that would result from construction-related activities also were assessed based on the magnitude and extent of change in these water quality parameters expected to occur under each project alternative. Toxicity impacts to aquatic life that would result from chemical spills during construction were assessed based on the probability of a spill event occurring and the volume of various contaminants likely to be spilled in any such event. Finally, potential toxicity impacts to aquatic organisms that could occur from the resuspension of contaminated sediments were assessed based on contamination levels determined for Sacramento River sediments collected within the project vicinity (Quanterra 1996).

C-085654

C-085654

4.2.4 Impacts

4.2.4.1 No-Project Impacts

Local changes in river gradient could result in changes in channel geometry, water depth (i.e., wetted screen area) and flow conditions, all of which could affect performance of the fish screen and internal fish bypass. The risk of local river gradient changes are discussed in Section 2.4.1, No-Project Alternative, and Section 4.1, Hydrology and Water Resources.

***Impact 4.2-1** – The no-project alternative would result in seasonal changes in the proportion of Sacramento River flow diverted into the oxbow, which could change fish losses at the HCPP fish screen due to impingement and/or entrainment.*

A beneficial impact. The relationship between the proportion of Sacramento River flow diverted and the relative number of young-of-the-year fish diverted at any given location is dependent upon numerous factors including: (1) volume and rate of the diversion relative to river flow; (2) local flow characteristics and channel morphology; (3) fish size; and (4) fish behavior and distribution within the river channel.

Under the no-project alternative, the proportion of Sacramento River flow diverted into the oxbow would be expected to decrease, relative to the existing condition, at all river flows (**Table 4.2-2**). Although quantitative estimates of the percentage of flow diverted into the oxbow are not currently available for the no-project alternative as defined in the project description (i.e., the no-project alternative including lower oxbow modifications and the presence of an oxbow flow control structure), it is expected that the reduction in diversions at HCPP, the presence of a flow control structure in the lower oxbow, and the constriction of the lower oxbow channel would all serve to decrease the amount of river flow diverted into the oxbow channel.

In addition, HCPP pumping rates would be modified, as necessary, to consistently meet NMFS and CDFG guidelines for approach and sweeping velocities at the fish screen. Subsequent to the modeling evaluations conducted by Reclamation (1996e), the project design has been modified to include the installation of flow-controlling baffles along the back side of the existing fish screen, as necessary, to maximize compliance with CDFG and NMFS approach and sweeping velocity criteria and minimize the potential for establishment of hydraulic hot-spots. Incorporating screen baffles into the project design is anticipated to maintain uniform approach and sweeping velocities along the screen, within NMFS and CDFG guidelines. All other factors remaining constant, meeting NMFS and CDFG approach and sweeping velocity guidelines more consistently would be expected to reduce fish losses from impingement and entrainment.

Finally, the estimated duration of fish exposure to the screen would not be expected to change substantially, if at all, from that occurring under the existing condition. Based on these findings, losses of migratory juvenile fish due to impingement and/or entrainment at the diversion fish screen would be expected to decrease, relative to the existing condition. This would constitute a beneficial impact to Sacramento River fishery resources.

C-085655

C-085655

Table 4.2-2 - Simulated Proportion of River Flow Diverted into the Oxbow											
								Screen Extension with Gradient Facility and Internal Fish Bypass			
	Existing Condition	No-Project		Screen Extension		Screen Extension with Gradient Facility[b]		Return to Oxbow[b]		Return to River[b]	
River Flow (cfs)	% of Flow to Oxbow	% of Flow to Oxbow[a]	Change (%)	% of Flow to Oxbow[a]	Change (%)	% of Flow to Oxbow	Change (%)	% of Flow to Oxbow	Change (%)	% of Flow to Oxbow	Change (%)
5,000	30	Decrease	na	Increase	na	32	2	31	1	31	1
7,000	45	Decrease	na	Increase	na	50	5	50	5	50	5
8,000	41	Decrease	na	Increase	na	46	5	45	4	45	4
10,000	34	Decrease	na	Increase	na	39	5	38	4	38	4
20,000	19	Decrease	na	Increase	na	25	6	25	6	24	5

a Quantitative values based on 2-D modeling results are not available for this alternative.

b For Sacramento River flows of 7,000, 8,000, 10,000, and 20,000 cfs, the HCPP diversion was assumed to be 3,000 cfs; at 5,000 cfs, the diversion was assumed to be 1,000 cfs.

na Not available.

Source: Ayres 1996d

C-085656

***Impact 4.2-2** – The no-project alternative could increase fish losses due to increased impingement and/or entrainment caused by increased diversions at Princeton-Codora-Glenn, Provident, and other smaller, unscreened Sacramento River diversions.*

A less-than-significant impact. Increased diversions at Princeton-Codora-Glenn, Provident, and other smaller, unscreened diversions that would be expected to occur under the no-project alternative could potentially result in proportional increases in impingement and/or entrainment losses of migratory juvenile fish at these diversion facilities. It should be noted that diversion intake structures at Princeton-Codora-Glenn and Provident are currently being addressed for improvement (i.e., installation of positive barrier screens at the intake structures) under the Central Valley Project Improvement Act (CVPIA). These screen improvement projects are scheduled to be installed in 1997 or 1998 (G. Stern, pers. comm., 1997). These improvements would be expected to reduce this impact to a less-than-significant impact. However, if the improvements are not implemented, or installation is delayed beyond the implementation of the no-project alternative, increased diversions at these facilities rather than from the HCPP would be expected to increase the overall losses of migratory juvenile fish in the upper Sacramento River due to impingement and/or entrainment at these and other diversion facilities. The actual magnitude of impact to emigrating juvenile fish that could occur under this alternative due to increased rates of diversion at the facilities identified above remains highly speculative. The potential for juveniles of special-status fish species to be lost as a result of increased diversions at other Sacramento River facilities, if scheduled improvements were to be delayed, could constitute a potentially significant impact to upper Sacramento River fishery resources.

***Impact 4.2-3** – The no-project alternative would permanently change the availability and distribution of potential predator holding habitat within the oxbow.*

A beneficial impact. The availability of predator holding areas (i.e., areas characterized by current velocities less than 2.0 ft/s) is influenced by the flow split between the oxbow and the Sacramento River, presence or absence of an oxbow flow control structure in the lower oxbow, and the constriction of the lower oxbow channel. Quantitative output from 2-D modeling is not available for the no-project alternative as defined in the project description (**Table 4.2-3**).

Under the no-project alternative, certain improvements to the lower oxbow would occur, including:

- channelization and formation of a trapezoidal channel;
- removal of hydraulic roughness elements; and
- hydraulic improvements near the bypass outfall.

These improvements would be expected to increase velocities through the lower oxbow and reduce local predator holding areas. However, it remains uncertain whether these improvements would outweigh the effect of decreased flows through the oxbow under this alternative. Considering the above, it would be expected that some level of overall reduction in predation would result, relative to the existing condition.

C-085658

Table 4.2-3 - Estimated Percentage of the Upper and Lower Oxbow Having Current Velocities of 2.0 ft/s or Greater

	Existing Condition		No-Project[b]		Screen Extension[b]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
									Return to Oxbow		Return to River	
River Flow (cfs)[a]	Upper Oxbow	Lower Oxbow	Upper Oxbow	Lower Oxbow	Upper Oxbow	Lower Oxbow	Upper Oxbow	Lower Oxbow	Upper Oxbow	Lower Oxbow	Upper Oxbow	Lower Oxbow
5,000	0	0	na	na	na	na	0	100	0	66	0	28
7,000	90	0	na	na	na	na	80	55	80	57	80	0
10,000	89	0	na	na	na	na	87	100	73	86	73	64
20,000	53	0	na	na	na	na	87	100	70	100	70	100

a The GCID diversion was assumed to be 3,000 cfs for all river flows except 5,000 cfs, for which the diversion was assumed to be 1,000 cfs. The difference shown between the 5,000 cfs and other river flow levels may be due to the difference in diversion rate.

b 2-D modeling results are not currently available for the no-project and screen extension alternatives.

na Not available.

Source: Ayres 1997b

C-085658

Impact 4.2-4 – Channelization of the lower oxbow would temporarily alter 3.7 acres of riverine habitat and permanently alter 8.9 acres of riverine habitat.

A less-than-significant impact. Improvements to the oxbow channel would permanently alter 8.9 acres of riverine habitat. Alteration of riverine habitat would occur due to the channelization of the lower oxbow (**Table 4.2-4**). Benthic macroinvertebrates would be temporarily displaced from approximately 3.7 acres of aquatic habitat within the oxbow as a result of in-channel work to make morphological modifications to the oxbow channel. Because the area of disturbance would not constitute a substantial proportion of the total habitat available to benthic macroinvertebrates in the upper Sacramento River, because construction-related impacts would be temporary, and because benthic macroinvertebrates possess the ability to rapidly recolonize disturbed areas following construction, the construction-related impacts to benthic macroinvertebrates and their habitat expected to occur under this alternative would be less than significant.

In addition to displacing benthic macroinvertebrates, oxbow modifications would alter existing warm-water fish habitat within the oxbow. The oxbow improvements proposed would remove instream debris and uneven surfaces and create a uniformly shaped trapezoidal channel. Removal of instream substrate, debris, and other hydraulic roughness elements could reduce spawning and rearing habitat available for local warm-water fish, such as bass and catfish. Nevertheless, the area potentially affected does not constitute a substantial fraction of the total spawning and rearing habitat available to warm-water fish in the upper Sacramento River, nor does it constitute essential or unique rearing habitat for any Sacramento River fish species. In fact, the proposed trapezoidal channel would be expected to reduce predator holding areas as a result of higher current velocities that would occur within the oxbow following channelization, and thereby improve conditions for migratory juvenile fish that are routed through the oxbow during their downstream emigration. Consequently, construction-related impacts to fish populations of the upper Sacramento River that could result from the lower oxbow modifications would be less than significant.

Table 4.2-4 - No-Project Alternative Impacts by Aquatic Habitat Type

Habitat Type	Total Acreage in the Project Vicinity[a]	Permanent Impact		Temporary Impact	
		Acreage	% of Total	Acreage	% of Total
SRA Cover	3.32	0.55	17	--	--
Non-Vegetated Erodible Shoreline	2.95	0.61	21	--	--
Riverine	127	8.9	7	3.7	3

[a] The project vicinity is defined as the area of habitat illustrated on Figure 3.5-1.

Impact 4.2-5 – Oxbow modifications under the no-project alternative would result in the loss of approximately 0.55 acre of SRA Cover and 0.58 acre of non-vegetated erodible shoreline.

A potentially significant impact. Channelization of the oxbow would impact approximately 2,412 linear feet, or about 0.55 acre, of SRA Cover (Table 4.2-4). The loss of SRA Cover would reduce the availability of preferred habitat to resident and migratory juvenile fish in this portion of the river. ~~Channelization of the lower oxbow would remove this type of habitat downstream from the screen area.~~ Although the improvements would reduce predation potential, ~~A~~any loss of SRA Cover would be considered a potentially significant impact due to its status as a Resource Category 1, as described in Section 3.2.4.5, Aquatic Habitat.

The channelization of the lower oxbow would also permanently alter 0.61 acre (2,677 linear feet) of non-vegetated erodible shoreline. Because this habitat does not provide unique habitat for any aquatic species, this impact would be considered less than significant. Although specific mitigation measures are not recommended for the no-project alternative, mitigation for loss of SRA Cover would be expected to be similar to that recommended under the screen extension alternative (Section 2.4.2).

***Impact 4.2-6** – The no-project alternative would result in seasonal changes in Sacramento River flow and water temperatures downstream of RBDD.*

A less-than-significant impact. Mean monthly Sacramento River flow downstream of RBDD is expected to be reduced by approximately 2.6% in May, 6.5% in June, and 5.1% in July relative to existing conditions (Section 4.1, Hydrology and Water Resources, Table 4.1-2). Mean monthly Sacramento River flow at this location would either increase or remain unchanged for all other months of the year. The anticipated reductions in mean monthly Sacramento River flow identified above could reduce the total availability of chinook salmon rearing habitat downstream of RBDD.

The anticipated reductions in Sacramento River flow during May and June would result in minor reductions (i.e., less than 1% each month) in the relative amount of rearing habitat (as assessed by changes in WUA) available to the juvenile lifestage of fall-run and late-fall-run chinook salmon, and changes (i.e., an increase of 2% in May and a decrease of 11% in June) in rearing habitat for the fry lifestage of fall-run and late-fall-run chinook salmon in the upper Sacramento River (**Table 4.2-5**). The changes in flow during July and August would result in minor reductions (i.e., less than 1%) in juvenile chinook salmon rearing habitat, and in minor reductions (i.e., 2% in July and less than 1% in August) in fry rearing habitat. Consequently, flow reductions of this magnitude would not be expected to result in substantial reductions in physical rearing habitat availability for juvenile and fry chinook salmon, or any other fish species in the Sacramento River downstream of RBDD.

The maximum increase in Sacramento River water temperatures downstream of RBDD expected to occur as a result of reduced river flows would be 0.3°F. An increase in mean monthly river temperature of this magnitude would occur during August at Butte City, with lesser or no temperature increases occurring for all other months of the year upstream of Butte City. This alternative would not result in any additional years when river water temperatures would exceed the 56°F (April 15- September 30) and 60°F (October 1 to October 31) temperature thresholds at Bend Bridge and Jelly's Ferry established by NMFS for the protection of winter-run chinook salmon (NMFS 1993). Also, based on the use of Reclamation's Sacramento River Salmon Mortality Model, the no-project alternative would not increase average annual mortality for any of the four runs of chinook salmon, including winter-run, compared to the mortality estimated to occur under the existing condition (**Table 4.2-6**).

Although Reclamation's model assumes a spawning distribution for winter-run chinook salmon that differs somewhat from the winter-run spawning distribution recently revised by NMFS (1996), the general spawning distribution pattern (i.e., relative percentage of spawning occurring per river reach) in the model is similar to that identified by NMFS (1996). Consequently, winter-run chinook salmon mortality estimates output by Reclamation's model would not be expected to differ significantly (or even measurably) from those that would be produced using this model and NMFS' (rather than Reclamation's) winter-run spawning distribution data.

Based on these findings, the seasonal decreases in Sacramento River flows and resultant increases in river water temperatures downstream of RBDD expected to occur under the no-project alternative would result in less-than-significant impacts to Sacramento River fishery resources.

***Impact 4.2-7** – Construction activities associated with oxbow improvements would result in temporary degradation of water quality within the oxbow and/or the Sacramento River downstream from the confluence of the oxbow and river.*

A less-than-significant impact. Oxbow channel improvements would disturb bottom sediments and increase bank erosion within the oxbow. This could substantially increase sediment loads and associated turbidity within the oxbow and/or the Sacramento River downstream of the confluence with the oxbow during and immediately following construction (Section 4.1). The magnitude of potential impacts to aquatic organisms (i.e., fish and benthic macroinvertebrates) in the oxbow and river would be dependent upon the timing and extent of sediment loading, and river flows during and immediately following construction.

The level of turbidity and suspended solids that can be tolerated by macroinvertebrates and fish is not only species-specific, but also depends on the constituents that comprise these parameters (e.g., clay, sewage sludge, algae) and the duration of exposure. For example, it has been reported that turbidity as high as 200 Nephelometric Turbidity Units (NTU) resulting from clay was harmless to fish (Tsai 1973).

Sediment loads and associated turbidity would be expected to be greatest within the lower oxbow, and substantially less in the Sacramento River downstream of its confluence with the oxbow. This would be due to elevated sediment loads and turbidity within the lower oxbow and dilution with Sacramento River water that would lower sediment loads and turbidities. Elevated sediment loads and associated turbidity levels during construction could reach levels that could adversely affect aquatic life within portions of the oxbow. However, the lower oxbow does not constitute essential or unique rearing habitat for any species of Sacramento River fish or benthic macroinvertebrate, and benthic macroinvertebrates can rapidly recolonize areas following disturbances. Moreover, any such water quality impacts would be temporary in nature. Finally,

C-085662

Table 4.2-5 - Change From Existing Condition in Weighted Usable Area (%) for Chinook Salmon Between RBDD and HCPP (Rearing Habitat)

	No-Project		Screen Extension		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
							Return to Oxbow		Return to River	
	Existing	2020	Existing	2020	Existing	2020	Existing	2020	Existing	2020
	Juveniles /Fry	Juveniles /Fry	Juveniles /Fry	Juveniles /Fry	Juveniles /Fry	Juveniles /Fry	Juveniles /Fry	Juveniles /Fry	Juveniles /Fry	Juveniles /Fry
April	0	NA	0	0	0	0	0	0	0	0
May	ND/+2	NA	ND/+2	+4/+2	ND/+2	+4/+2	ND/+2	+4/+2	ND/+2	+4/+2
June	-1/-11	NA	ND/+2	+1/+14	ND/+2	+1/+14	ND/+2	+1/+14	ND/+2	+1/+14
July	ND/-2	NA	ND/+2	+3/+12	ND/+2	+3/+12	ND/+2	+3/+12	ND/+2	+3/+12
August	ND/ND	NA	+2/+7	-2/+22	+2/+7	-2/+22	+2/+7	-2/+22	+2/+7	-2/+22
September	0	NA	0	0	0	0	0	0	0	0

ND No detectable change (less 1% change).
NA Not applicable. The no-project condition is considered the baseline for the 2020 analysis.
Source: DWR 1993

Table 4.2-6 - Estimated Early Life Stage Mortality for the Four Runs of Chinook Salmon in the Upper Sacramento River for No-Project and Project Alternatives [a,b]
Early Life Stage Mortality (%)

Runs of Chinook Salmon	Hydrologic Baseline		No-Project		Screen Extension		Screen Extension with Gradient Facility		Screen Extension With Gradient Facility and Internal Fish Bypass			
									Return to Oxbow		Return to River	
	Existing	Future	Existing	Future	Existing	Future	Existing	Future	Existing	Future	Existing	Future
Fall-Run	9	10	9	10	9	10	9	10	9	10	9	10
Late-Fall-Run	1	1	1	1	1	1	1	1	1	1	1	1
Winter-Run	15	13	15	13	15	13	15	13	15	13	15	13
Spring-Run	12	12	12	12	12	12	12	12	12	12	12	12

[a] Values provided represent average annual mortality of emergent fry from egg potential for the 1922-1991 hydrologic period of record.
[b] Modeled mortality was estimated using Reclamation's Sacramento River Salmon Mortality Model.
Note: Early life stage mortality estimates produced by the model represent mortality that would be expected specifically due to temperature changes in the upper Sacramento River.

sediment loads and turbidity would not be anticipated to be sufficiently high in the Sacramento River downstream of the oxbow to result in any significant adverse impacts to fish or benthic macroinvertebrates in the river.

4.2.4.2 Screen Extension Impacts

Local changes in river gradient could result in changes in channel geometry, water depth (i.e., wetted screen area) and flow conditions, all of which could affect performance of the fish screen. The risk of local gradient changes is discussed in Section 2.4.1, No-Project Alternative, and Section 4.1, Hydrology and Water Resources. Impacts attributed to the no-project alternative that would also apply to this alternative are not re-stated in this section. Differences in potential impacts to the aquatic resources of the Sacramento River that would occur under this alternative, relative to the previous alternative, are discussed below.

Construction

Impact 4.2-8 *– Cofferdams placed in the oxbow for construction of the screen extension could temporarily change the relative amount of predator holding habitat within the oxbow.*

A less-than-significant impact. Channel hydraulics immediately adjacent to cofferdams could be expected to create additional predator holding areas at locations where cofferdams are installed, relative to that which would occur in these same locations under the existing condition. Reasonable measures to minimize the predator holding areas resulting from hydraulic effects are included in the project description (Chapter 2, Project Description and Development of Alternatives). Because the amount of additional predator holding area that would be created while cofferdams were present within the oxbow would be anticipated to be small relative to the total amount of predator holding area throughout the oxbow, and because any additional predator holding areas created would be temporary, predation impacts to juvenile salmonids and other migratory juvenile fish associated with cofferdam installations for construction of the screen extension would be considered less than significant.

Impact 4.2-9 *– Construction activities within the oxbow associated with the screen extension alternative could result in the temporary disruption (i.e., delay and/or blockage) of upstream adult immigration and/or downstream juvenile emigration through the oxbow.*

A potentially significant impact for juveniles; less than significant for adults. Adult fish passage through the oxbow could potentially be affected by increased flow velocities and noise (i.e., underwater vibrations) that would occur as a result of in-channel construction activities.

Underwater sound pressure levels of sufficient magnitude could result in delay or even blockage of migratory fish movements into and/or through the oxbow, and could even cause damage to fish tissues if high-intensity exposures were to occur for sufficient periods of time. Response of fish to underwater sound pressure levels is affected not only by intensity (dB), but also by the frequency, measured in cycles per second or Hz. A study of emigrating Atlantic salmon smolts

C—085663

C-085663

found that at 150 Hz, there was no observable effect on the fish, even at intensities 114 dB above the hearing threshold at this frequency (Knudsen et al. 1994). This study concluded that low-frequency sounds (i.e., 5-10 Hz) were most effective in producing an avoidance response in the Atlantic salmon smolts. Hastings et al. (1996) exposed fish (*Astronotus ocellatus*, the oscar) for one hour to sound pressure levels of 100, 140, and 180 dB (re. µPa). The only tissue damage (i.e., some, but limited, hair cell damage in the inner ear) occurred at 300 Hz continuous tones at 180 dB (re. µPa). By comparison, underwater explosions that have been shown to physically injure or kill fish produced sound pressure levels in the range of 229 to 234 dB (re. µPa) (Norris and Mohl 1983).

For this project, the sheet piles to be driven into the riverbed for cofferdam installation ~~will~~ would primarily be "vibrated" into the riverbed using vibratory-type pile-driving equipment.~~,~~ ~~rather than being driven or pounded in using impact-type, pile-driving equipment.~~ The frequencies of vibratory pile drivers, similar to those that are likely to be used for this project, range from 400 to 1,600 cycles/minute (RCE 1993), which is equivalent to approximately 7 to 27 Hz. The sound pressure levels expected to result from sheet-pile driving using vibratory-type equipment would range from approximately 70-80 dB at 50 feet (EPA 1971). For comparison, 80 dB approximates the sound pressure level of a busy office (Bell and Bell 1994). Sound pressure levels of 70-80 dB are equivalent to 96-106 dB (re. µPa). In water, the sound pressure levels would be lower. Because the sound pressure levels in air would be lower than the levels found to cause tissue damage, the sound pressure levels in the water that would be expected to result from installing sheet piles using vibratory-type, pile-driving equipment would be significantly below levels required to cause physical damage or to kill fish. Furthermore, such sound pressure levels would not be expected to substantially disrupt migratory movements of fish through the oxbow because: (1) fish migrating through the oxbow would be expected to maintain the greatest distance possible between themselves and the actual locations where sheet piles are being installed (i.e., the sources of underwater sound pressures); and (2) the current construction schedule dictates that work within the oxbow will take place for 10 hours/day and 5 days/week, thereby resulting in no elevated underwater sound pressure levels at night or on weekends. Hence, even if underwater vibrations resulting from construction were to be somewhat disruptive to adult fish immigration through the oxbow, nights and weekends would provide sufficient opportunities for undisrupted fish passage.

Although sheet pile installation would be accomplished primarily with vibratory pile drivers, impact pile drivers would be required to complete the seating of the sheet piles at a design elevation necessary to prevent water from entering the construction area. Sound pressure levels expected to result from sheet-pile driving using impact pile-driving equipment would be approximately 95 db. Although this noise level would be greater than that of the vibratory pile driver, the noise level would still be below that which would cause tissue damage in fish. Conservative estimates indicate that impact pile driving could be required for either two to three hours a day, possibly one full day/week, or possibly one full week (interspersed with multiple weeks of vibratory hammer use) if final seating of all sheet piles in a segment is performed at one time. Because the impact pile driver would be used only when the vibratory method is not feasible, because sound pressures produced by this equipment would not be expected to cause direct injury or mortality to fish, and because fish would have sufficient opportunities to migrate

C-085664

C-085664

either through the oxbow or during nights and weekends when construction activities are not occurring, the limited use of impact pile drivers as described above would not be expected to result in substantial interference with fish migration.

Finally, under the screen extension alternative, the existing road culverts and other structural impediments to adult fish immigration through the oxbow would be removed. This would constitute a beneficial impact to immigration through the oxbow.

Because: (1) the vast majority of adult fish, particularly salmonids, are believed to immigrate through the main channel of the Sacramento River and not the oxbow; (2) current velocities within the oxbow during construction are not expected to reach levels greater than those that would exist along fish migration routes through the natural riffle at RM 202.5; (3) the level of underwater vibrations expected to be produced from construction-related activities is not anticipated to be sufficiently great to disrupt (i.e., delay and/or block) immigration that does occur through the oxbow; (4) construction activities within the oxbow would be temporary and would take place 10 hours per day and 5 days per week (i.e., not at night or on weekends); and (5) the existing road culverts and other structural impediments to adult fish immigration through the oxbow would be removed, any construction-related impacts to adult fish immigration through the oxbow that could occur under this alternative would be considered less than significant.

Downstream migration of juvenile fish would not be hindered by encountering higher oxbow current velocities created during construction because these fish move with the current rather than against it. In fact, higher current velocities in some areas could actually be beneficial to juvenile outmigrants if these higher velocities were to reduce the relative amount of predator holding habitat (i.e., areas characterized by current velocities less than 2.0 ft/s) within the oxbow.

Disruption of normal emigration behavior of juvenile fish due to underwater vibrations caused by the installation of the cofferdams could result in delay and possibly even blockage of migratory movements through the oxbow. However, for the same reasons stated above, any impact that construction-produced underwater vibrations could have on emigration of juvenile fish would be considered less than significant. In addition, removal of the existing road culverts and channelization of the lower oxbow, which would occur under this alternative, would constitute a beneficial impact to juvenile fish emigration.

Juvenile emigrants passing through the oxbow could become stranded when cofferdams are enclosed. Fry and young juvenile salmonids, as well as those species that are weak swimmers as juveniles, would be most prone to stranding when the cofferdams are installed. Although the vibrations and sediment re-suspension (see Impact 4.2-12) that would occur during installation of the cofferdams would be expected to cause most juvenile fish residing in the area to relocate and, therefore, avoid stranding behind the cofferdams, some fish would undoubtedly become stranded. Most stranded fish would probably be subject to low water quality or direct mortality upon water removal within the area enclosed by the cofferdams. Installation of cofferdams in the oxbow beginning in mid-May, as currently proposed, would avoid stranding impacts to winter-run chinook salmon outmigrants. However, stranding losses of emigrating fall-run, late-fall-run, and spring-run chinook salmon, splittail, and green sturgeon could occur. Because juveniles of the

C-085665

C-085665

various fish species, including special-status species, could be lost as a result of water removal from enclosed cofferdam areas, the risk of stranding would constitute a potentially significant impact to upper Sacramento River fishery resources.

***Impact 4.2-10** – Construction of the screen extension could alter riverine habitat.*

A less-than-significant impact. No riverine habitat would be impacted in addition to that discussed under Impact 4.2-4 of the no-project alternative.

***Impact 4.2-11** – Construction of the fish screen extension would result in the loss of an additional 0.16 acre of SRA Cover.*

A potentially significant impact. Extension of the fish screen would impact approximately 715 linear feet, or about 0.16 acre, of SRA Cover (**Table 4.2-7**) in addition to that discussed under the no-project alternative.~~, upstream of the screen.~~ Any loss of SRA Cover would be considered a potentially significant impact, due to its status as Resource Category 1, as described in Section 3.2.4.5, Aquatic Habitat.

Table 4.2-7 - Screen Extension Alternative Impacts by Aquatic Habitat Type

Habitat Type	Total Acreage in the Project Vicinity[a]	Permanent Impact		Temporary Impact	
		Acreage	% of Total	Acreage	% of Total
SRA Cover	3.32	0.16	5	--	--
Non-Vegetated Erodible Shoreline	2.95	0.16	5	--	--
Riverine	127	--	--	--	--

[a] The project vicinity is defined as the area of habitat illustrated on Figure 3.5-1.

Note: Impacts due to channelization of the lower oxbow are represented under the no-project alternative, Table 4.2-2.

This alternative would also result in the loss of an additional 715 linear feet, or about 0.16 acre of non-vegetated erodible shoreline. Because this habitat does not provide unique habitat for any species, this impact would be considered less than significant.

***Impact 4.2-12** – Construction activities associated with the screen extension alternative would result in temporary degradation of water quality within the oxbow and/or the Sacramento River downstream from the confluence of the oxbow and river.*

A less-than-significant impact. Installation of cofferdams, oxbow channel improvements, and other construction activities associated with this alternative would disturb bottom sediments and increase bank erosion within the oxbow. As discussed under Impact 4.2-10, this could substantially increase sediment loads and associated turbidity within the oxbow and/or the Sacramento River downstream of the confluence with the oxbow during and immediately following construction (Section 4.1, Hydrology and Water Resources). The magnitude of potential impacts to aquatic organisms (i.e., fish and benthic macroinvertebrates) in the oxbow and river would be dependent upon the timing and extent of sediment loading, and river flows during and immediately following construction.

Turbidity and sedimentation levels that would occur within the oxbow and river cannot be definitively predicted prior to construction activities. However, because: (1) the lower oxbow does not constitute essential or unique rearing habitat for any Sacramento River fish or benthic macroinvertebrate species; (2) benthic macroinvertebrates can rapidly recolonize disturbed areas; (3) sediment loads, turbidity, and contaminant levels would not be anticipated to be sufficiently high in the Sacramento River downstream of the oxbow to adversely impact aquatic life in the main-river channel; (4) water quality impacts that could occur in the oxbow would be temporary in nature; and (5) Best Management Practices (BMPs) would be implemented to minimize turbidity, sedimentation, and contaminant impacts, water quality-related impacts to aquatic life that could occur under this alternative, as a result of construction activities within the oxbow, would be less than significant.

Operation

The following impacts are based on the existing Sacramento River gradient. The screen extension alternative does not include gradient control measures. If the hydraulic gradient were to change further, additional changes in riverine conditions would likely occur, which could alter the applicability of the impacts discussed below.

***Impact 4.2-13** – Operation and maintenance of the screen extension alternative would result in changes in the proportion of Sacramento River flow diverted into the oxbow, which could change fish losses at the HCPP fish screen due to impingement and/or entrainment.*

A beneficial impact. The existing conditions were defined by Ayres for the 2-D model (Ayres 1996d) as those that existed in 1992, and included the roadway crossing of the lower oxbow with three underlying culverts, a non-improved condition in the upper oxbow, and the existing (unchannelized) condition of the lower oxbow. Although hydraulic modeling results are not currently available specifically for the screen extension alternative (i.e., screen extension with an oxbow flow control structure in the lower oxbow), the proportion of Sacramento River flow diverted into the oxbow would be expected to increase, relative to the existing condition, due to the increase in HCPP pumping rates that would occur under this alternative (Table 4.2-2). The relationship between the proportion of river flow diverted and the resultant proportion of fish diverted has been discussed previously in this section (see Impact 4.2-1); it was determined, that for this EIR/EIS, it will be assumed that juvenile fish are diverted into the oxbow relative to the proportion of Sacramento River flow entering the oxbow. Based on this assumption, an increase in the proportion of river flow diverted into the oxbow would be expected to result in an increase in the relative number of migratory juvenile fish diverted into the oxbow and, therefore, routed past the HCPP fish screen.

By design, approach and sweeping velocities at the fish screen would be maintained within NMFS and CDFG guidelines. Because the NMFS guideline of a 60-second exposure time would require 7 internal fish bypasses, which would reduce the bypass flows in the lower oxbow and potentially increase predator holding habitat, it has been agreed that an exposure time of up to 2.5 minutes would be acceptable for this site (Reclamation 1996g). Additionally, the uniformity of approach and sweeping velocities across the screen face would be expected to improve under this alternative, due to baffling, left bank guide wall, and modifications to the approach channel, thereby reducing the number of hydraulic "hot spots" along the screen face, where juvenile fish are most prone to impingement and/or entrainment.

Flow pattern evaluations were conducted by Reclamation (1996e) to evaluate approach (**Table 4.2-8**) and sweeping (**Table 4.2-9**) velocity characteristics for each of the project alternatives. For this alternative, evaluations of sweeping velocities at river flow/diversion pumping rates of 7,000/2,500 cfs indicated that sweeping velocities were in excess of 2.0 ft/s along the entire length of the screen face, and ranged from 2.25 ft/s to 3.28 ft/s. At higher river flow/diversion pumping rates (e.g., up to 40,000/3,000 cfs), results indicate that sweeping velocities above 2.5 ft/s were maintained along the entire length of the screen face, except at the downstream end of the screen. At that location, eddy currents apparently develop at high river flow rates (e.g., greater than 20,000 cfs), which force water movement back through the screen face, thereby reducing sweeping velocities along a downstream portion of the screen (Reclamation 1996e).

Subsequent to the modeling evaluations conducted by Reclamation (1996e), the project design has been modified to include the installation of flow-controlling baffles along the back side of the extended fish screen, as necessary, to maximize compliance with CDFG and NMFS approach and sweeping velocity criteria and minimize the potential for establishment of hydraulic hot-spots. Incorporating screen baffles into the project design is anticipated to maintain uniform approach and sweeping velocities along the screen, within NMFS and CDFG project fish protection guidelines.

The estimated maximum amount of time that fish would be exposed to the screen would increase from two minutes under the existing condition to approximately nine minutes under this alternative (Reclamation 1996d). However, the two-minute exposure time for existing conditions assumes optimal conditions (i.e., hydraulic hot-spots do not occur along the screen that would hinder fish passage, and bypass ports are consistently effective). Given that the existing actual screen exposure time may be longer than two minutes, and that screen performance would be expected to be improved under the screen extension alternative, the increase in exposure time would not be expected to represent a significant impact to the upper Sacramento River fishery resources.

With a screen mesh size of 3/32-inch and improved approach velocities at the screen, migratory juvenile fish greater than 30 mm in length that are routed through the oxbow and past the fish screen would be at minimal risk of impingement and entrainment. Fish species that occur in the project vicinity at sizes smaller than 30 mm would be subjected to both entrainment and impingement due to their physical size and weaker swimming abilities. Species of juvenile fish occurring within the project vicinity that measure less than 30 mm include green sturgeon and splittail. However, impingement and entrainment of juvenile fish would be expected to be reduced, compared to existing conditions, based on improvements in screen performance.

C-085668

C-085668

C-085669

Table 4.2-8 - Simulated Screen Approach Velocities at the HCPP Fish Screen (ft/s)[a]

River Flow	No-Project			Screen Extension			Screen Extension with Gradient Facility			Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow			Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River[b]		
(cfs)	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.
5,000	0.33	na	na	0.19	-0.36	0.13	0.12	-0.25	0.07	0.17	-0.01	0.09	0.17	-0.01	0.09
7,000	0.33	na	na	0.42	0.17	0.32	0.35	0.26	0.30	0.45	0.20	0.29	0.45	0.20	0.29
10,000	0.33	na	na	0.49	0.20	0.32	0.34	0.12	0.26	0.41	0.22	0.30	0.41	0.22	0.30
20,000	0.33	na	na	0.29	0.08	0.23	0.36	-0.68	0.24	0.37	0.11	0.27	0.37	0.11	0.27
40,000	0.33	na	na	0.45	-1.60	0.22	0.45	-1.64	0.22	0.45	-1.56	0.23	0.45	-1.56	0.23
60,000	na	na	na	na	na	na	0.44	-0.11	0.27	0.52	-1.46	0.17	0.52	-1.46	0.17

a For comparison to the existing approach velocities at the fish screen, refer to Table 3.2-1.

b Approach velocities were unavailable for this alternative. Approach velocities would be expected to be similar to those for the previous (i.e., bypass return to oxbow) alternative, which are the values presented.

na Not available.

Note: In some cases, a high approach velocity or negative approach velocity (reverse flow) is shown. This could be expected to occur during high flows, due to a high volume of water passing through the screen at the upstream end, independent of pumping or gravity diversion rates, resulting in reverse flows at the downstream end of the screen; however, the incorporation of baffles behind the screen would be expected to minimize these conditions.

Source: (Reclamation 1996e) Test Numbers: 5, 7, 8, 9, 11, 15, 17, 18, 21, 23, 24, and 25.

C-085669

C-085670

Table 4.2-9 - Simulated Sweeping Velocities at the HCPP Fish Screen (ft/s)[a]

River Flow	No-Project			Screen Extension			Screen Extension with Gradient Facility			Screen Extension with Gradient Facility and Internal Fish Bypass					
										Return to Oxbow			Return to River[b]		
(cfs)	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.
5,000	na	na	na	1.61	0.46	1.29	1.30	0.35	1.04	1.43	0.93	1.11	1.43	0.93	1.11
7,000	na	na	na	3.28	2.25	2.69	2.84	1.83	2.43	3.22	1.44	2.43	3.22	1.44	2.43
10,000	na	na	na	3.05	1.69	2.48	2.86	2.07	2.37	3.27	1.40	2.51	3.27	1.40	2.51
20,000	na	na	na	2.56	1.92	2.21	2.96	0.75	2.53	3.07	2.29	2.49	3.07	2.29	2.49
40,000	na	na	na	3.70	0.95	3.10	3.73	1.03	2.96	3.71	1.20	2.96	3.71	1.20	2.96
60,000	na	na	na	na	na	na	3.56	0.09	2.87	3.87	0.95	3.07	3.87	0.95	3.07

a For comparison to the existing sweeping velocities at the fish screen, refer to Table 3.2-1.

b Sweeping velocities were unavailable for this alternative. Sweeping velocities would be expected to be similar to those for the previous (i.e., bypass return to oxbow) alternative, which are the values presented because operation facilities are assumed to be the same.

na Not available.

Note: Sweeping flows may be affected by the percentage of flow diverted into the oxbow at the upstream confluence with the Sacramento River (see Table 4.2-2).

Source: (Reclamation 1996e) Test Numbers: 5, 7, 8, 9, 11, 14, 15, 17, 18, 19, 21, 23, 24, and 25.

C-085670

Because the relative number of fish potentially exposed to the screen and their screen exposure times would increase, overall losses of juvenile fish at the screen due to impingement and/or entrainment could increase. Conversely, losses due to impingement and entrainment would not necessarily increase under this alternative if screen performance (i.e., uniformity of approach and sweeping velocities) would be enhanced sufficiently to "off-set" the fact that up to approximately four percent more fish could be routed past the screen, and that these fish would be exposed to the screen face for up to an additional seven minutes, relative to the existing condition. The improved approach and sweeping velocities under this alternative relative to the existing condition would be expected to outweigh the potential for increased exposure of juvenile fish to the screen and would represent a beneficial impact to upper Sacramento River fishery resources.

Although significant screen performance improvements would be expected to benefit juvenile fish species compared to existing conditions, the potential for some impingement and entrainment could still exist. A Fish Protection Evaluation and Monitoring Program (Chapter 6, Environmental Commitments and Mitigation and Monitoring) has been developed to assess the fish screen improvements during early years of operation and, if necessary, to recommend changes which could further optimize screen performance.

Impact 4.2-14 *– Sedimentation expected to occur within the oxbow and adjacent to the fish screen under the screen extension alternative could result in reduced screen performance.*

A less-than-significant impact. Sedimentation within the oxbow and adjacent to the fish screen could affect screen performance. Most sedimentation near the screen would be expected to occur behind the screen, rather than in front of it. Nevertheless, sediments that accumulate adjacent to the screen and elsewhere in the oxbow would be removed by dredging, as necessary, to maintain desired screen performance (Reclamation 1996d). The maintenance dredging required for this alternative would not be anticipated to be substantially different from that occurring under the existing condition. Because dredging would be performed as needed to maintain oxbow hydraulics and screen performance (i.e., average and uniformity of approach and sweeping velocities), sedimentation within the oxbow would not be expected to permanently affect oxbow hydraulics or screen performance and, therefore, would constitute a less-than-significant impact.

Impact 4.2-15 *– Operation and maintenance of the screen extension alternative would permanently change the availability and distribution of potential predator holding habitat within the oxbow.*

A beneficial impact. The availability of predator holding areas (i.e., areas characterized by current velocities less than 2.0 ft/s) is influenced by the flow split between the oxbow and the Sacramento River, the oxbow flow control structure in the lower oxbow, and the constriction of the lower oxbow channel. Quantitative data from two-dimensional modeling are not available for the screen extension alternative as defined in the project description (Table 4.2-3). Nevertheless, based on available information, the amount of predator holding habitat throughout the entire oxbow would be expected to decrease, relative to the existing condition, due to the increase in diversions and resultant increase in flows through the oxbow. Additionally, the constriction of the lower oxbow channel would increase velocities in the lower oxbow, resulting in less available predator holding areas. The decrease in availability of potential predator holding area that would be expected to occur in the oxbow under the screen extension alternative would constitute a beneficial impact to salmonids and other anadromous fish that emigrate through the oxbow as juveniles. Also, because this would constitute only a very minor reduction in the availability of predator holding habitat in the upper Sacramento River, it would not adversely affect predatory fish populations.

Impact 4.2-16 *– Operation and maintenance of the screen extension alternative could permanently disrupt (i.e., delay and/or block) fish immigration and/or emigration through the oxbow.*

A beneficial impact. As discussed under Impact 4.2-13, impingement and entrainment of migratory juvenile fish at the screen would be reduced relative to the existing condition, which would reduce the degree of disruption of juvenile fish emigration. Also, as discussed under Impact 4.2-15, the total availability of predator holding habitat within the project vicinity would be expected to decrease under this alternative. This would further reduce the degree of disruption of juvenile fish emigration by reducing losses due to predation.

In addition to the factors discussed above, removal of hydraulic roughness elements within the oxbow via channelization would reduce the degree of disruption of adult immigration and juvenile emigration through the oxbow. Removal of the existing road culverts from the lower oxbow and other hydraulic roughness elements that could have disrupted adult immigration through the oxbow in the past would substantially improve conditions for immigration under this alternative. Consequently, this would constitute a beneficial impact to anadromous fishery resources.

Impact 4.2-17 *– Operation and maintenance of the screen extension alternative would result in seasonal changes in Sacramento River flow and resultant changes in river water temperatures downstream of RBDD.*

A beneficial impact for both the existing (1995) and future (2020) hydrologic conditions.

Existing (1995) Hydrologic Conditions

Mean monthly Sacramento River flow downstream of RBDD would increase by approximately 0.8% in May, 3.8% in June, 1.8% in July, and 8.3% in August (Section 4.1, Table 4.1-8), relative to the existing condition. Mean monthly Sacramento River flows at this location would not change for any other months of the year. As shown in Table 4.2-5, anticipated increases in Sacramento River flows during May and June would result in no appreciable change in the relative amount of rearing habitat (as assessed by changes in WUA) in the upper Sacramento River available to juvenile chinook salmon. Increases in flow during May and June would result in a 2% increase in rearing habitat for fry for both months. Changes in flow during July and August would result in no appreciable difference in July, and a 2% increase in rearing habitat for juveniles. Increases in rearing habitat for the fry life stage would be 2% in July and 7% in August. Therefore, mean monthly flow increases in the Sacramento River downstream RBDD

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C-085672

expected to occur during the months May through August under this alternative would represent a beneficial impact to upper Sacramento River fishery resources. Among the fish species that could potentially benefit from these flow increases are fall-run chinook salmon, late-fall-run chinook salmon (juvenile rearing and emigration) and winter-run chinook salmon (incubation, juvenile rearing and emigration).

Mean monthly Sacramento River water temperatures at Vina would remain unchanged or decrease for all months of the year (Section 4.1, Hydrology and Water Resources, Table 4.1-8). At Butte City, mean monthly Sacramento River water temperatures would increase by 0.1°F in April, but would decrease or remain unchanged for all other months of the year (Section 4.1, Table 4.1-9). Moreover, this alternative would not result in any additional years when Sacramento River water temperatures would exceed the 56°F (April 15 to September 30) and 60°F (October 1 to October 31) temperature thresholds established for Bend Bridge and Jelly's Ferry by NMFS for the protection of winter-run chinook salmon (NMFS 1993).

Based on output from Reclamation's Sacramento River Salmon Mortality Model, the screen extension alternative would not increase average annual mortality, relative to the existing condition, for any of the four runs of chinook salmon, including winter-run (Table 4.2-6). As previously discussed, although Reclamation's model assumes a spawning distribution for winter-run chinook salmon that differs somewhat from the winter-run spawning distribution recently revised by NMFS (1996), the general spawning distribution pattern (i.e., relative percentage of spawning occurring per river reach) in the model is similar to that identified by NMFS (1996). Consequently, winter-run chinook salmon mortality estimates output by Reclamation's model would not be expected to differ significantly (or even measurably) from those that would be produced using this model and NMFS' (rather than Reclamation's) winter-run spawning distribution data.

Based on these findings, the seasonal increase in Sacramento River flow and resultant changes in river water temperatures downstream of RBDD expected to occur under this project alternative would constitute a beneficial impact to Sacramento River fishery resources.

Future (2020) Hydrologic Conditions

The 2020 hydrologic scenario was analyzed to determine changes attributable to the project alternatives within the framework of Reclamation's PROSIM assumptions for the year 2020. For the future level analysis, the no-project condition under a 2020 hydrologic scenario served as the baseline for assessing changes resulting from project alternatives.

Compared to the (2020) no-project condition, mean monthly Sacramento River flow downstream of RBDD would increase by approximately 3.6% in May, 11.0% in June, 6.7% in July, and 6.9% in August (Table 4.1-7). Mean monthly Sacramento River flows at this location would not change for any other months of the year. Anticipated increases in Sacramento River flows from May through August would result in changes in the relative amount of rearing habitat (as assessed by changes in WUA) available to juvenile chinook salmon. As shown in Table 4.2-5, anticipated increases in Sacramento River flows during May and June would result in a 4%

increase and 1% increase in juvenile chinook salmon rearing habitat, respectively, and a 2% and 14% increase in rearing habitat available for fry chinook salmon. Increases in Sacramento River flow in July would result in a 3% increase in juvenile rearing habitat, and a 12% increase in fry rearing habitat. Changes in Sacramento River flows in August would result in a 2% decrease in juvenile rearing habitat, and a 22% increase in fry rearing habitat. As previously discussed, mean monthly flow increases in the Sacramento River downstream of RBDD expected to occur during the months May through August under this alternative in the future would represent a beneficial impact to upper Sacramento River fishery resources, including late-fall-run chinook salmon (juvenile rearing and emigration) and winter-run chinook salmon (incubation, juvenile rearing and emigration).

Mean monthly Sacramento River water temperatures at Vina would remain unchanged or decrease for all months of the year (Table 4.1-8). At Butte City, the maximum increase in mean monthly Sacramento River water temperature identified from the modeling conducted was 0.1°F, which was shown to occur in April and May. Modeling results showed either no change or reductions in mean monthly water temperatures for all other months of the year at this river location (Table 4.1-9). Moreover, this alternative would not result in any additional years when Sacramento River water temperatures would exceed the 56°F (April 15- September 30) and 60°F (October 1 to October 31) temperature thresholds established for Bend Bridge and Jelly's Ferry by NMFS for the protection of winter-run chinook salmon (NMFS 1993). Additionally, based on output from Reclamation's Sacramento River Salmon Mortality Model, the screen extension alternative would not increase average annual mortality, relative to the future base condition (Table 4.2-6) for any of the four runs of chinook salmon, including winter-run.

Based on the foregoing discussion, the seasonal increases in Sacramento River flows and resultant changes in river water temperatures downstream of RBDD expected to occur in the future under this project alternative would constitute a beneficial impact to Sacramento River fishery resources.

4.2.4.3 Screen Extension with Gradient Facility Impacts

Impacts attributed to the screen extension alternative that would also apply to this alternative are not included in this section. Differences in potential impacts to aquatic resources of the Sacramento River that would occur under this alternative, relative to the previous alternative, are discussed below.

The risk of local hydraulic gradient changes discussed in Section 2.4.1 (No-Project Alternative) and Section 4.1 (Hydrology and Water Resources), would be minimized with construction of the gradient facility. Maintaining sufficient gradient would optimize the long-term performance of the fish screen.

Construction

***Impact 4.2-18** – Construction of the gradient facility would temporarily alter the proportion of Sacramento River flow diverted into the oxbow, which could temporarily change fish losses at the HCPP fish screen due to impingement, entrainment, or predation.*

A less than significant impact. Installation of cofferdams in the Sacramento River to facilitate construction of the gradient facility would result in routing river flows through approximately half the channel's normal width for approximately 500 linear feet. During the construction period, altered hydraulics within the Sacramento River channel would force additional river flow through the oxbow. This additional proportion of river flow diverted into the oxbow could result in an increased number of migratory juvenile fish being exposed to the fish screen. The predicted flow distribution between the Sacramento River and oxbow during each of the four phases of gradient facility construction (at river flow rates of 9,500; 12,000; 15,000; and 20,000 cfs) and a diversion pumping rate of 1,500 cfs is provided in **Table 4.2-10**.

Because actual measurements of the Sacramento River flow diverted into the oxbow under existing conditions are not available, 2-D modeling results were used in this analysis (Tables 4.2-3 and 4.2-9). Based on these modeling results (Ayres 1996d and 1997d), the proportion of flow diverted into the oxbow could increase up to 22% during gradient facility construction. Gradient facility construction activities during Phase 4 occur during the primary emigration periods for winter-run and late-fall-run chinook salmon (**Figure 4.2-1**). Phase 4 construction is of particular concern because it occurs during the peak outmigration period of the endangered winter-run chinook salmon. However, because it is expected that the HCPP fish screen would be improved prior to gradient facility construction, such improvements would result in sufficiently large reductions in losses of emigrating fish at the screen to "off-set" routing up to 22% more emigrating fish through the oxbow and past the screen.

***Impact 4.2-19** – Cofferdams placed in the Sacramento River for construction of the gradient facility could temporarily change the relative amount of predator holding habitat within that portion of the river.*

A less-than-significant impact. The construction schedule proposed for this alternative (see discussion under Impact 4.2-20) would require that various cofferdams be in place at the gradient facility from mid-May through mid-November of a given year. Channel hydraulics immediately adjacent to the cofferdams could create local flow characteristics which could provide additional localized predator holding areas, relative to that which would exist at these same locations under the existing condition. Because the amount of additional predator holding area that would be created from installation of the cofferdams would be small, relative to the total amount of predator holding area throughout this reach of the Sacramento River, and because any additional predator holding area created would be temporary, predation impacts to emigrating salmonids and other migratory juvenile fish associated with cofferdams installed for gradient facility construction would be considered less than significant.

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C-085675

Table 4.2-10 - Predicted River/Oxbow Flow Split During Gradient Facility Construction Under Various River Flows

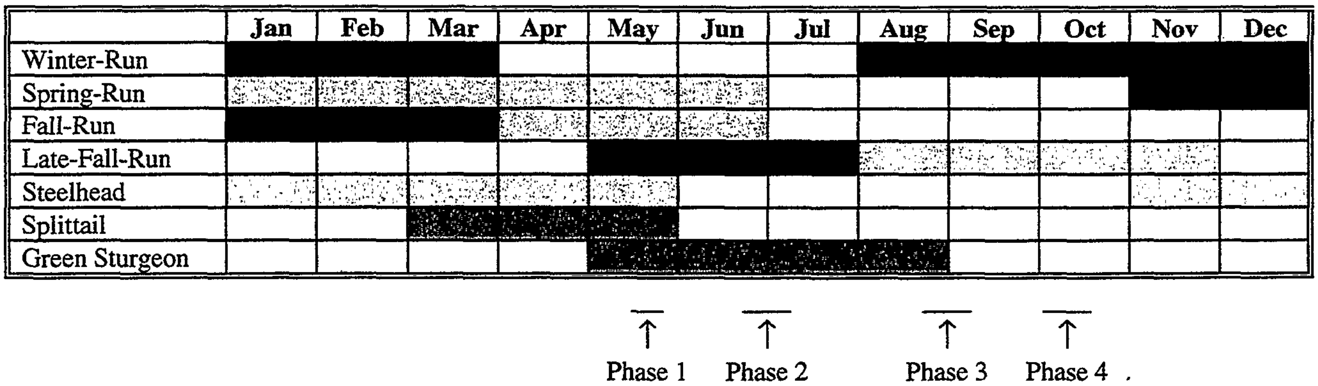
Values Given in Parentheses Represent the Percentage of Total Upstream River Flow

Location	Sacramento River Flow (cfs)	Flow Split (cfs)			
		Phase 1	Phase 2	Phase 3	Phase 4
Upper Oxbow Flow	9,500	3,100 (33)	4,420 (47)	3,360 (35)	5,300 (56)
Construction Reach River Flow	9,500	6,400 (67)	5,080 (53)	6,140 (65)	4,200 (44)
Upper Oxbow Flow	12,000	3,610 (30)	4,520 (38)	3,610 (30)	5,120 (43)
Construction Reach River Flow	12,000	8,390 (70)	7,480 (62)	8,390 (70)	6,880 (57)
Upper Oxbow Flow	15,000	4,080 (27)	5,250 (35)	4,170 (28)	5,900 (40)
Construction Reach River Flow	15,000	10,920 (73)	9,750 (65)	10,830 (72)	9,100 (60)
Upper Oxbow Flow	20,000	4,890 (24)	6,470 (32)	5,150 (26)	7,290 (36)
Construction Reach River Flow	20,000	15,110 (76)	13,530 (68)	14,850 (74)	12,710 (64)

Note: The predicted flows shown in the table for 9,500 cfs were based on a larger gradient facility configuration than has been proposed for the project and represent a worst-case scenario. Hence, river flow entering the oxbow would be expected to be somewhat less than that presented. HCPP rates at all flows were assumed to be 1,500 cfs.

Source: Ayres 1996d; 1997d

FIGURE 4.2-1. PRIMARY PERIODS OF FRY AND/OR JUVENILE EMIGRATION PAST THE HCPP FOR SELECTED FISH SPECIES OF MANAGEMENT CONCERN



Note: The periods proposed for cofferdam installation during the four phases are designated by lines beneath the grid. Darker shading indicates species or life stages at greater risk.

Impact 4.2-20 – Construction of the gradient facility could disrupt (i.e., delay and/or block) fish immigration and/or emigration in the Sacramento River.

A less-than-significant impact to adult fish; a significant impact to juvenile fish. The current construction schedule for this alternative requires that cofferdam installation for Phase 1 construction of the gradient facility begin in mid-May, and continue for approximately two weeks. Cofferdam installation for Phase 2 construction of the gradient facility would begin the first week of June and end in mid-June. Following construction of the south half of the gradient facility, removal of both Phase 1 and 2 cofferdams is scheduled to begin in late July and would require approximately one week. Cofferdam installation to facilitate construction of the third quadrant would be initiated during the third week of August and be completed in the second week of September. Cofferdamming for construction of the fourth and final quadrant of the gradient facility would begin the first week of October and be completed approximately two weeks later. Finally, during mid-November, approximately one week would be required to remove the Phase 4 cofferdams.

Both immigrating and emigrating anadromous fish could be impacted by gradient facility construction. Periods during which fish species of primary management concern immigrate past the HCPP are shown on **Figure 4.2-2**. During each of the four phases of gradient facility construction, about half the river channel's width for approximately 500 linear feet would be enclosed by cofferdams to facilitate installation of sheet piles and placement of rock. River discharge moving through the restricted portion of the channel would result in higher-than-normal current velocities at the site of channel constriction, for any given river flow rate. Immigration of certain fish species through the constricted channel could be blocked if river flow velocities were to exceed the swimming capabilities of species attempting to immigrate to upstream spawning habitats via this route.

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FIGURE 4.2-2. PRIMARY PERIODS OF ADULT IMMIGRATION PAST THE HCPP FOR SELECTED FISH SPECIES OF MANAGEMENT CONCERN

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Winter-Run	■	■	■	■	■	■	■					
Spring-Run			■	■	■	■	■	■	■			
Fall-Run							■	■	■	■	■	
Late-Fall-Run	■	■	■							■	■	■
Steelhead	■	■	■									■
Splittail[a]	■	■	■	■								
Green Sturgeon[b]	■	■	■								■	■

[a] Spawn throughout the Sacramento River.
[b] J. Brown, CDFG, pers. comm., March 27, 1997.

Ayres (1996d and 1997d) modeled hydraulic conditions within the vicinity of the gradient facility during each of the four phases of construction, based on river flow rates of 9,500 cfs, 12,000 cfs, 15,000 cfs, and 20,000 cfs. GCID pumping rates were assumed to be 1,500 cfs at all river flows. Based on these flow conditions, the most severe hydraulic conditions at the gradient facility would occur during the last phase (Phase 4) of construction (Ayres 1996d and 1997d).

Depth-averaged current velocities along the most probable fish migration route during Phase 4 of construction would be expected to be 2.0-4.0 ft/s, which does not exceed the range of cruising speeds of chinook salmon and steelhead, but could surpass cruising and/or sustained swimming speeds of weaker-swimming species such as splittail and green sturgeon. Although the results indicate that potential fish migration routes would exist through the gradient facility and in the oxbow, passage conditions during construction would become increasingly restrictive as river flows increase from 9,500 cfs to 20,000 cfs. (**Table 4.2-11**):

Construction of the gradient facility would have the potential to affect the upstream migration of all four runs of chinook salmon, because construction would occur during a portion of the immigration period for each run.

Based on depth-averaged oxbow current velocities modeled by Ayres (1997d), fish migration routes (i.e., areas having a minimum depth of one foot) would be available throughout most of the oxbow. Velocities would not be expected to exceed a range of 2.0-4.0 ft/s, which is similar to the velocities within a natural riffle on the Sacramento River. However, the velocity contour plots provided by Ayres (1997d) indicate that if the oxbow were to be constricted before or during gradient facility construction, high velocities in the range of 4.0-10.0 ft/s would occur just downstream of the fish screen, which could block upstream migration through the oxbow. The significance of this impact would be increased if there were potential for blockage of upstream migration at the site of the gradient facility during construction. Therefore, it is recommended that the modifications to the lower oxbow occur after the construction of the screen extension and gradient facility, as is currently proposed in the project description, to avoid the potential for disruption of fish migration.

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Table 4.2-11 - Comparison of Fish Swimming Speeds to Maximum Expected Current Velocities Along Migration Routes Through the Gradient Facility During Construction

Species	Velocity (ft/s) Along Fish Migration Route - During Gradient Facility Construction[a]	Velocity (ft/s) Along Fish Migration Routes - Natural Riffle @ RM 202.5[b]	Cruising Speeds (ft/s)[c]	Sustained Swimming Speeds (ft/s)[d]	Potential Problem Passing Gradient Facility Construction Area
Chinook Salmon	2.0-4.0	3.0-4.0/1.0-3.0[e]	3.0-4.0	4.0-11.00	No
Steelhead	2.0-4.0	3.0-4.0/1.0-3.0[e]	4.0-5.0	5.0-15.0	No
Splittail	2.0-4.0	3.0-4.0/1.0-3.0[e]	Unknown[f]	Unknown[f]	Possibly
Green Sturgeon	2.0-4.0	3.0-4.0/1.0-3.0[e]	Unknown[f]	Unknown[f]	Possibly

[a] Where water depth is one foot or greater.
[b] Depth-averaged current velocities.
[c] Cruising speeds are employed by adult fish for migration movements (a speed that can be sustained for hours) (Bell 1986).
[d] Fish employ sustained swimming speeds for passage through difficult areas (a speed that can be sustained for minutes) (Bell 1986).
[e] Near-bottom current velocities.
[f] Unknown, but expected to be less than 2.0 ft/s.
Note: Migration routes were analyzed at river flows of 9,500, 12,000, 15,000, and 20,000 cfs.

Based on depth-averaged current velocities that would occur in the flowing portion of the main river channel throughout construction (as indicated by 2-D modeling output), chinook salmon immigration would not be substantially disrupted or blocked. Therefore, construction of the gradient facility at river flows of approximately 20,000 cfs or less would result in less-than-significant impacts to adult chinook salmon immigrating to upstream spawning habitats.

Because the primary period of steelhead immigration occurs outside the planned construction window of mid-May through November, steelhead immigration would not be affected by gradient facility construction.

Potential impacts to immigration of adult splittail would be considered less than significant for the following reasons: (1) most, if not all of adult splittail immigration would be expected to be completed before the initiation of construction; (2) most of splittail spawning in the Sacramento River is believed to occur downstream of the HCPP (Moyle et al. 1995); and (3) viable migration routes would be expected to occur in shallow waters close to shore and through the oxbow, where alternate migration routes would be available, assuming that the modifications to the lower oxbow would be constructed after completion of the gradient facility.

Immigration of green sturgeon could be affected by increased river channel velocities during construction of the gradient facility. Although green sturgeon would potentially be unable to swim through portions of the main river channel, it is anticipated that migration along the channel bottom (where current velocities are lower) and/or through the oxbow would provide alternative migration routes that would facilitate passage to upstream spawning habitats. The availability of the oxbow as an alternate migration route during construction assumes that the modifications to the lower oxbow would be constructed after completion of the gradient facility. Modifying the oxbow prior to gradient facility construction would result in substantially higher current velocities within the oxbow during the period when the gradient facility would be under construction. Current velocities through the oxbow under this scenario may be sufficiently high to block immigration of green sturgeon through the oxbow. Nevertheless, because upstream migration routes would be anticipated to remain available to green sturgeon during construction of the gradient facility as currently planned (at river flow rates of 20,000 cfs or less), potential impacts to immigration of green sturgeon would be considered less than significant.

In addition to physical blockage due to high current velocities, adult immigration could be disrupted (i.e., delayed/blocked) due to underwater vibrations produced during construction and/or increased turbidity at and downstream of the construction site. As previously discussed (see Impact 4.2-9), underwater sound pressure levels produced by installation of sheet piles would not be of sufficient intensity to disrupt fish migration through the construction site.

Finally, increases in downstream turbidity and sedimentation would primarily be a concern during the periods of cofferdam installation and removal. Some localized riverbed scour could occur at the downstream end of the cofferdams, but turbidity and sedimentation would not be expected to be problematically high throughout the entire gradient facility construction period. Best management practices would be implemented to minimize downstream turbidity and sedimentation during these critical periods of construction. As a result, turbidity and sedimentation that could occur would not be not expected to be sufficiently great for a sufficient period of time to cause substantial, if any, disruption of adult fish immigration past the gradient facility. Based on the above discussion, any impact of gradient facility construction on adult immigration would be considered less than significant.

In addition to potential disruptions to adult fish immigration, gradient facility construction could directly or indirectly result in mortality of emigrating fry and juveniles due to: (1) vibrations associated with cofferdam installation and gradient facility construction; (2) stranding inside the cofferdams; (3) high turbidity associated with cofferdam installation and/or removal; and (4) increased losses from impingement and entrainment at the fish screen and predation in the oxbow due to routing more emigrating fish through the oxbow under higher oxbow flow rates. Potential impacts to emigrating fish associated with each of these issues are discussed separately below.

As previously discussed (see Impact 4.2-9), underwater sound pressure levels produced by installation of sheet piles would not be of sufficient intensity to disrupt fish migration through the construction site.

Perhaps the greatest concern with regard to potential impacts of gradient facility construction to migratory juvenile fish (particularly winter-run chinook salmon) pertains to losses due to stranding upon the installation of cofferdams and subsequent removal of water in preparation for gradient facility construction within each of the four quadrants. Fry and early juvenile life stages, as well as older juveniles of species that are weak swimmers, would be most prone to stranding during cofferdam installation and water removal. Because fry and/or juveniles of one or more of the four runs of chinook salmon and other fish species of management concern emigrate past the

HCPP during all months of the potential construction period, defined as mid-May through November (Figure 4.2-1), no period of the year exists when construction could be scheduled to completely avoid impacts to juvenile fish. Consequently, some losses of migratory juvenile anadromous fish would be expected to occur during gradient facility construction.

The fish species affected and the magnitude of impact would depend largely on when cofferdam installation and removal of water would occur. To better illustrate the relative impacts to migratory juvenile fish that could occur under the four-phase, one-year, dry construction scenario, the periods of occurrence of young fish within the project vicinity depicted on Figure 4.2-1 have been differentially shaded. The darker the shading, the higher the concern for stranding losses as determined by species status (i.e., winter-run losses are of greater concern than losses of fall-run chinook salmon) and life stage (i.e., all else being equal, fry losses would be expected to be higher than juvenile losses because fry are more fragile and less likely to avoid the construction area).

Most stranded fry and small juvenile fish would probably be lost upon water removal from areas enclosed by the cofferdams, even if rescue seining were employed prior to complete water removal. Installation of cofferdams beginning in mid-May, as proposed in the current construction schedule, would pose risks of stranding loss to juvenile spring-run, fall-run and late-fall-run chinook salmon, steelhead, splittail, and green sturgeon. With the exception of steelhead and splittail, emigrants of these same species would be at risk during the second phase of cofferdam installation, currently scheduled to occur in late June to early July. Dry construction on the inside of the cofferdams following land-side water removal would not be expected to result in significant adverse impacts to young-of-the-year winter-run chinook salmon or other fry/juvenile anadromous emigrant fish passing the construction site.

Cofferdam installations associated with Phase 3 would pose risks of stranding losses to the endangered winter-run chinook salmon, late-fall-run chinook salmon, and green sturgeon. Phase 4 cofferdam installation would pose risks to winter-run and late-fall-run chinook salmon only (Figure 4.2-1). Of particular concern with regard to cofferdam installation are phases three and four of gradient facility construction, which are currently scheduled to occur during the peak winter-run chinook salmon emigration period of the year. Stranding losses of fry and juveniles of multiple anadromous fish species of management concern, particularly the endangered winter-run chinook salmon, that would be expected to occur during installation and subsequent water removal within the cofferdams for gradient facility construction (as currently scheduled) would constitute a significant impact to upper Sacramento River fishery resources.

Increases in downstream turbidity and sedimentation would primarily be a concern during the periods of cofferdam installation and removal, and would not be expected to be problematically high throughout the entire gradient facility construction period. Best management practices would be implemented to minimize downstream turbidity and sedimentation during these critical periods of construction. As a result, turbidity and sedimentation would not be expected to be sufficiently great for a sufficiently long period of time to cause substantial disruption of juvenile fish emigration past the gradient facility. In fact, recent observations and data suggest that increased turbidity levels encourage downstream movements of emigrating fish. Hence, higher turbidity and flow levels could act positively on emigrating fry and juveniles by encouraging them to move through the construction site more quickly. Once downstream of the construction site, emigrating fish could utilize more natural riverine habitats to their advantage for both feeding and avoiding predation.

During construction of the gradient facility, a greater proportion of total river flow will be routed through the oxbow. Diverting a higher proportion of river flow through the oxbow during the construction period would route a proportionately greater number of anadromous fish outmigrants past the screen, which could result in higher relative losses due to increased rates of impingement and entrainment. For a compete discussion of this issue, see Impact 4.2-18. In addition, predation losses of juvenile anadromous fish within the oxbow could increase during the construction period when a greater proportion of outmigrants are routed through the oxbow. However, routing of additional outmigrants through the oxbow may be, at least in part, off-set by the fact that oxbow flows will be higher. Higher oxbow flow rates could effectively reduce the relative amount of predator holding areas within the oxbow by decreasing the total acreage having depth-averaged current velocities less than 2.0 ft/s. For this reason, coupled with the fact that any additional predation would occur only during construction, potential predation-related impacts of gradient facility construction would be considered less than significant.

The higher current velocities that would exist in the Sacramento River at the gradient facility during construction would not be expected to adversely impact juvenile emigrants directly, and could reduce the number and amount of predator holding areas within this section of the river. Consequently, predation rates on juvenile emigrants could decline for this portion of the river during the construction period. This would constitute a beneficial impact to migratory juvenile fish.

***Impact 4.2-21** – Construction of the gradient facility would result in the temporary loss of 1.7 acres of riverine habitat and the permanent loss of 13.4 acres of riverine habitat in the Sacramento River.*

A less-than-significant impact. Construction of the gradient facility would permanently alter 13.4 acres of riverine habitat (**Table 4.2-12 and Table 4.2-13**). Alteration of riverine habitat could affect benthic macroinvertebrates, warm-water fish habitat, and fall-run chinook spawning habitat.

Most of benthic macroinvertebrates colonizing the riverbed within the footprint of the gradient facility would be displaced or lost as a result of gradient facility construction. Construction of the gradient facility would temporarily displace benthic macroinvertebrates from approximately 13.4 acres of Sacramento River aquatic habitat. However, because: (1) benthic macroinvertebrates can rapidly recolonize disturbed areas; (2) the construction sites would affect a minor portion of upper Sacramento River benthic macroinvertebrate habitat; and (3) the areas to be affected do not constitute unique or critical habitat for any benthic macroinvertebrate species, direct construction-related impacts to benthic macroinvertebrates within the project vicinity under this alternative would be considered less than significant.

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Table 4.2-12 - Gradient Facility Impacts by Aquatic Habitat Type					
Habitat Type	Total Acreage in the Project Vicinity[a]	Permanent Impact		Temporary Impact	
		Acreage	% of Total	Acreage	% of Total
SRA Cover	3.32	0.78	23	--	--
Non-Vegetated Erodible Shoreline	2.95	0.64	22	--	--
Riverine	127	13.2	11	1.7	1

[a] The project vicinity is defined as the area of habitat illustrated in Figure 3.5-1.

Table 4.2-13 - Screen Extension with Gradient Facility Impacts by Aquatic Habitat Type					
Habitat Type	Total Acreage in the Project Vicinity [a]	Permanent Impact		Temporary Impact	
		Acreage	% of Total	Acreage	% of Total
SRA Cover	3.32	1.5	45	--	--
Non-Vegetated Erodible Shoreline	2.95	1.42	48	--	--
Riverine	127	22.3	18	5.4	4

[a] The project vicinity is defined as the area of habitat illustrated on Figure 3.5-1

In addition to direct impacts, gradient facility construction could indirectly affect benthic macroinvertebrates residing downstream of the gradient facility construction site due to construction-related increases in turbidity and sedimentation that could occur for an undetermined distance downstream of the gradient facility site. Best management practices (Section 2.4.2) would be employed during gradient facility construction to minimize the magnitude of turbidity and sedimentation impacts to downstream aquatic life. Such practices include pumping high-turbidity water from within the cofferdam-enclosed construction areas to settling ponds, as necessary, prior to discharging that water back into the river, and monitoring downstream turbidity levels. In addition, staging areas would be identified for equipment re-fueling and maintenance to minimize the possibility of spilling fuels and/or other contaminants into the river.

Because the foregoing impacts to benthic macroinvertebrates residing downstream of the gradient facility would be temporary, would affect a minor portion of the upper Sacramento River macroinvertebrates, and would be controlled to the extent possible using BMPs, indirect construction-related impacts to benthic macroinvertebrates downstream of the gradient facility would be considered less than significant.

In addition to displacing benthic invertebrates, construction of the gradient facility would alter existing warm-water fish habitat, potentially reducing spawning and rearing habitat for local warm-water fish such as bass and catfish. Nevertheless, the area potentially affected does not constitute a substantial fraction of the total spawning and rearing habitat available to warm-water fish in the upper Sacramento River, nor does it constitute essential or unique rearing habitat for any Sacramento River fish species.

The alteration of aquatic habitat that would occur under the gradient facility would be unlikely to affect any aquatic mammals using this reach of the Sacramento River. River otters would be capable of moving to another location if disturbed by activities at the gradient facility, and would be likely to continue using the site of the gradient facility as foraging habitat once construction is completed.

The construction of the gradient facility would also result in the loss of a negligible amount of marginal-quality fall-run chinook salmon spawning habitat. Hence, construction of the gradient facility would result in less-than-significant impacts to fall-run chinook salmon spawning habitat availability in the upper Sacramento River. Because the construction of the gradient facility would not result in significant impacts to benthic macroinvertebrate habitat, warn-water fish habitat or fall-run chinook salmon habitat, the alteration of riverine habitat at the site of the gradient facility would be considered less-than-significant.

***Impact 4.2-22** – Construction of the gradient facility would result in the loss of 0.78 acre of SRA Cover.*

A potentially significant impact. Construction of the gradient facility would impact an estimated 3,395 linear feet, or about 0.78 acre, of SRA Cover, in addition to the SRA Cover losses described under the previous alternative (Table 4.2-12 and Table 4.2-13). As described under Impact 4.2-11 of the screen extension alternative, any loss of SRA Cover would be considered a potentially significant impact, due to its status as a Resource Category 1, as described in Section 3.2.4.5, Aquatic Habitat.

Construction of the gradient facility also would impact 2,802 linear feet, or 0.64 acre, of non-vegetated erodible shoreline. ~~Because this type of shoreline does not provide unique habitat, this impact would be considered less than significant.~~ This type of shoreline is generally represented by gradually sloping gravel bars or steeper slopes of various soil types within the project area. Shoreline of this type can provide habitat to a variety of species, including the State listed bank swallow (see Section 4.5, Terrestrial Biology). Non-vegetated erodible shoreline habitat can play an important role in river ecosystems by allowing the river to meander and create ephemeral habitats in various stages of succession. However, because the amount of this type of shoreline affected by the project would be small relative to that in the total project area and overall upper Sacramento River basin, this impact would be considered less than significant.

***Impact 4.2-23** – Construction of the gradient facility could result in the degradation of water quality due to re-suspension of river sediments and as a result of contaminant spills.*

A less-than-significant impact. Installation of cofferdams and other activities associated with constructing the gradient facility would disturb bottom sediments and increase bank erosion at the construction site. This would result in increased sediment loads and associated turbidity within the Sacramento River at and downstream of the gradient facility, both during and immediately following construction. The magnitude of potential impacts to aquatic organisms (i.e., fish and benthic macroinvertebrates) in the Sacramento River would be dependent upon the timing and extent of sediment loading, and flow in the river during and immediately following construction. Direct impacts to benthic macroinvertebrates and fish that could result from increased turbidity and suspended sediment levels associated with gradient facility construction have been previously discussed (see Impact 4.2-21).

In addition to direct impacts due to elevated levels of turbidity and sedimentation, aquatic organisms could be indirectly impacted by increased contaminant levels resulting from in-channel construction. Preliminary contaminant analyses conducted on sediment core samples collected in the project area (Quanterra Environmental Services 1996) indicate that concentrations of metals, PCBs and other environmentally persistent contaminants in project area sediments are minimal and/or below established toxicity levels for aquatic life. Therefore, re-suspension of project area sediments during construction of the gradient facility would not be expected to introduce contaminants into the water column (either dissolved or adsorbed) at levels sufficient to adversely affect aquatic life.

Sacramento River water quality also would be degraded if contaminant spills were to occur during construction of the gradient facility. Based on the construction activities that would occur, the potential exists for spills of small volumes (relative to river discharge) of diesel fuel and other petroleum products into the Sacramento River. The magnitude of dilution that would occur in the Sacramento River following a spill event (based on the relatively small volumes of diesel fuel or other products that would be at risk for spill events) would be expected to prevent any substantial toxicological impacts to Sacramento River aquatic biota downstream of the gradient facility. In addition, BMPs would be implemented during the construction period that are designed to minimize downstream sedimentation, turbidity, and the possibility of contaminant spills.

Because: (1) BMPs would be implemented during gradient facility construction to minimize the potential for direct turbidity, sedimentation and/or contaminant-spill impacts to aquatic life at and downstream of the gradient facility during construction; (2) project area sediments that would be re-suspended from construction-related activities would not pose toxicity risks to downstream aquatic biota; and (3) because gradient facility construction would be temporary in nature, then water quality impacts to the Sacramento River would be considered less than significant.

Alternative Gradient Facility Construction Methods

In-River (Wet) Construction of the Gradient Facility

~~Wet construction would minimize the amount of cofferdam installation that would be needed, which would reduce the impacts to aquatic resources associated with closure of the cofferdams and subsequent removal of water. The time required to complete construction could be shorter than that of dry construction.~~

~~Fishery resources would not be isolated from equipment and materials during the construction period. Direct impacts to fish from turbidity, contaminant spills, and/or equipment and building materials would be more difficult to prevent with wet construction methods.~~

~~Wet construction could include the placement of temporary rock berms in the river channel, potentially altering channel hydraulics near the rock berms. These changes in hydraulics could increase predator holding areas and/or interfere with fish passage during the period that the rock berms are in place.~~

~~Because of the potential for direct impacts to aquatic resources and the potential for increased predation, the wet construction method could result in potentially significant impacts to aquatic resources. However, it remains uncertain whether these impacts would be greater than those expected to occur under the four-phase, dry construction method (Section 4.2.4, Impacts).~~

Wet construction of the gradient facility, as described in Section 2.4.3.2 (Screen Extension with Gradient Facility Operations and Maintenance), would not require the installation of cofferdams before beginning construction. Consequently, the time required to complete construction of the gradient facility would be expected to be shorter when using wet versus dry construction methods. Wet construction of the gradient facility could potentially be completed between mid-April and mid-November, depending on river conditions. Wet construction also would provide additional flexibility regarding the construction schedule, including the ability to restrict construction activities during periods of high flow or to minimize impacts to fish species of management concern. For example, in-channel work could continue up until the Coleman release of hatchery fish or until large numbers of migrating juvenile winter-run chinook salmon are identified in the project area through monitoring. In-channel construction could then cease for a specified period of time, to accommodate fish passage, and resume later and continue until high winter flows require in-channel work to cease again.

Although potential impacts to aquatic resources would differ somewhat under wet versus dry construction methods, overall impacts anticipated under wet construction would not be expected to be greater than those described for the four-phase, dry construction method (Section 4.2.4, Impacts). Elimination of cofferdams would reduce or eliminate the impacts to aquatic resources associated with closure of the cofferdams and subsequent removal of water. However, contrary to dry (cofferdam) construction methods, fish would not be isolated from construction activities when using wet construction methods. Consequently, both direct and indirect impacts to fisheries resources could result from the driving of sheet piles, excavation, and/or rock placement that would occur under wet construction.

Direct impacts to fish could include mortality from construction equipment and rock placement and disruption of either adult upstream immigration or downstream juvenile emigration. Indirect impacts to fish could result from elevated river turbidity, uncontained contaminant spills into the river and possibly increased predation on emigrating anadromous species near temporary rock berms. Rock berms would likely create back-eddies and other hydraulic effects that could be used by predatory fish as holding areas. Such areas would be expected to occur near the ends and along the downstream sides of the berms. Predatory fishes holding in these areas could effectively prey upon juvenile anadromous fishes emigrating past the berm or attempting to hold/feed along its downstream side.

Although adult fish would generally be expected to avoid the areas of active construction, young-of-the-year fishes, particularly fry and early juvenile life stages, may not be capable of doing so. Loss rates for young-of-the-year fishes passing through the construction area would be highly variable, and would depend, in part, on the species in question and their behavior within the construction area, river flow rates and the type of construction activities taking place. Hence, as stated for dry construction, it should be noted that the use of wet construction methods could result in potentially significant impacts to Sacramento River fish resources.

Measures would be available to minimize the potential for adverse impacts to fish during wet construction. To the extent possible, construction activities (e.g., in-channel sheetpile driving and rock placement) would be scheduled to minimize impacts to listed species (i.e., winter-run chinook salmon) and species of particular management concern (e.g., spring-run chinook salmon). Another action for minimizing direct impacts to fish would include restricting the size of the active construction area or the rate of construction during sensitive periods. Because juvenile fish migrate close to shore, construction activities along the bank and near shore would be conducted, to the extent feasible, during the periods least likely to impact juvenile fish species, including winter-run chinook salmon.

River turbidity levels during construction of the gradient facility using wet construction methods would not be expected to exceed levels that currently occur during dredging operations at HCPP. Nevertheless, turbidity levels downstream of the site would be monitored during construction of the gradient facility to minimize the potential for impacts to aquatic resources.

Wet construction methods could increase the potential for contaminant spills in the river from construction equipment because not all equipment (e.g., barges) would be refueled onshore. To minimize the potential for contaminant spills in the river, contractors would be required to submit operational procedures (spill prevention and countermeasure plan) to mitigate for spills as part of their construction bid specifications. Contractors also would be required to develop and submit a contingency plan outlining how any spills that were to occur would be contained and cleaned-up to minimize impacts to Sacramento River water quality and aquatic life.

The potential for predation and direct mortality due to rock placement associated with the construction and use of rock berms would be minimized by limiting the use of berms to areas where no other method of access to the construction area is feasible. In addition, the construction and use of rock berms will be limited, to the degree possible, to periods least likely to impact juvenile fishes of listed species and species of special concern.

Although it would not be possible to avoid all potential impacts to all fish species of management concern, implementation of these actions would minimize wet construction impacts to the most sensitive species and life stages of fish.

One-Phase (Dry) Construction of the Gradient Facility

Phased cofferdam installation to facilitate constructing the gradient facility in quarters would not be required, which would save time and potentially shorten the overall construction window. Shortening the construction window could reduce the impacts to some aquatic species by decreasing the amount of time that sensitive life stage(s) are exposed to construction activities.

All juvenile fish emigrating past the HCPP during the construction period would be routed past the fish screen, which cwould ~~likely result in substantial~~ increases ~~in~~ losses due to impingement and/or entrainment.

The gravel berm used to divert river flows through the oxbow also would impound water for an undetermined distance upstream of the dam. The reduced current velocities and increased depth that would be expected to occur upstream of the dam would substantially change river habitat, and could result in increased predation losses within this portion of the river. Additionally, the area of the Sacramento River channel below the gradient facility construction site and above the confluence of the oxbow with the river would be expected to contain back eddies and slow-water areas that could provide a substantial amount of predator holding habitat.

This construction method would require a much larger area of water removal at one time compared to the four-phase construction method. Fish losses associated with water removal of areas enclosed by the cofferdams could increase as the relative size of the area enclosed at one time increases. Second, partial or complete failure of the gravel berm prior to finishing the gradient facility could result in significant adverse impacts to both the gradient facility and aquatic resources. Such failure would be unlikely with the sheet pile method of construction. Finally, increased velocities in the oxbow during construction could potentially block fish migration. However, further information on expected velocities in the oxbow (which are currently unavailable) would be required to fully evaluate this method.

Because of the potential for: (1) increased losses of juvenile fish at the fish screen due to impingement and entrainment; (2) substantially increased predation upstream and downstream of the gradient facility site; (3) increased losses of fish during removal of water within the cofferdams; and (4) blockage of fish migrating upstream, the one-phase construction method would be expected to result in significant, unmitigable impacts to aquatic resources of the upper Sacramento River.

Two-Phase (Dry) Construction of the Gradient Facility

Reduced cofferdamming, relative to the four-phase construction method, could shorten the amount of time required to construct the gradient facility. A shorter construction window could decrease the amount of time certain fish species would be impacted, thereby reducing the relative magnitude of impact(s). The two-phase method would require water removal from half of the gradient facility area at a time. Fish losses associated with water removal of areas enclosed by cofferdams could increase as the relative size of the area dewatered increases.

Velocity contour plots developed by Ayres Associates with two-dimensional modeling at river flow rates of 9,500 cfs, 12,000 cfs, 15,000 cfs, and 20,000 cfs during the two-phase method of construction indicate that a fish migration route (i.e., areas of depth greater than 1 foot and velocity of approximately 2.0-4.0 ft/s) would be available at all flows. Although velocities during construction would be lower than that of the four-phase construction method, fish migration upstream past the gradient facility would have to follow a migration route for about 1,000 feet, roughly twice as far as that of the four-phase method.

If the two-phase method were completed in one year, no adverse impacts to aquatic resources in addition to those evaluated for the four-phase construction method would be expected to occur. If the two-phase method could not be completed in one year, the potential for bank erosion and damage to a partially completed gradient facility during the winter high flow period would be greater than that for the four-phase approach. Damage to river banks and an incomplete gradient facility could ultimately result in a longer construction period (i.e., spanning two years) to complete the gradient facility which could increase the potential impacts to aquatic resources.

Two-Year Construction Schedule

A two-year construction schedule would allow more flexibility for the contractor and would provide more options for scheduling cofferdam installation to avoid the peak migration period for fish species of primary management concern, including winter-run chinook salmon, splittail, and green sturgeon.

A two-year schedule, by definition, would impact Sacramento River aquatic resources in two consecutive years rather than just one (e.g., impact two year-classes of fish rather than one). However, the benefits of scheduling installation of cofferdams to minimize impacts to juvenile fish emigrating past the gradient facility could outweigh the adverse impacts that would result to two year-classes.

Operation

Impact 4.2-24 – *Operation and maintenance of the screen extension with gradient facility alternative would result in changes in the proportion of Sacramento River flow diverted into the oxbow, which could change fish losses at the HCPP fish screen due to impingement and/or entrainment.*

A beneficial impact. A detailed discussion of the potential change in the relative degree of impingement and entrainment that could occur as a result of diverting an additional proportion of river flow into the oxbow has been provided for the previous alternative (see Impact 4.2-13). The same issues identified in that discussion also pertain to this alternative; consequently, the same assessment approach has been applied here.

Under this alternative, an additional 5-6% of river flow would be diverted into the oxbow, depending on river flow and diversion pumping rates (Table 4.2-2). Physical model results (Reclamation 1996e) indicate that screen approach and sweeping velocities under this alternative would generally be similar to those identified for the previous alternative (Table 4.2-6 and Table 4.2-8). However, the addition of the gradient facility (Section 2.4.3) for this alternative would be expected to improve approach and sweeping velocities at the screen, relative to the existing condition, and relative to the previous alternative.

Although the exact change in the estimated maximum amount of time that fish would be expected to be exposed to the screen under this alternative could not be definitively determined from Reclamation's Conceptual Design Study (Reclamation 1996d), it would be expected to be somewhat less than the up to seven additional minutes estimated for the previous alternative, due to the increased head differential resulting from the gradient facility.

Because an increased number of migratory juvenile fish would be diverted into the oxbow and routed past the HCPP fish screen, and because screen exposure times would be expected to increase under this alternative relative to the existing condition, overall losses of juvenile fish at the screen due to impingement and/or entrainment could increase. Conversely, losses due to impingement and entrainment could be reduced under this alternative if screen performance (i.e., average and uniformity of approach and sweeping velocities) were enhanced sufficiently to "off-set" the fact that up to approximately 6% more fish could be routed past the screen, and that these fish would be exposed to the screen face for a longer period of time, relative to the existing condition. The improved approach and sweeping velocities that would occur under this alternative relative to the existing condition would be expected to outweigh the potential for increased exposure of juvenile fish to the screen and would constitute a beneficial impact to upper Sacramento River fishery resources.

***Impact 4.2-25** – Operation and maintenance of this alternative would permanently change the availability and distribution of potential predator holding habitat within the oxbow and in the Sacramento River at the gradient facility.*

A beneficial impact. Extension of the fish screen, channelization of the oxbow, and construction of the gradient facility under this alternative would change the relative availability of potential predator holding habitat (i.e., areas characterized by current velocities less than 2.0 ft/s) within the project vicinity.

Based on the 2.0 ft/s criteria, increases of approximately 10% and 2% in the availability of potential predator holding habitat would be expected to occur in the upper oxbow, relative to the existing condition, at river flows of 7,000 and 10,000 cfs, respectively (Table 4.2-3). Conversely, the relative availability of potential predator holding habitat in the upper oxbow would be reduced by approximately 34% under this alternative at a river flow of 20,000 cfs. The availability of potential predator holding habitat in the lower oxbow would be reduced to zero at river flows of 5,000, 10,000, and 20,000 cfs, and would be reduced by approximately 55% at a river flow rate of 7,000 cfs (Table 4.2-3). Changes in improvements at the 7,000 cfs river flow can be attributed to assumed increased HCPP pumping rates between the 5,000 cfs and 7,000 cfs river flows.

Predators could potentially find holding places at the downstream end of the screen, where eddy currents could become established at higher flows (as indicated by approach velocity data (Table 4.2-8), and where emigrating fish would be funneled through the narrowest part of the oxbow. A comparison of sweeping velocities under existing conditions (Table 3.2-1) and simulated sweeping velocities under this alternative (Table 4.2-9) indicates that predator holding area availability in front of the screen face would decrease under this alternative, based on the 2.0 ft/s criteria. Under this alternative, average sweeping velocities would be less than 2.0 ft/s only at river flows of 5,000 cfs.

The hydraulics of the back eddy on the north side of the confluence of the lower oxbow with the Sacramento River would not be expected to be altered substantially under this alternative. Consequently, losses of emigrating juvenile fish from predators holding in the vicinity of this back eddy would not be expected to change substantially under this alternative, relative to the existing condition.

The rock dikes placed upstream of the gradient facility to protect the river bank could provide additional predator holding areas; however, the rock dikes would also contribute to habitat complexity in this area of the Sacramento River, potentially providing additional feeding areas and escape cover for juvenile fish. Because the rock dikes could provide both predator holding areas and escape cover habitat for juvenile fish, and because any additional predation that would be directly associated with these structures is expected to be relatively minor within the context of all predation occurring within the project area, any predation-related impact to anadromous fish associated with the rock dike structures would be less than significant.

Finally, operation and maintenance of the gradient facility could permanently change the relative amount of predator holding habitat in that portion of the Sacramento River channel. By design, a greater portion of the river channel (where the gradient facility would be built) would have current velocities of 2.0 ft/s or greater following gradient facility construction compared to the same portion of the channel absent the gradient facility. Consequently, the relative availability of potential predator holding habitat within this portion of the Sacramento River would be expected to decrease under this alternative, relative to the existing condition. Nevertheless, significance criteria developed for assessing predation impacts associated with the gradient facility dictate that the relative availability of potential predator holding habitat within the gradient facility be compared to that potentially available in natural riffle habitat and, therefore, is discussed below.

The deeper, slower velocity areas of the gradient facility, designed as resting areas for immigrating fish, could attract and hold predators, which could result in higher predation rates than would be expected to occur in a natural riffle at the same location. Design criteria developed for the gradient facility to minimize potential predation impacts on juvenile emigrating fish were primarily focused on minimizing turbulence (Ayres 1996d), which tends to disorient juvenile fish, thereby making them more susceptible to predators. These criteria would generally be met with the gradient facility design through the use of gradual structural transitions where changes in bed elevation occur (e.g., between resting areas). Hence, the relative amount of predator holding habitat within the gradient facility would not differ substantially from that which would exist in a natural riffle in the same location.

Based on the discussion above, the relative availability of predator holding habitat would be expected to: (1) decrease along the screen face; (2) remain unchanged or decrease within the upper oxbow at river flows of 5,000 and 20,000 cfs, and increase by approximately 10% and 2% at river flows of 7,000 and 10,000 cfs, respectively; (3) decrease substantially in the lower oxbow at all river flows; (4) remain essentially unchanged at the confluence of the lower oxbow with the river; (5) increase slightly at rock dikes upstream of the gradient facility; and (6) would not differ substantially at the gradient facility (relative to a natural riffle, but would decrease at the gradient facility site relative to the existing condition). Because the area anticipated to exhibit an increase in the relative amount of predator holding habitat (i.e., portions of the upper oxbow under certain river flows) would be small (from an actual square-footage perspective) relative to the areas anticipated to experience a reduction in the amount of predator holding areas (i.e., the screen face and the lower oxbow and upper oxbow at high river flow rates), the overall potential for losses of migratory juvenile fish due to predation within the project vicinity would be expected to decrease under this alternative. This would constitute a beneficial impact to Sacramento River fishery resources, particularly salmonid resources. Although the amount of predator holding areas in the project vicinity would be expected to be reduced under this alternative, the Fish Protection Evaluation and Monitoring Program would include monitoring of the gradient facility to identify any potential predation impacts and corrective actions, if necessary.

Impact 4.2-26 *– Operation and maintenance of the gradient facility could disrupt (i.e., delay and/or block) upstream adult fish immigration and/or downstream juvenile fish emigration.*

A less-than-significant impact. Changes in channel morphology and hydraulics within the river at the gradient facility could impact anadromous fish species by impeding upstream migration of adults and adversely affecting passage conditions for downstream migrating juveniles. Consequently, the gradient facility was designed to mimic natural riffles of the upper Sacramento River to assure that it would not pose barriers to adult immigration or juvenile emigration beyond those presented by natural riffles within the river. The gradient facility has been designed to accomplish its hydraulic purpose with minimal, if any, long-term impacts to Sacramento River fishery resources. It was determined that rather than attempting to identify and meet species-specific swimming-speed criteria for the numerous fish species using the upper Sacramento River (with no data available for many species), a "design riffle" concept would be adopted to direct gradient facility design. This concept was based on the rationale that if fish can effectively pass natural riffles in the Sacramento River, then the hydraulic conditions at natural riffles would provide a reasonable basis from which to develop hydraulic performance criteria for the gradient facility.

To develop appropriate hydraulic performance criteria for the gradient facility, Ayres (1996d) evaluated the geomorphic and hydraulic conditions of three natural riffles of the upper Sacramento River, located at RM 188.5, RM 202.5, and RM 254.5. The natural riffle at RM 202.5 was selected for 2-D hydraulic modeling to further evaluate fish passage and predation conditions because it was considered to be most representative of natural riffles on the Sacramento River and represented less severe hydraulic conditions than either of the other two riffles. Much of the following discussion of the gradient facility and its potential long-term impacts to Sacramento River fishery resources is taken directly from Ayres (1996d).

The design evaluation of the gradient facility focused on determining the hydraulic conditions and maximum water velocities that would effectively permit passage of upstream migrating chinook salmon (fall-, late fall, winter- and spring-run races), steelhead, and green sturgeon. Information (Ayres 1997a) was also gathered on passage conditions for effectively passing juveniles of these same species. Resultant design features of the gradient facility intended to mimic the longitudinal and cross-sectional attributes of natural riffles and enhance fish passage include: (1) the creation of multiple channels; (2) the orientation of the thalweg channel with the natural river thalweg; (3) the frequent placement of depressions (i.e., resting areas for immigrating fish) along the most probable fish immigration routes; and (4) the use of smooth structural transitions between the gradient facility and the natural riverbed, as well as within the gradient facility itself (e.g., between resting areas) (Ayres 1997a).

Several structural and hydraulic features of the gradient facility would create favorable passage conditions for fish relative to existing natural riffles. First, based on field measurements and observations of natural riffles, the length of the gradient facility would fall well within the range of lengths of natural riffles in the Sacramento River. Second, positioning of the thalweg channel of the gradient facility along the right bank in line with the natural thalweg would help to preserve channel continuity and avoid potential disruption of fish migration. Third, the placement of resting areas along other potential routes would ensure that suitable alternate routes would be made available if river morphology changes or if fish enter the structure from the left side. Finally, the distances over which fish would have to expend greater energy to reach relatively slow-velocity water or resting areas would be reduced in the gradient facility because of the frequent placement of depressions along major fish migration routes. Although not typical of natural riffle morphology, the depressions are considered important features for overcoming the otherwise low hydraulic variability of the gradient facility compared to natural riffles (Ayres 1996d).

To quantitatively evaluate the performance of the proposed gradient facility, 2-D hydrodynamic modeling results from the gradient facility and the naturally occurring riffle at RM 202.5 were compared. Selection of potential fish-migration routes was based on the assumption that a fish would enter the downstream end of the gradient facility or natural riffle from the deepest part of the natural channel (e.g., thalweg) and would select routes with depths greater than 2 feet. In some cases, it was assumed that the fish would pass shallower depths (i.e., 1-2 feet) if an alternative deeper route was not available.

At Sacramento River flows between 4,000 and 4,500 cfs, depths along potential fish-migration routes in the gradient facility would range from 6 to 7 feet within resting areas, with depths generally 3-4 feet elsewhere. At comparable flow, depths along potential fish-migration routes in the natural riffle at RM 202.5 would range from 2 to 3 feet in the crossover portion of the channel to 5-6 feet in the thalweg. Mean column water velocities along potential fish migration routes in the gradient facility were predicted to range from 2.0-3.0 ft/s in resting areas to 4.0-5.0 ft/s between resting areas, with near-bed water velocities of 1.0-2.0 ft/s throughout. Potential fish migration routes through the natural riffle (at RM 202.5) would have mean-column water velocities ranging from 3.0-4.0 ft/s to 5.0-6.0 ft/s, with near-bed water velocities ranging from 1.0-3.0 ft/s (Ayres 1996d).

Hydraulic modeling results indicate that the range of water depths and velocities that would be encountered by fish in the gradient facility compare favorably with those observed in the natural riffle located at RM 202.5 (Ayres 1996d). Under the flows assessed, these data suggest that the gradient facility would not be expected to be any more restrictive to fish passage (either immigration or emigration) than the natural riffle located at RM 202.5. Hence, any potential impacts that operation and maintenance of the gradient facility could have on adult immigration or juvenile emigration would be considered less than significant.

Nevertheless, because hydraulics within the gradient facility suitable for fish passage (both immigration and emigration) depend on long-term maintenance of the structural and hydraulic characteristics of the gradient facility itself, and because the performance of the gradient facility under natural river conditions cannot be fully evaluated before construction, a Fish Protection Evaluation and Monitoring Program will be developed and implemented (Chapter 6, Environmental Commitments and Mitigation and Monitoring).

***Impact 4.2-27** – Sedimentation that could occur upstream and within the gradient facility could alter aquatic habitat and/or adversely affect fish passage through the gradient facility.*

A less-than-significant impact. Maintenance of the gradient facility could include the possible need to dredge the depression pools of the gradient facility and the river channel immediately upstream of the gradient facility. If required, dredging methods would be the same as used for the oxbow. Current physical model development and testing for the gradient facility will provide further information on the possible need for river dredging and other maintenance activities. Based on available information, the frequency and amount of gradient facility dredging, if required, would be expected to be less than currently occurs in the oxbow. The effects of the gradient facility on sediment transport and deposition are difficult to predict because the sediment supply in the reach appears to governed by local bank erosion and tributary input (RCE 1994a; Mussetter 1997). The amount could vary from year to year, depending on the magnitude of flows and the deposition characteristics of the gradient facility. Because dredging would occur within isolated locations in the gradient facility (e.g., within the resting pools), because dredging would not occur when fish species listed as endangered or threatened would be migrating upstream or downstream, this impact would be considered less than significant.

Dredging could affect benthic macroinvertebrates; however, impacts that could occur as a result of dredging activities in the Sacramento River and within the gradient facility itself would be expected to be less than significant, because: (1) the Sacramento River does not constitute essential or unique rearing habitat for any Sacramento River benthic macroinvertebrate species; (2) benthic macroinvertebrates can rapidly recolonize disturbed areas; (3) water quality impacts that could occur would be temporary in nature; and (4) BMPs would be implemented to minimize turbidity impacts.

4.2.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass to Oxbow Impacts

Impacts attributed to the previous project alternatives that would also apply to this alternative are not included in this section. Differences in potential impacts to the aquatic resources of the Sacramento River that would occur under this alternative, relative to the previous alternatives, are discussed below.

The internal fish bypass to the oxbow would exist within the same physical space as described for the screen extension alternative. Additional bypass-related impacts to fish that are discussed for this alternative would include latent mortality resulting from physical injury received in the bypass system and predation near the bypass outfall. The acreage of riverine habitat impacted under this alternative would be identical to that discussed for the screen extension with gradient facility alternative (i.e., a total for screen extension, oxbow improvements, and gradient facility construction of 22.3 acres of riverine habitat, which includes 1.5 acres of SRA Cover).

Construction

Impact 4.2-28 *– Cofferdams installed in the oxbow for construction of the bypass outfall would temporarily change the relative amount of potential predator holding habitat within the oxbow.*

A less-than-significant impact. Construction of the internal bypass outfall within the lower oxbow would require additional cofferdamming in the lower oxbow for the period of construction. The current construction schedule indicates that cofferdams required for construction of bypass components within the oxbow would be installed during mid-May of 1998, and not removed until late October of 1999. Cofferdams placed in the lower oxbow could create back eddies and influence channel hydraulics in other ways that could create predator holding areas adjacent to the cofferdams (i.e., areas characterized by current velocities less than 2.0 ft/s). Predation on juvenile fish emigrating through the oxbow could, therefore, temporarily increase at locations where cofferdams are installed, relative to predation losses occurring in these same areas under the existing condition. However, because the relative increase in potential predator holding habitat that could be associated with installation of cofferdams during construction would be expected to be small relative to the total amount of predator holding area throughout the oxbow, and because any additional predator holding areas created would be temporary, predation impacts to migratory juvenile fish within the oxbow associated with cofferdams installed for constructing the internal bypass outfall would be considered less than significant.

Operation

Impact 4.2-29 *– Operation and maintenance of the screen extension with gradient facility and internal fish bypass to the oxbow alternative would result in changes in the proportion of Sacramento River flow diverted into the oxbow, which could change fish losses at the HCPP fish screen due to impingement and/or entrainment.*

A beneficial impact. As discussed previously (Impact 4.2-13), the relationship between the proportion of river flow diverted and the relative number of fish diverted is dependent upon numerous factors for any given location. The proportion of Sacramento River flow diverted into the oxbow would be expected to increase by approximately 4-6% under this alternative, relative to the existing condition, depending on mean monthly Sacramento River flow and HCPP pumping rates (Table 4.2-2). Hence, the relative number of migratory juvenile fish routed through the oxbow and past the fish screen would be expected to increase by approximately 4-6% under this alternative. As with the previously discussed alternatives, flow-regulating baffles incorporated into the project design for this alternative (Section 2.4.4) are anticipated to maintain uniform approach and sweeping velocities within NMFS and CDFG guidelines.

Addition of the internal fish bypass system under this alternative would result in screen exposure times for fish that would be up to 2.5 minutes between bypass ports. As previously discussed, (Impact 4.2-13), the existing 2-minute screen exposure time implies optimal bypass port operational conditions, which do not currently exist. The improvements in bypass port operation, and in approach and sweeping velocities (Table 4.2-6 and Table 4.2-8) that would occur under this alternative would be expected to improve fish passage at the screen, relative to the existing condition, which would represent a beneficial impact to upper Sacramento River fishery resources.

The flow split between the internal bypass system and the oxbow channel would be about 25/75%, respectively (at river flows of 7,000 cfs and pumping rates of 3,000 cfs). Flow through the screen structure (screen and internal bypasses) would increase when the internal bypasses are open (Reclamation 1996f). A dye distribution study conducted by Reclamation (Reclamation 1996e) to determine the effect of operating an internal bypass on hydraulics at the screen face showed that internal bypass operation increased the movement of flow toward the screen, relative to that observed without an internal bypass system in operation. Reclamation's (1996e) studies indicated that additional hydraulic hot-spots (compared to the previous alternative) could occur at the fish screen upon operation of the internal bypass system. These findings suggest that additional impingement and/or entrainment of fish at the screen could occur under this alternative, relative to the previous alternative. However, before such a conclusion can be reached, a number of important points must be considered and evaluated.

First, changes in water movement toward the screen due to operation of the internal bypass system would be expected to be relatively minor, as indicated by comparing screen approach velocities for this alternative to those for the previous alternative and existing condition (Table 4.2-6). Second, juvenile fish do not necessarily move passively with the currents (like dye), but rather generally maintain directed movements. Third, adjustable baffles behind the screen would allow fine-tuning of the flow and velocity distribution, which would improve uniformity of flow and velocity distribution along the screen (Reclamation 1996f). Fourth, a Fish Protection Evaluation and Monitoring Program (Chapter 6) will be developed to conduct a comprehensive field evaluation of hydraulic conditions and fish passage, and to identify actions, if any, needed to optimize screen performance. Finally, small fish fry and eggs that do move passively with water currents would not be expected to be entrained at substantially different rates under this alternative compared to the previous alternative, and would be expected to entrain at a reduced rate relative to the existing condition, based on approach and sweeping velocities modeled for this alternative. Based on this discussion, operation of the internal bypass system would not be expected to directly result in substantial, if any, changes in the rates of fish entrainment and/or impingement relative to the previous alternative, and would be expected to result in decreased juvenile fish losses due to these factors compared to the existing condition.

The positive effects of improved screen performance, the addition of an internal bypass system, and enhanced oxbow hydraulics under this alternative would be expected to off-set the fact that the relative number of fish being diverted into the oxbow and passing the screen could increase by approximately 4-6%. Consequently, the net level of fish impingement and/or entrainment would be expected to decrease under this alternative, relative to that occurring under the existing condition. This would constitute a beneficial impact to Sacramento River fishery resources.

Impact 4.2-30 *– Operation and maintenance of the screen extension with gradient facility and internal fish bypass to the oxbow alternative would permanently change the availability of potential predator holding habitat within the oxbow and in the Sacramento River at the gradient facility.*

A beneficial impact. Various elements of this alternative would change the relative availability of potential predator holding habitat (i.e., areas characterized by current velocities less than 2.0 ft/s) within the project vicinity. A detailed discussion pertaining to changes in predation potential, based on changes in the relative availability of potential predator holding habitat, has been provided in Section 4.2.3, Methods. The same issues identified in that discussion also pertain to the predation assessment for this alternative; consequently, the same assessment approach has been applied here.

A comparison of sweeping velocities under existing conditions (Table 3.2-1) and simulated sweeping velocities under this alternative (Table 4.2-9) indicates that predator holding area availability in front of the screen face would decrease under this alternative, based on the 2.0 ft/s criteria. Under this alternative, average sweeping velocities would be less than 2.0 ft/s only at river flows of 5,000 cfs.

The operation of the bypass ports could decrease the sweeping velocity in a localized area near each of the bypass ports, and thereby result in localized "hot spots" and/or potential predator holding areas. However, baffling and other modifications would be expected to improve flow uniformity at these localized areas. In addition, operation of the screen cleaning device on a frequent schedule (e.g., every five minutes) could reduce the utilization of these areas by potential predators.

Based on the 2.0 ft/s criteria, increases of approximately 10% and 16% in the availability of potential predator holding habitat would be expected to occur in the upper oxbow, relative to the existing condition, at river flow rates of 7,000 and 10,000 cfs, respectively (Table 4.2-3). Conversely, the relative availability of potential predator holding habitat in the upper oxbow would be reduced by approximately 17% under this alternative at a river flow of 20,000 cfs. No change in the availability of potential predator holding area in the upper oxbow would occur at a river flow of 5,000 cfs. Relative to the existing condition, the availability of potential predator holding habitat in the lower oxbow would be reduced by 66%, 57%, 86%, and 100% at river flow rates of 5,000, 7,000, 10,000, and 20,000 cfs, respectively (Table 4.2-3). Changes in improvements at the 7,000 cfs river flow can be attributed to assumed increased HCPP pumping rates between the 5,000 cfs and 7,000 cfs river flows.

The back eddy which currently exists on the north side of the confluence of the lower oxbow with the Sacramento River would not be expected to change under this alternative. Also, as discussed for the previous alternative, operation and maintenance of the gradient facility would be expected to decrease the relative availability of potential predator holding habitat at the location of the gradient facility in the Sacramento River, relative to the existing condition. Nevertheless, significance criteria developed for assessing predation impacts associated with the gradient facility dictate that the relative availability of potential predator holding habitat within the gradient facility be compared to that potentially available in natural riffle habitat. As discussed for the previous alternative, the relative opportunities for predators to hold within the gradient facility would not be expected to differ substantially from that offered by a natural riffle at this same location (Ayres 1996d).

Changes in the estimated time of fish transport through the bypass system for this alternative range from approximately 1 less minute (at a velocity of 5.0 ft/s) to 1 additional minute (at a velocity of 3.0 ft/s), compared to the existing condition (i.e., 5 minutes). Transport time is of concern because, in general, fish returned to the oxbow via the bypass system would be disoriented for some period of time. It is during this period of disorientation that juvenile fish would be most prone to predation. Research studies have shown that fish exposed to multiple stressors at frequent intervals, or for longer periods of time, require longer periods to regain sufficient orientation and behavioral mechanisms (e.g., schooling, reaction times) to avoid predation. For example, Mesa (1994) showed that juvenile chinook salmon stressed by agitation were eaten in significantly greater numbers by northern squawfish, compared to the control group of salmon, when exposed to this predatory fish for up to one hour after being stressed by agitation.

Physiological responses to stress can include primary responses, such as plasma cortisol concentrations, and secondary or metabolic responses, such as plasma glucose. In a study by Barton et al. (1986), cortisol and glucose were compared in healthy and unhealthy fish subjected to the same multiple disturbances. The results of this study indicated that fish can experience a cumulative response to stress. Maule et al. (1988) also concluded that stress in fish could occur cumulatively, demonstrated by a decrease in white blood cells, decreased osmoregulatory ability, and reduced swimming endurance.

The hydraulics at the bypass bays, within the bypass pipe, and at the outfall under this alternative would, by design, be expected to be improved relative to the existing conditions. Improved hydraulics would be expected to reduce agitation of bypassed fish, thereby stressing them less during transport. The physical and hydraulic improvements in the bypass system that would reduce agitation and stress of bypassed fish would be expected to outweigh the up to one additional minute that fish could potentially remain in the bypass pipes under this alternative, compared to the existing condition. Consequently, bypassed fish under this alternative would be expected to be less disoriented upon their return to the oxbow than bypassed fish under the existing condition. However, relative to the previous alternative, the internal fish bypass could provide additional opportunities for predation due to concentration of the fish in the bypass pipes, point source release of the fish into the oxbow, disorientation of the juvenile fish, disruption of schooling behavior, and localized hydraulics at the bypass outfall that could create predator holding habitat.

Based on the available data, it is anticipated that the relative availability of predator holding habitat would: (1) decrease overall along the screen face; (2) remain unchanged and decrease within the upper oxbow at river flows of 5,000 and 20,000 cfs, respectively, and increase by approximately 10% and 16% at river flows of 7,000 and 10,000 cfs, respectively; (3) decrease substantially in the lower oxbow at all river flows; (4) remain essentially unchanged at the confluence of the lower oxbow with the river; and (5) would not differ substantially at the gradient facility (relative to a natural riffle, but would decrease at the gradient facility site relative to the existing condition).

Because: (1) the area anticipated to exhibit an increase in the relative amount of predator holding habitat (i.e., portions of the upper oxbow under certain river flows) would be smaller (from an actual square-footage perspective) than the areas expected to experience a reduction in the amount of predator holding habitat (i.e., the screen face and the lower oxbow and upper oxbow at high river flow rates); and (2) the small increase in the time of transport in the internal bypass that could occur would not be expected to result in additional disorientation of bypassed fish (due to improved hydraulics), the overall potential for losses of migratory juvenile fish due to predation within the project vicinity would be expected to decrease under this alternative, relative to the existing condition. This would constitute a beneficial impact to Sacramento River fishery resources, particularly salmonid resources. Although the amount of predator holding habitat would be expected to be reduced under this alternative, the Fish Protection Evaluation and Monitoring Program would include monitoring of predation near the bypass outfall, and identify corrective actions should predation at the outfall prove to be substantial.

***Impact 4.2-31** – Sediments could accumulate adjacent to the screen and/or in the bypass pipes, which could adversely affect bypass performance.*

A less-than-significant impact. Direct mortality of fish due to physical injury and/or indirect mortality from stress associated with the bypass system could increase if sediments accumulated near the bypass bays or within the internal bypass pipes, thereby degrading bypass bay hydraulics and/or causing turbulent flows inside the bypass pipes. Because hydraulics at the bypass bays, within the pipe, and at the outfall would be improved, by design, over that occurring under the existing condition, and because dredging and other maintenance activities would occur routinely to maintain performance of the internal bypass system, no adverse impacts to migratory juvenile fish would be expected to occur due to sedimentation adjacent to or within the bypass system. Therefore, any sedimentation that could occur under this alternative would constitute a less-than-significant impact to bypass system performance and, consequently, survival of migratory juvenile fish passing through the bypass system.

4.2.4.5 Screen Extension With Gradient Facility and Internal Fish Bypass to River Impacts

Impacts attributed to the previous project alternatives that would also apply to this alternative are not included in this section. Differences in potential impacts to the aquatic resources of the Sacramento River that would occur under this alternative, relative to the previous alternatives, are discussed below.

Construction

***Impact 4.2-32** – Cofferdams placed in the lower oxbow and Sacramento River for construction of the bypass system could temporarily change the availability of potential predator holding habitat within the lower oxbow and river at the outfall location.*

A less-than-significant impact. Construction of the internal bypass outfall within the Sacramento River is anticipated to require cofferdams within the lower oxbow (to route the bypass pipe across the oxbow channel) and the Sacramento River (to facilitate installation of the bypass outfall) for approximately six months. Cofferdams placed in the lower oxbow and Sacramento River could create back eddies and influence local channel hydraulics in other ways that could create potential predator holding areas adjacent to the cofferdams (i.e., areas characterized by current velocities less than 2.0 ft/s). Predation on migratory juvenile fish could, therefore, temporarily increase at these locations, relative to the degree of predation that would occur at these same locations under the existing condition. However, because the amount of additional predator holding area expected to be created from installation of the cofferdams would be anticipated to be small, relative to the total amount of predator holding area throughout the project vicinity, and because any additional predator holding areas created would be temporary, predation impacts to juvenile salmonids and other juvenile outmigrant fish associated with the cofferdams installed for construction of the internal bypass system with an outfall in the Sacramento River would be considered less than significant.

***Impact 4.2-33** – Construction of the bypass with an outfall in the Sacramento River would result in an additional impact to 1.8 acres of riverine habitat at the outfall location in the Sacramento River.*

A less-than-significant impact. Construction of the bypass outfall located in the Sacramento River would temporarily displace benthic macroinvertebrates from approximately 1.8 acres of riverine habitat, in addition to riverine habitats discussed under previous alternatives (Table 4.2-12 and Table 4.2-13). Construction could also permanently change habitat used by resident and migratory fish. However, as discussed for previous alternatives, because the area of habitat disturbance identified constitutes a minor fraction of the total riverine aquatic habitat available to macroinvertebrates and fish in the upper Sacramento River, because this area does not provide unique or critical habitat for any species of fish or benthic macroinvertebrate, and because macroinvertebrates can rapidly recolonize areas following disturbance, this impact would be considered less than significant.

Operation

Impact 4.2-34 – Operation and maintenance of this alternative would result in seasonal changes in the proportion of Sacramento River flow diverted into the oxbow, which could change fish losses at the HCPP fish screen due to impingement and/or entrainment.

A beneficial impact. As discussed previously (see Impact 4.2-13), the relationship between the proportion of river flow diverted and the relative number of fish diverted is dependent upon numerous factors for any given location. Changes in the proportion of Sacramento River flow diverted into the oxbow under this alternative have been estimated to be identical to those discussed for the previous alternative, with the exception that a slightly smaller proportion of river flow would be anticipated to be diverted under this alternative when river flows are 20,000 cfs (Table 4.2-2). Hence, the discussion of impingement and entrainment impacts for the previous alternative (i.e., Impact 4.2-30) also applies to this alternative.

As was determined for the previous alternative, the positive effects of improved screen performance, the addition of an internal bypass system, and enhanced oxbow hydraulics under this alternative would be expected to off-set the fact that the relative number of fish passing the screen could increase by approximately 4-5%, relative to the existing condition. Consequently, the net level of fish impingement and/or entrainment would be expected to decrease under this alternative, relative to the existing condition. This would constitute a beneficial impact to Sacramento River fishery resources.

Impact 4.2-35 – Operation and maintenance of this alternative would permanently change the availability and distribution of potential predator holding habitat within the oxbow and in the Sacramento River at the gradient facility.

A potentially significant impact. Various elements of this alternative would change the relative availability of potential predator holding habitat (i.e., areas characterized by current velocities less than 2.0 ft/s) within the project vicinity. A detailed discussion pertaining to changes in predation potential, based on changes in the relative availability of potential predator holding habitat, has been provided in the Methods section (4.2.3). The same issues identified in that discussion also pertain to the predation assessment for this alternative; consequently, the same assessment approach has been applied here. Moreover, the impact discussion pertaining to predation for the previous alternative (i.e., Impact 4.2-30) also applies to this alternative. Differences in the availability of potential predator holding habitat under this alternative compared to the previously discussed alternatives are discussed below.

A comparison of sweeping velocities under existing conditions (Table 3.2-1) and simulated sweeping velocities under this alternative (Table 4.2-9) indicates that predator holding area availability in front of the screen face would decrease under this alternative, based on the 2.0 ft/s criteria. Under this alternative, average sweeping velocities would be less than 2.0 ft/s only at river flows of 5,000 cfs.

Based on the 2.0 ft/s criteria, changes (compared to the existing condition) in the relative amount of potential predator holding habitat would be the same as those described for the previous alternative (see Impact 4.2-30). Relative to the existing condition, potential predator holding habitat in the lower oxbow would be reduced by 28%, 64%, and 100% at river flow rates of 5,000, 10,000, and 20,000 cfs, respectively, and would not change from the existing condition at a river flow rate of 7,000 cfs (Table 4.2-3). Changes in improvements at the 7,000 cfs river flow can be attributed to assumed increased HCPP pumping rates between the 5,000 cfs and 7,000 cfs river flows. Velocities in the lower oxbow would be expected to be lower than those described for the previous alternative, because the flow diverted into the internal fish bypass system would be returned to the river rather than the lower oxbow.

The relative degree of predation associated with the back eddy located on the north side of the confluence of the lower oxbow with the river channel would be expected to decrease under this alternative, because only the portion of migratory juvenile fish passing through the oxbow that are not bypassed would be prone to predation at this location. All fish entering the internal bypass system would exit the bypass system in the Sacramento River, downstream of this back eddy.

Changes in the estimated time of fish transport in the bypass system for this alternative range from 8 (at a velocity of 5.0 ft/s) to 13 (at a velocity of 3.0 ft/s) additional minutes, relative to the time of transport in the bypass system under the existing condition (i.e., 5 minutes). Except at very high river flows, velocity in the bypass system would be 3.0 ft/s, resulting in a transport time of 22 minutes. As discussed under the previous alternative (see Impact 4.2-30), transport time is of concern because fish exiting the internal bypass system would be disoriented for some period of time. It is during this period of disorientation that juvenile fish are likely to be most prone to predation.

The hydraulics at the bypass bays under this alternative would, by design, be expected to reduce the stress on bypassed fish. However, these improvements might not be sufficient to off-set additional disorientation that bypassed fish could experience as a result of being in the bypass pipes for up to an additional 17 minutes, relative to the existing condition. The configuration of the bypass pipelines is also a concern, particularly at the location that crosses the oxbow. The bypass pipelines could require multiple bends under and along the oxbow and potentially be subject to hydraulic problems that could cause additional stress for juvenile fish.

As discussed in Section 3.2.4.2 (Internal Fish Bypass System Performance), a study of the existing bypass system at HCPP found that fish could take up to 14 hours to be recovered at the bypass outfall. Because: (1) literature indicates that juvenile fish can experience cumulative stress in a bypass system (see Impact 4.2-30); (2) fish subjected to stress can become more vulnerable to predation; and (3) because the improved hydraulics at the entrance to the internal bypass system might not be sufficient to outweigh the potential for increased stress and resultant disorientation and/or injury, predation near the bypass outfall (return to river) could result in increased predation, relative to the existing condition or the previous alternative.

Furthermore, the currently proposed river outfall would be located at the upper end of a large (i.e., approximately 750-1,000 feet long), deep, low-velocity pool within the Sacramento River (Ayres 1996d). Disoriented fish exiting the internal bypass system at this river location would be expected to experience potentially substantial losses due to predation by Sacramento squawfish, American shad, striped bass, and other predatory fish holding within this pool habitat. Hence, losses of bypassed fish due to predation near the bypass outfall and latent mortality under this alternative would be expected to be higher than losses due to these same factors under either the existing condition, or the previous alternative.

Based on the available data, it is anticipated that the relative availability of predator holding habitat would: (1)decrease along the screen face; (2) increase at the internal bypass outfall; (2) remain unchanged and decrease within the upper oxbow at river flows of 5,000 and 20,000 cfs, respectively, and increase by approximately 10% and 16% at river flows of 7,000 and 10,000 cfs, respectively; (3) decrease substantially in the lower oxbow at all river flows except 7,000 cfs; (4) remain essentially unchanged at the confluence of the lower oxbow with the river; and (5) would not differ substantially at the gradient facility (relative to a natural riffle, but would decrease at the gradient facility site relative to the existing condition).

Because it remains uncertain whether the reduction in predation expected to occur at the screen face and within the lower oxbow at a river flow of 5,000 cfs, and within the upper and lower oxbow at a river flow of 20,000 cfs for non-bypassed fish, would be sufficient to off-set the increase in predation anticipated to occur at the bypass outfall (due to location of outfall and increased disorientation of bypassed fish), changes in losses of migratory juvenile fish due to predation under this alternative at river flow rates of 5,000 and 20,000 cfs would constitute a potentially significant impact to Sacramento River fishery resources.

Because the relative availability of predator holding habitat within the oxbow (from an actual square-footage perspective) would increase somewhat under this alternative at a river flow rate of 7,000 cfs and would remain essentially unchanged (relative to the base condition) at a river flow rate of 10,000 cfs, and because predation would be expected to increase at these flow rates at the bypass outfall, the overall potential for losses of migratory juvenile fish due to predation within the project vicinity would be expected to increase under this alternative at river flow rates of 7,000 and 10,000 cfs. The increased losses of migratory juvenile fish expected to occur under this alternative at these river flow rates would constitute a potentially significant impact to Sacramento River fishery resources.

4.2.5 Mitigation

The lead agencies are evaluating construction schedule options to assess the feasibility of staging in-river construction activities so that potential impacts to special-status fish species would be minimized to the extent feasible. The following mitigation measures are recommended in addition to those incorporated in the project description as described in Section 2.4.2 (Screen Extension Alternative).

C-085703

Mitigation Measure for Impact 4.2-9 – Construction activities within the oxbow associated with the screen extension alternative could result in the temporary disruption (i.e., delay and/or blockage) of upstream adult immigration and/or downstream juvenile emigration through the oxbow.

The potential exists for mortality of migratory juvenile fish that become trapped in areas of the oxbow enclosed by cofferdams, where they would then be subject to poor water quality and stranding upon removing water from the enclosed area to facilitate construction. Based on river conditions (e.g., depth, substrate type) within areas enclosed by the cofferdams, appropriate methods (e.g., seining, electrofishing, etc.) would be employed as soon as possible following completion of cofferdam installation, and prior to water removal to reduce the magnitude of losses of migratory juvenile fish associated with cofferdam installation. Monitoring and rescue seining would be conducted by qualified fisheries biologists. These mitigation measures would be expected to minimize impacts; however, it is likely that mortality to an unknown number of individual fish of special-status species would occur. Thus, the impact could remain potentially significant after mitigation.

Mitigation Measure for Impact 4.2-20 – Construction of the gradient facility could disrupt (i.e., delay and/or block) fish immigration and/or emigration in the Sacramento River.

Implement Mitigation Measure 4.2-9. These mitigation measures would be expected to minimize impacts to juvenile fish; however, it is likely that mortality to an unknown number of individual fish of special-status species would occur. Thus, the impact would remain significant after mitigation. To minimize disturbance of adult fish migrating upstream during construction, it is recommended that lower oxbow improvements occur after the construction of the screen extension and gradient facility., ~~as is currently proposed in the project description.~~ This would allow an open fish migration route during all phases of construction, and prevent potentially significant impacts to adult fish migration.

Mitigation Measure for Impact 4.2-35 – Operation and maintenance of the screen extension with gradient facility and internal fish bypass to river alternative would permanently change the availability of potential predator holding habitat within the oxbow and in the Sacramento River at the gradient facility.

Potentially significant predation impacts could occur under this alternative as a result of the combined effects of increased travel time in the bypass, potential hydraulic effects of the pipeline configuration under and along the oxbow, and a bypass outfall near a large predator holding area in the Sacramento River. If predation or other problems were identified with operation of the return to oxbow alternative that resulted in a decision to extend the bypass to the river, mitigation to reduce potential predation impacts could include hydraulic improvements for the pipeline and siting the bypass outfall in the river in an area that would minimize predation (e.g., velocities greater than 2.0 ft/s to reduce predator holding areas).

4.3 Geology and Soils

4.3.1 Introduction

This section presents the criteria used to assess impact significance, the methods of analysis, the projected changes in geology and soils due to the no-project and project alternatives, and a discussion of the significance of expected impacts. Discussions of geologic considerations related to riverbank stability, river channel alignment, and river gradient are included in Section 4.1, Hydrology and Water Resources.

4.3.2 Impact Significance Criteria

There are no formal, specific regulations or criteria for analyzing geology and soils impacts. The following impact significance criteria for geology and soils are derived from the California Environmental Quality Act Guidelines (i.e., the list of Significant Effects in Appendix G and the Environmental Checklist Form in Appendix I), and from the *Guidelines for Geologic/Seismic Considerations in Environmental Impact Reports* (CDMG 1982).

The following impacts to geology and soils would be considered significant:

- substantial unstable earth conditions, including unstable slopes, or substantial changes in geologic substructures that could affect human safety; or
- the exposure of people or property to major geologic hazards, including unstable slopes, ground failure, liquefaction, and lateral spreading.

Impacts to geology and soils would be considered less than significant if they do not meet these criteria.

4.3.3 Methods

Effects on geology and soils within the project area were evaluated by comparing expected effects on topography and soils resulting from each of the alternatives. Risks due to seismicity in the area on the project features were also analyzed. The basis for determining soils and geology impacts does not change substantially from existing to future conditions.

4.3.4 Impacts

4.3.4.1 No-Project Impacts

Construction

Construction of this alternative would result in the permanent disturbance of .06 acre of Riverwash soils and .38 acre of Columbia soils. Construction would result in temporary impacts to 1.19 acres of Columbia soils and 1.15 acres of Riverwash soils. Construction of the proposed

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project would not be expected to uncover contaminated soils within the project area (Quanterra 1996).

Potential impacts to geology and soils resulting from construction of the no-project alternative would not be expected to result in substantial unstable earth conditions or the exposure of people or property to major geologic hazards. Therefore, potential impacts would be considered less than significant.

Operation

Lateral deformation of slopes could result from seismic activity in the area. Unconfined embankments or river embankments that are not seismically stable would be the most susceptible to such movement under conditions of total or partial liquefaction. In the case of a nearby substantial seismic event (i.e., 5.0 or greater on the Richter scale), settlement of soils containing significant amounts of fines (i.e., greater than 20 percent) could occur within the project area. Soils most susceptible to settling include alluvium (i.e., all of the soil types within the project area), and artificial fills such as dredge spoil piles.

No substantial changes in dredging volumes would be expected under the no-project alternative. Some changes in dredge spoil handling (Section 2.4.1, No-Project Alternative) could occur. This would include possible dredge spoil processing and stockpiling on GCID's vacant parcel of land across from the HCPP service yard at the corner of First Avenue and Cutler Avenue. It is expected that the dredge spoil piles, either on Montgomery Island or on the vacant parcel, would remain at current levels of up to approximately 25 feet in height regardless of the option.

Under this alternative, the diversion rate at Hamilton City Pumping Plant (HCPP) would be limited to about 1,400 cubic feet per second. This would result in less water available for use by farmers within the GCID service area and lower Colusa Basin and would require the use of more recaptured water and groundwater. Additional use of groundwater could also lead to some subsidence in the project area. No substantial changes would be expected to geology and soils with construction of new wells and recapture stations under this alternative.

Potential impacts to geology and soils resulting from operation of the no-project alternative would not be expected to result in substantial unstable earth conditions or the exposure of people or property to major geologic hazards. Therefore, potential impacts would be considered less than significant.

4.3.4.2 Screen Extension Impacts

Construction

Construction of this alternative would result in the permanent disturbance of 0.2 acre of Riverwash, 2 acres of Columbia soils, and 1 acre of Hillgate soils. Construction would result in temporary impacts to 1 acre of Columbia, 0.3 acre of Hillgate, and 0.3 acre of Riverwash soils.

Construction of the proposed project would not be expected to uncover contaminated soils within the project area (Quanterra 1996).

Potential construction impacts to geology and soils resulting from the screen extension alternative would not be expected to result in substantial unstable earth conditions or the exposure of people or property to major geologic hazards, therefore, they would be considered less than significant.

Operation

During operation, it is expected that the dredge spoil piles could reach up to approximately 25 feet in height on either the north end of Montgomery Island to GCID's lands across from HCPP as discussed above for the no-project alternative.

These spoil piles would not be expected to result in substantial unstable earth conditions or the exposure of people or property to major geologic hazards because slopes would be maintained at a safe angle. Therefore, potential impacts would be considered less than significant.

4.3.4.3 Screen Extension with Gradient Facility Impacts

Construction

In addition to the impacts identified for the screen extension alternative, construction of this alternative would result in the permanent disturbance of 6.9 acres of Riverwash soils. Construction would also result in temporary impacts to 13.7 acres of Riverwash soils.

Potential construction impacts to geology and soils resulting from the screen extension with gradient facility alternative would not be expected to result in substantial unstable earth conditions or the exposure of people or property to major geologic hazards. Therefore, construction impacts would be considered less than significant.

Alternative Gradient Facility Construction Methods

The alternative methods and schedules that have been proposed for constructing the gradient facility are discussed in detail in Section 2.4.3 (Screen Extension with Gradient Facility Alternative). Impacts to geology and soils associated with the proposed four-phase, one-year alternative are discussed above.

Impacts to geology and soils resulting from the alternative wet construction method, the one- or two-phase dry construction methods, and the two-year construction method would not be expected to differ substantially from those described above for the four-phase, dry construction method.

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Operation

During operation, impacts to geology and soils from this alternative would be substantially similar to the screen extension alternative.

4.3.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass Impacts

Construction

Construction of this alternative would not result in substantial additional permanent disturbance of soils beyond those identified for the screen extension with gradient facility alternative.

Potential construction impacts to geology and soils resulting from the screen extension with gradient facility and internal fish bypass alternative would not be expected to result in substantial unstable earth conditions or the exposure of people or property to major geologic hazards. Therefore, they would be considered less than significant.

Operation

During operation, impacts to geology and soils for this alternative would be substantially similar to the screen extension alternative.

4.3.5 Mitigation

No potentially significant impacts are identified. Therefore, no mitigation is recommended.

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4.4 Recreation and Navigation

4.4.1 Introduction

This section presents the criteria used to assess impact significance, the methods of analysis, the projected changes in recreation and navigation from existing conditions, a discussion of the significance of expected impacts, and a discussion of measures recommended to mitigate potentially significant impacts.

4.4.2 Impact Significance Criteria

There are no formal, specific regulations or criteria for analyzing recreation and navigation impacts. The following impact significance criterion for recreation and navigation is derived from the California Environmental Quality Act Guidelines (i.e., the list of Significant Effects in Appendix G and the Environmental Checklist Form in Appendix I) and from the Public Trust Doctrine, which, in protecting the sovereign lands of the State, is designed to protect the rights of the public to use watercourses for recreation and navigation (SLC 1993).

The following impacts to recreation and navigation would be considered significant:

- substantial conflict with established recreational uses of the project area, including reducing the quality or quantity of recreational opportunities or limiting the ability of vessels longer than 21 feet to pass through the project area; and

- substantial changes in recreation safety or hazards.

Impacts to recreation and navigation would be considered less than significant if they do not meet these criteria.

4.4.3 Methods

The analysis addresses the immediate surroundings of the Hamilton City Pumping Plant (HCPP), the Sacramento River channel and banks from approximately River Mile (RM) 205 to RM 206, the oxbow channel, and Montgomery Island.

Existing and future (2020) conditions for hydrology are not expected to be the same (Section 4.1, Hydrology and Water Resources). However, the future hydrologic conditions are not expected to result in substantial differences in recreation and navigation opportunities within the project area. Therefore, it is assumed in the following analysis that future recreation and navigation conditions would not change substantially from existing conditions.

Effects on recreation and navigation opportunities within the project area were evaluated by assessing how the expected changes in river flows and channels and surrounding terrestrial vegetation from the alternatives would impact recreation. Effects on recreation safety were evaluated by comparing expected changes in river morphology and by identifying potential hazards resulting from each of the alternatives.

4.4.4 Impacts

4.4.4.1 No-Project Impacts

Construction

No potential impacts to recreation and navigation have been identified for the new or improved wells and recapture stations associated with this alternative (Section 2.4.1, No-Project Alternative). However, potential impacts could result from construction and operation activities associated with the lower oxbow improvements (Table 2.4-1).

The no-project alternative includes the construction of a new oxbow flow control structure, bridge across the oxbow, and trapezoidal channel through the lower oxbow. Some temporary conflicts and changes in recreational or navigational uses of the project area would be expected with these activities. Some safety hazards would also result during construction of the lower oxbow improvements due to the presence of heavy equipment, placement of in-water structures and materials, and localized changes in water velocities. Such temporary safety hazards would last approximately three to six months (Table 2.4-1) and could represent a potentially significant impact.

***Impact 4.4-1** – Construction activities in the oxbow could interfere with recreational boating and increase potential boating hazards.*

A potentially significant impact. The presence of heavy equipment and temporary obstructions (i.e., construction equipment and materials) both on the shore and within the oxbow channel under this alternative could interfere with recreational boating opportunities and increase hazards for boaters in the channel. This impact would be relatively short-term, lasting approximately 3 months during construction. Because this impact would reduce the quality of recreational opportunities within the project area, it would be considered potentially significant. Mitigation to lessen the significance of this impact is presented in Section 4.4.5.

Operation

During operation of the no-project alternative, the bridge across the oxbow would represent a new safety hazard for non-motorized vessels floating through the oxbow. While recreational vessels are currently prohibited from the fish screen area, the potential exists for inner-tubes, rafts or canoes to float through the oxbow, past the fish screen, and become entrained into the higher velocity oxbow flows downstream of the fish screen. During average water year conditions, there would be no safety hazard. Entrainment of vessels during higher flow conditions when water levels approach the height of the bridge could represent a safety hazard. Bridge design and posting of warning signs would substantially reduce the significance of this potential impact.

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Impact 4.4-2 – Potential boating hazards would increase in the oxbow.

A less-than-significant impact. Improvements to the oxbow channel would lessen the occurrence of underwater snags and other materials potentially hazardous to recreational vessels. However, the presence of the new bridge in the oxbow flow control structure vicinity would represent a new safety hazard for non-motorized vessels as described above. Warning signs proposed at the upstream end of the oxbow would notify recreationists of the hazard and direct the non-motorized vessels to avoid the oxbow. As a result, no potentially significant adverse impacts to recreation and navigation would be anticipated during operation of this alternative.

4.4.4.2 Screen Extension Impacts

The following impacts would be expected in addition to those described for the lower oxbow under the no-project alternative.

Construction

Additional changes in recreational uses and navigation hazards for this alternative would not be expected to cause impacts substantially different from those shown for the no-project alternative.

Operation

Additional changes in recreational uses and navigation hazards for this alternative would not be expected to cause impacts substantially different from those shown for the no-project alternative.

4.4.4.3 Screen Extension with Gradient Facility Impacts

The following impacts would be expected in addition to those discussed for the screen extension alternative.

Construction

Impact 4.4-3 *– Construction activities could limit boat access along the river, increase potential boating hazards in the river channel, and interfere with nearby river shore recreation.*

A significant impact. The presence of heavy equipment and temporary obstructions both on the river bank and within the Sacramento River channel under this alternative could interfere with and pose hazardous conditions for recreational boating and other recreational opportunities (i.e., hunting and fishing). These obstructions would be present for approximately seven months during the construction of the gradient facility and would be present during the higher use summer season. In addition, predicted velocities along the Sacramento River would substantially increase within the gradient facility area (Ayres 1997d). Because this impact would increase hazards and reduce the quality of recreational opportunities within the project area, it would be considered significant. Mitigation to lessen the significance of this impact is presented in Section 4.4.5.

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Alternative Gradient Facility Construction Methods

The alternative methods and schedules that have been proposed for constructing the gradient facility are discussed in Section 2.4.3 (Screen Extension with Gradient Facility Alternative). Impacts to recreation and navigation associated with the proposed four-phase, one-year alternative are discussed above. This section discusses advantages and disadvantages associated with the other construction scenarios and schedules as they differ from the four-phase, one-year alternative.

In-River (Wet) Construction of the Gradient Facility

This alternative would involve the use of barges, sheet pile drivers, cranes, ~~and~~ large draglines, and other equipment within the Sacramento River to construct the gradient facility. It would also involve the use of up to 150-foot long rock berms extending from shore into the river. Impacts to recreation and navigation resulting from the wet construction method would differ from the four-phase (dry) construction method in that more barges, ~~and~~ draglines, and other equipment and activities would pose additional hazards for recreational boaters. Specifically, this equipment and the rock berms would pose additional in-water obstructions and hydraulic anomalies that could represent safety hazards. However, construction of the gradient facility with the wet construction method could take less time than it would with the dry construction methods, which could lessen the overall period during which the safety hazards and disruption of recreational boating occur~~s~~ within the area. Measures, such as the posting of signs and the use of buoys and other markers, could be implemented to warn recreationists of the additional hazards posed within the river under this construction method. Significant adverse impacts in addition to those described above for the four-phase, one-year alternative would not be expected to result from this construction method.

One-Phase (Dry) Construction of the Gradient Facility

This alternative would involve damming off the Sacramento River and diverting all of its flow through the oxbow. Because the construction of multiple cofferdams would not be necessary, construction of the gradient facility under this alternative is anticipated to ~~be approximately three months, possibly~~ require up to approximately six months. Some increased hazards could result to vessels entrained through the oxbow during gradient facility construction because of anticipated higher velocities and narrowed channel through the oxbow. Impacts to recreation and navigation resulting from this construction method would otherwise not differ substantially from the proposed four-phase (dry) construction method.

Two-Phase (Dry) Construction of the Gradient Facility

Impacts to recreation and navigation resulting from the two-phase, dry construction method, would not be expected to be substantially different than those described above for the four-phase, dry construction method. Significant adverse impacts in addition to those described above for

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the four-phase, one-year alternative would not be expected to result from this construction method.

Two-Year (Dry) Construction Schedule

Impacts to recreation and navigation resulting from the two-year, dry construction method also would not be expected to be substantially different than those described above for the four-phase, dry construction method. Significant adverse impacts in addition to those described above for the four-phase, one-year alternative would not be expected to result from this construction method.

Operation

Impact 4.4-4 *– Potential recreational boating hazards could increase in the river.*

A significant impact. The completed gradient facility would include deeper center channels at a width and depth similar to the existing river channel at low river conditions. Depths within the gradient facility would not be expected to fall below 2.5-3.0 feet at flow rates of 3,000-3,500 cfs (Ayres 1996d). The shallowest portion of the gradient facility would be along the west side of the river channel immediately downstream of the gradient facility, which is an area that has historically been very shallow and is part of the edge of a natural riffle at RM 205.5. The width and depth of the gradient facility would be expected to be sufficient for the passage of most 21-foot water craft.

The gradient facility could result in increased hazards to recreational boaters, including at low flows the presence of the submerged longitudinal rock berm along the center portion of the gradient facility; and the potential for debris accumulation along the edges in shallow areas. In addition, the four rock dikes that would be present along the east bank of the Sacramento River across from the oxbow intake channel could pose threats to recreational vessels. Eddies and other localized flow phenomena associated with the gradient facility could increase hazards to smaller vessels (Ayres 1996), but it would not be expected to be more than natural riffle conditions. Because this impact would increase hazards and could reduce the quality of recreational opportunities within the project area, it would be considered significant. Mitigation to lessen the significance of this impact is discussed in Section 4.4.5.

4.4.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass Impacts

No changes in addition to those discussed above for the screen extension with gradient facility alternative would be expected under this alternative with either the return to oxbow or return to river option.

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4.4.5 Mitigation

The following mitigation measures are recommended in addition to those incorporated in the project description as described in Section 2.4.2 (Screen Extension Alternative).

Mitigation Measure for Impact 4.4-1 *– Construction activities could interfere with recreational boating and increase potential boating hazards and potential boating hazards could increase in the oxbow.*

As necessary, temporary barriers and signs would be erected along the oxbow channel to limit access to construction areas and to warn recreationists of potential hazards (M. Sotelo, pers. comm., 1997). During operation, permanent signs would be installed and maintained. The California Department of Boating and Waterways (CDBW) would be consulted further for recommendations concerning the placement of these barriers and signs. While not a permitting agency, the CDBW would also be invited to review the construction operations to assure that construction proceeds in accordance with compliance recommendations.

Implementation of this mitigation measure would reduce the expected impacts to recreation and navigation to a less-than-significant level.

Mitigation Measure for Impact 4.4-3 *– Construction activities could limit boat access along the river, increase potential boating hazards in the river channel, and interfere with nearby river shore recreation.*

As necessary, temporary barriers and signs would be erected along the Sacramento River channel to limit access to construction areas and to warn recreationists of potential hazards. Because of the expected substantial increases in river speeds, recreational boating along the affected portion of the Sacramento River would be restricted during construction of the gradient facility. This area would be clearly demarcated with barriers and signs. The CDBW would be consulted for recommendations concerning the placement of barriers and signs. The CDBW would also be invited to review the construction operations to assure that construction proceeds in accordance with compliance recommendations.

Implementation of this mitigation measure would reduce the expected impacts to recreation and navigation to a less-than-significant level.

Mitigation Measure for Impact 4.4-4 *– Potential recreational boating hazards could increase in the river.*

Seasonal or permanent buoys would be used to clearly define the limits of the low-water navigation channel over the gradient facility in the Sacramento River channel. A 50-foot buffer zone would be delineated around the rock dikes with permanent buoys. All proposed facilities that could be submerged during high or low flow conditions would be marked in accordance with Section 659 of the Harbors and Navigation Code (M. Sotelo, pers. comm., 1997; California Administrative Code, Title 14, Section 7000). Warning signs would be placed along both banks

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of the river upstream and downstream of the gradient facility at distances of 500, 1,000, and 1,500 feet. While not a permitting agency, the CDBW could review proposed facilities to ensure that impacts to navigation are minimized to the extent feasible as part of construction planning and design (M. Sotelo, pers. comm., 1997). Any additional recommendations of the CDBW would be incorporated into final construction plans to the extent feasible.

Implementation of this mitigation measure would reduce the expected impacts to recreation and navigation to a less-than-significant level.

4.5 Terrestrial Biology

4.5.1 Introduction

This section presents the analyses of impacts on terrestrial resources. It includes criteria for determining significance of the impacts, the methods for determining the impacts, the results of the impact analyses, and the mitigation measures for addressing the impacts. The analysis addresses issues identified in Table 2.6-2 (Issues Carried Forward for Further Analysis): riparian, scrub/willow, and wetland habitats, and species of concern.

4.5.2 Impact Significance Criteria

The California Environmental Quality Act (CEQA) (Section 15065(a)) Guidelines (Appendix G, Significant Effects) specify that a lead agency shall find that a project could have a significant effect on the terrestrial, non-riverine biological environment when the project has the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a wildlife species, cause a wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, or reduce the number or restrict the range of a rare or endangered plant or animal.

Riparian systems provide habitat that is used by numerous species including species of special concern. Smith (1977) estimates that approximately 775,000 acres of riparian woodland existed along the Sacramento River and its tributaries in 1850. Of this, only an estimated 12,000 acres (about 2 percent) remained as of 1977 (Roberts, et al. 1977; Smith 1977). The Upper Sacramento River Fisheries and Riparian Habitat Management Plan (The Resources Agency 1989) estimates the extent of riparian habitat along the Sacramento River at 500,000 acres in 1850, with banks of vegetation spreading four to five miles. Of this, less than 5 percent remains. Due to the drastic historical reduction of riparian habitat, and its adverse effect on many of the species reliant on this habitat, any reduction in the quantity or quality of riparian habitat would be considered potentially significant.

The CEQA Guidelines (Section 15380) define a "rare or endangered" species as those specifically listed under Federal or California State law. The guidelines further allow for non-listed species to be treated as "rare or endangered" under the following circumstances:

- if the species' survival and reproduction in the wild are in immediate jeopardy;
- if the species is existing in such small numbers throughout all or a significant portion of its range that it could become endangered if its environment worsens;
- if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and could be considered under the Federal definition of "threatened;" and

- if the project would cause a change in species composition, abundance, or diversity beyond normal variability; or would result in the measurable degradation of sensitive habitats through filling, inundation, or other land use alteration.

4.5.3 Methods

This section describes the issues and methods by which impacts are analyzed for the no-project and project alternatives. Issue discussions are organized in the same order that issues are identified in Table 2.6-2 (Issues Carried Forward for Further Analysis).

Impacts addressed in this section include those involving riparian, scrub/willow, and wetland habitats, and species of concern that could reside in these habitats. For the purpose of impacts analysis and mitigation recommendations, riparian forests and scrub/willow habitat are considered together under the "riparian" category. Issues involving grassland, gravel bar shoreline, ruderal, and agricultural habitats were eliminated as indicated in Table 2.6-1 (Issues Considered and Eliminated from Further Analysis).

The habitats within the immediate area of the proposed project were initially mapped by the U.S. Fish and Wildlife Service (USFWS) for use in the draft Habitat Evaluations Procedure (HEP) analysis (USFWS 1995a) using 1992 aerial photographs. Areas of impact were determined by planimeter. These habitats have been verified and updated through review of 1996 aerial photographs and field inspection. In its HEP analysis, the USFWS identified the total acreage impacted, by habitat type, as calculated for the analysis. USFWS habitat maps have subsequently been converted to AutoCad (version R13 C-4) files and areas calculated. Where differences were found to occur in the acreage calculated from the AutoCad drawings and those provided in the HEP analysis, the AutoCad acreages are utilized in the EIR/EIS. The acreage determined by AutoCad would be adopted in subsequent drafts of the HEP analysis.

The habitat impact acreages for the project alternatives described in this Draft EIR/EIS are slightly different than those shown in the Fish and Wildlife Coordination Act Report (Appendix E). The differences are a result of slightly different assumptions for project design. The differences are not substantial for any of the habitats, and are expected to change again in the future with final design and final habitat surveys.

No substantial changes are projected for terrestrial resources for the foreseeable future. Most of the impacts to terrestrial resources would occur during the construction phase of the project and would result from the removal of vegetation for the placement of structures and construction of access and maintenance roads. Noise impacts would be involved during the installation of sheetpile and with construction vehicle traffic. Permanent impacts would result where structures are placed and access roads maintained for operations. Impacts for all species within the area of the project, including special-status species, would be directly related to disruption of habitat. As an example, loss of riparian habitat would likely affect the habitat of valley elderberry longhorn beetle. Temporary impacts would occur in construction zones and staging areas, and along roadways used solely for construction access. Sites of temporary disturbance would be restored and revegetated, or naturally re-colonized by plants following construction.

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In the absence of recent site- and resource-specific surveys, many of the impacts below are described as *potentially* significant. Additional data on the location, quality, extent, and composition of extant plant communities and special-status species' occurrences, would be collected as part of final project design and used to determine final mitigation requirements.

Further information on listed and proposed listed species is provided in the Biological Assessment (Appendix A). Mitigation measures presented in the EIR/EIS, as well as in the Biological Assessment, are intended to guide final project design to avoid sensitive biological resources, and provide compensation for unavoidable significant impacts.

4.5.4 Impacts

4.5.4.1 No-Project Impacts

Construction

The no-project alternative, as described in Section 2.4.1 (No-Project Alternative) would limit the amount of surface water that could be delivered from Hamilton City Pumping Plant (HCPP) to approximately 1,400 cubic feet per second (cfs) year-round. To improve hydraulics in the upper oxbow channel, approximately 150 linear feet of riprap would be placed along both banks of the oxbow. Improvements would also occur along approximately 2,600 linear feet on the south bank of the lower oxbow to facilitate construction of the trapezoidal channel. These improvements would occur up to the 140-foot elevation level and could affect approximately 0.5 acre of riparian habitat and 0.4 acres of ruderal habitat. Although the significance criteria identifies any impact to riparian habitat as significant, because the impacted habitat occurs in narrow and intermittent bands along the oxbow, this loss of riparian habitat would be considered a less than significant impact.

Based on surveys for elderberry shrubs (JSA 1996), approximately 51 elderberry stems 2.54 (1 inch) or greater in diameter would be impacted by bank modifications both upstream and downstream of the existing screen. This could affect the federally listed valley elderberry longhorn beetle (VELB) and represent a significant impact. ~~no elderberry, and therefore no valley elderberry longhorn beetles (VELB) would be affected by these channel modifications.~~ A 5-acre storage area would be located on a 13.7-acre parcel at First Avenue and Cutler Avenue across the street from the HCPP in an area of moderate human use. This parcel has been recently farmed and is currently in a ruderal, fallow state. Use of this parcel would not have potentially significant impacts to terrestrial resources.

Impacts could occur to terrestrial biological resources as a result of constructing approximately 50 new wells to increase groundwater pumping, and/or facilities for drain recapture to supplement further reduced diversions from HCPP. Although the location of these facilities is unknown at this time, they would likely be constructed in areas of previous disturbance. Drain recapture facilities would presumably be placed along or adjacent to existing canals and ditches. Construction of these facilities could affect species such as the giant garter snake. Groundwater

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pumping and drain recapture facility construction would require independent environmental documentation and public/agency review to determine impacts on biological and other resources. Analysis of projected impacts due to these facilities at the present time would therefore be speculative and is not included in this document.

Impact 4.5-1 – Construction activities would permanently alter riparian habitat.

A less-than-significant impact. Under the no-project alternative impacts to riparian vegetation would include .5 acre of habitat within the lower oxbow downstream of the existing fish screen. Riparian impacts could affect riparian species such as the State endangered yellow-billed cuckoo. Impacts would include placement of riprap below the 140-foot elevation along the oxbow and construction of a trapezoidal channel to improve oxbow flow characteristics.

Impact 4.5-2 – Construction activities could affect the nesting habitat of predatory bird species of concern.

A potentially significant impact. No-project construction activities could impact nesting Swainson's hawks, or other raptorial species such as the osprey, through disturbance of the nesting site or destruction of a nesting tree. The significance of impacts would depend on final design and construction plans, and on the proximity of the nesting sites relative to the site of the proposed construction.

Impact 4.5-3 – Construction activities would permanently alter vertical erosion prone banks which could provide suitable nesting habitat for bank swallows.

A potentially significant impact. One bank swallow was reported using a burrow on a newly eroded bank immediately downstream of the fish screen on May 6, 1997 (G. Stern pers. comm., 1997). This potential nesting site would be impacted under the no-project alternative.

Operation

Operation of the no-project alternative would result in potential impacts to 5.0 acres of ruderal habitat for stockpiling dredge materials at the project site. This would result if the optional dredge stockpile site is used across from the HCPP service yard.

There are no additional impacts exclusive to the operation of the no-project alternative. Impacts attributed to the no-project alternative are summarized in **Table 4.5-1**.

Impact 4.5-4 - Construction activities would result in a reduction in abundance of elderberry shrubs, which could affect VELB.

A significant impact. Construction of the no-project alternative would result in potential impacts to approximately 51 elderberry stems 2.54 cm (1 inch) or greater in diameter at the base (JSA 1996) **(Figure 4.5-1).** Elderberry shrubs provide the federally threatened VELB with its sole

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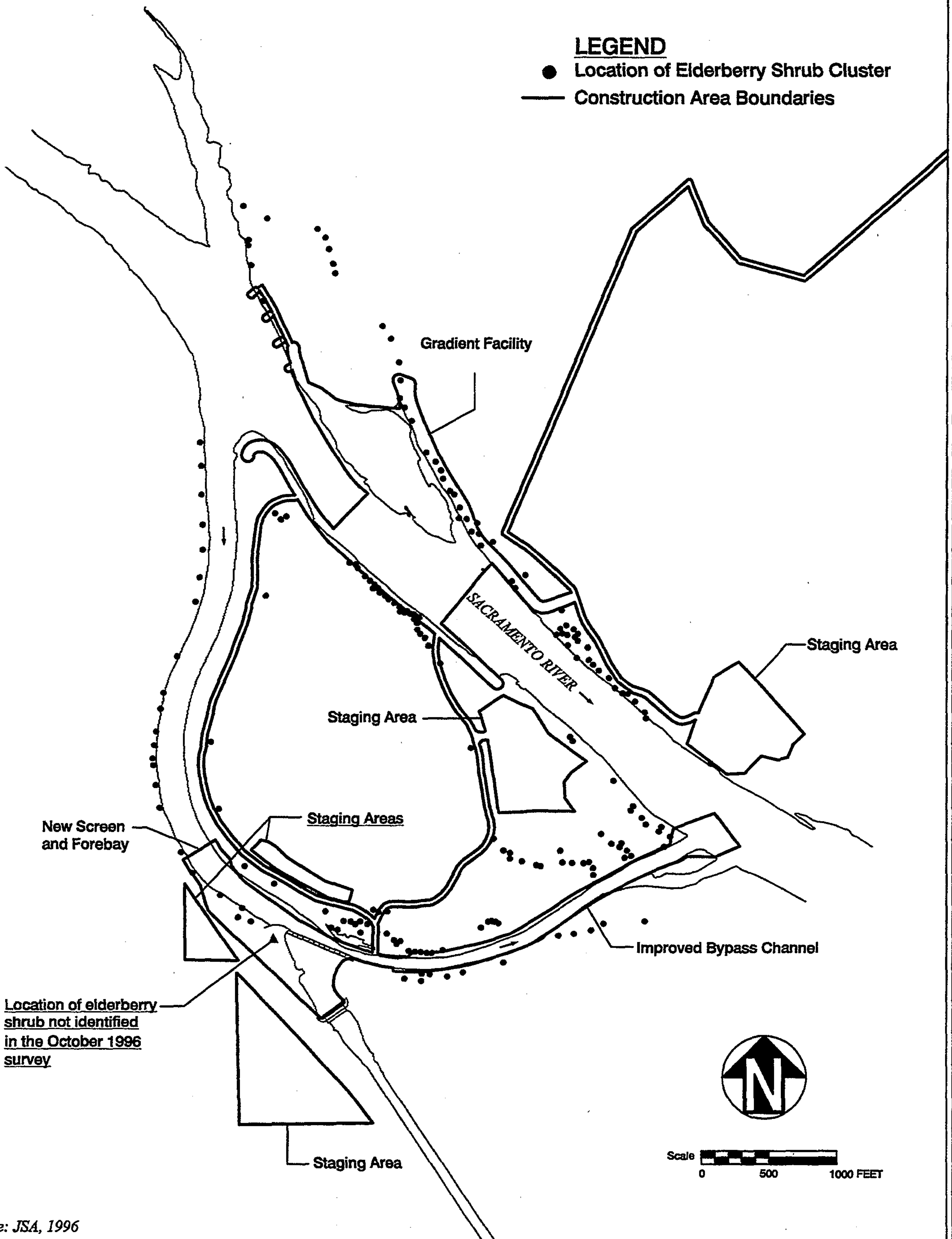
C-085719

FIGURE 4.5-1. LOCATION OF ELDERBERRY SHRUB CLUSTERS IN RELATION TO PROPOSED CONSTRUCTION AREAS



Source: JSA, 1996

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source of reproductive habitat and food resources. The degree of impact could change prior to construction of the no-project alternative due to shoreline erosion from high river flows. New surveys could be required to determine the final number of stems impacted.

Table 4.5-1 - No-Project Alternative
Impacts by Terrestrial Habitat Type

Habitat Type	Total Acreage in the Project Vicinity[a]	Permanent Impact		Temporary Impact	
		Acreage	% of Total	Acreage	% of Total
Riparian[b,c]	227.0	0.5	less than 0.1	0	--
Scrub Willow[b]	3.3	0	--	0	--
Grassland	~~60.7~~61.2	0	--	0	--
Wetland	8.6	0	--	0	--
Sand/Gravel Bar	26.3	0	--	0	--
Row Crops[d]	~~19.9~~22.1	0	--	0	--
Orchard[d]	21.6[e]	0	--	0	--
Ruderal (Disturbed)	~~66.6~~68.7	5.4	~~7.5~~7.9	0	--
Total	~~434.0~~438.8	5.9	1.3	0	--

[a] The project vicinity is defined as the area of habitat illustrated on Figure 3.5-1.
[b] Riparian vegetation includes Mixed Riparian Forest and Valley Oak Riparian Forest. For the purposes of mitigation calculation, scrub willow is included with general riparian.
[c] Within the area affected by the project, habitat for elderberry shrub and therefore VELB occurs in conjunction with riparian forest habitat and is therefore, included under riparian.
[d] Orchards and row crops lie immediately outside of the present river associated habitats on both banks of the Sacramento River and constitute most of the habitat types outside of the immediate vicinity of the river shoreline.
[e] Total orchard acreage includes only that acreage delineated on Figure 3.5-1 and the 50-foot wide corridors needed for access roads to pass through orchards.

4.5.4.2 Screen Extension Impacts

Construction

Construction of the screen extension alternative would permanently alter 9.0 acres of native and non-native vegetation, including ruderal habitat adjacent to the HCPP facilities. This alteration would occur due to the construction of the screen extension (including sheet pile wall) and expanded forebay, new access and maintenance roads (including bridge abutments for bridge access to Montgomery Island), hydrologic improvements to the lower oxbow, and permanent storage and yard facilities. Temporary disturbance would impact a total of ~~8.6~~ 13.4 acres including temporary access roads, construction staging and storage areas, and areas incidentally impacted (buffer zones) adjacent to the construction zone. Total acreage impacts by habitat type are displayed in **Table 4.5-2**.

Construction activities would impact sensitive non-riverine communities that include shoreline features potentially subject to Corps jurisdiction under Section 404 of the Clean Water Act, and California Department of Fish and Game (CDFG) jurisdiction pursuant to Section 1600 of the Fish and Game Code (Streambed Alteration). Further, construction could impact special-status

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C-085721

species protected under the Federal and/or California Endangered Species Act or species recognized as significant under CEQA.

Table 4.5-2 - Screen Extension Alternative Impacts by Terrestrial Habitat Type

Habitat Type	Total Acreage in the Project Vicinity[a]	Permanent Impact		Temporary Impact	
		Acreage	% of Total	Acreage	% of Total
Riparian[b,c]	227.0	1.9	0.8	0	--
Scrub Willow[b]	3.3	0	--	0	--
Grassland	~~60.7~~61.2	0.8	~~0.1~~1.3	~~0.3~~0.8	~~less than 0.1~~1.3
Wetland	8.6	0	--	0	--
Sand/Gravel Bar	26.3	0	--	0	--
Row Crops[d]	~~19.9~~22.1	0	--	~~0~~2.2	~~--~~10.0
Orchard[d]	21.6[e]	0	--	0	--
Ruderal (Disturbed)	~~66.6~~68.7	6.3	~~9.5~~9.2	~~8.3~~10.4	~~12.5~~15.1
Total	~~434.0~~438.8	9.0	2.1	~~8.6~~13.4	~~2.0~~3.1

[a] The project vicinity is defined as the area of habitat illustrated on Figure 3.5-1.
[b] Riparian vegetation includes Mixed Riparian Forest and Valley Oak Riparian Forest. For the purposes of mitigation calculation, scrub willow is included with general riparian.
[c] Within the area affected by the project, habitat for elderberry shrub and therefore VELB occurs in conjunction with riparian forest habitat and is therefore included under riparian.
[d] Orchards and row crops lie immediately outside of the present river associated habitats on both banks of the Sacramento River and constitute the most of the habitat types outside of the immediate vicinity of the river shoreline.
[e] Total orchard acreage includes only that acreage delineated on Figure 3.5-1 and the 50-foot-wide corridors proposed for access through orchards.

***Impact 4.5-1** – Construction activities would permanently alter riparian habitat.*

A potentially significant impact. Impacts to riparian vegetation from the screen extension alternative would include 1.9 acres of riparian habitat upstream of the existing fish screen. Riparian habitats provide cover that is used by numerous bird species, including the State endangered yellow-billed cuckoo. Upstream impacts include construction of the forebay and fish screen, and hydraulic improvements to the upper oxbow.

***Impact 4.5-2** – Construction of the screen extension could affect the nesting habitat of predatory bird species of concern.*

A potentially significant impact. Construction of the screen extension alternative could impact nesting Swainson's hawks, or other raptorial species such as the osprey, through disturbance of the nesting site or destruction of a nesting tree.

***Impact 4.5-3** – Construction activities would permanently alter vertical erosion prone banks which could provide suitable nesting habitat for bank swallows.*

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A potentially significant impact. One bank swallow was reported using a burrow on a newly eroded bank immediately downstream of the fish screen on May 6, 1997 (G. Stern pers. comm., 1997). This potential nesting site would be impacted under the screen extension alternative.

Impact 4.5-4 *– Construction activities would result in a reduction in abundance of elderberry shrubs, which could affect VELB.*

A significant impact. Construction of the screen extension alternative would result in impacts to approximately 153 elderberry stems 2.54 centimeters (cm) (1.0 inch) or greater in diameter at ground level (JSA 1996) (Figure 4.5-1). Elderberry shrubs provide the Federal threatened VELB with its sole source of reproductive habitat and food resources. The degree of impact could change prior to project construction due to shoreline erosion resulting from high river flows. New surveys may be required to determine the final numbers of stems impacted.

Operation

Operation of the screen extension alternative would result in potential impacts to 5.0 acres of ruderal habitat for stockpiling dredge materials at the project site. This would result if the optional dredge stockpile site is used across from the HCPP service yard. There are no additional impacts exclusive to the operation of the screen extension alternative.

4.5.4.3 Screen Extension with Gradient Facility Impacts

The impacts and impact acreage described for the screen extension alternative would also apply to this alternative.

Construction

The gradient facility would permanently alter 22.7 acres, and temporarily impact 35.7 acres, of native and non-native vegetation (including orchards) along the east and west banks of the Sacramento River. These impacts would occur due to the construction of the gradient facility, new access and maintenance roads, storage and stockpiling areas, and desilting basins. The acreage that would be impacted solely by construction of the gradient facility and upstream rock dikes is provided by habitat type in **Table 4.5-3.**

The total acreage permanently impacted by construction of the fish screen extension plus gradient facility would be 31.7 acres. Temporary disturbance would occur to a total of ~~44.3~~ 49.1 acres including construction staging and storage areas, desilting basins and areas incidentally disturbed (buffer zones) adjacent to construction zones. Total cumulative acreage impacted temporarily and permanently by the fish screen extension and gradient facility would be ~~76.0~~80.8 acres. Total acreage impacts for all features of this alternative are displayed by habitat type in **Table 4.5-4.**

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Table 4.5-3 - Gradient Facility
Impacts by Terrestrial Habitat Type

Habitat Type	Total Acreage in the Project Vicinity[a]	Permanent Impact		Temporary Impact	
		Acreage[c]	% of Total	Acreage[c]	% of Total
Riparian[b]	227.0	8.3	3.7	0	--
Scrub Willow[b]	3.3	1.0	30.3	0	--
Grassland	~~60.7~~61.2	0.4	~~0.6~~0.7	22.1	~~36.4~~36.1
Wetland	8.6	2.3	~~20.7~~26.7	0	--
Sand/Gravel Bar	26.3	2.3	8.7	8.9	33.8
Row Crops[c]	~~19.9~~22.1	0	--	0	--
Orchard[c]	21.6[d]	7.6	35.2	0	--
Ruderal (Disturbed)	~~66.6~~68.7	0.8	1.2	4.7	~~7.1~~6.8
Total	~~434.0~~438.8	22.7	5.2	35.7	~~8.2~~8.1

[a] The project vicinity is defined as the area of habitat illustrated on Figure 3.5-1.
[b] Riparian vegetation includes Mixed Riparian Forest and Valley Oak Riparian Forest. For the purposes of mitigation calculation, scrub willow is included with general riparian.
[c] Orchards and row crops lie immediately outside of the present river associated habitats on both banks of the Sacramento River and constitute most of the habitat types outside of the immediate vicinity of the river shoreline.
[d] Total orchard acreage includes only that acreage delineated on Figure 3.5-1 and the 50-foot wide corridors needed access roads to pass through orchards.

Table 4.5-4 - Screen Extension with Gradient Facility Alternative
Impacts by Terrestrial Habitat Type

Habitat Type	Total Acreage in the Project Vicinity[a]	Permanent Impact		Temporary Impact	
		Acreage[c]	% of Total	Acreage[c]	% of Total
Riparian[b]	227.0	10.2	4.5	0	--
Scrub Willow[b]	3.3	1.0	30.3	0	--
Grassland	~~60.7~~61.2	1.2	2.0	~~22.4~~22.9	~~36.9~~37.4
Wetland	8.6	2.3	26.7	0	--
Sand/Gravel Bar	26.3	2.3	8.7	8.9	33.8
Row Crops[c]	~~19.9~~22.1	0	--	~~0~~2.2	~~--~~10.0
Orchard[c]	21.6[d]	7.6	35.2	0	--
Ruderal (Disturbed)	~~66.6~~68.7	7.1	~~10.7~~10.3	~~13.0~~15.1	~~19.5~~22.0
Total	~~434.0~~438.8	31.7	~~7.3~~7.2	~~44.3~~49.1	~~10.2~~11.2

[a] The project vicinity is defined as the area of habitat illustrated on Figure 3.5-1.
[b] Riparian vegetation includes Mixed Riparian Forest and Valley Oak Riparian Forest. For the purposes of mitigation calculation, scrub willow is included with general riparian.
[c] Orchards and row crops lie immediately outside of the present river associated habitats on both banks of the Sacramento River and constitute most of the habitat types outside of the immediate vicinity of the river shoreline.
[d] Total orchard acreage includes only that acreage delineated on Figure 3.5-1 and the 50-foot wide corridors needed for access roads to pass through orchards.

Impact 4.5-1 – Construction activities would permanently alter riparian habitat.

A potentially significant impact. Construction of the gradient facility would result in permanent impacts to 8.3 acres of riparian vegetation and 1.0 acre of scrub willow habitat. Construction of both the screen extension and gradient facility under this alternative would result in permanent impacts to 11.2 acres of riparian vegetation, including 10.2 acres of riparian forest and 1.0 acre of scrub willow habitat. Dense, mature stands of riparian vegetation could provide habitat for such species as the State endangered yellow-billed cuckoo.

Impact 4.5-2 – Construction of the screen extension could affect the nesting habitat of predatory bird species of concern.

A potentially significant impact. Raptorial birds, such as the Swainson's hawk (State threatened) or osprey (State species of concern), nest in snags and tall trees in riparian forests. Construction of the screen extension and gradient facility alternative could impact nesting Swainson's hawks or osprey depending on the nest proximity to construction activities.

Impact 4.5-3 – Construction activities would permanently alter vertical erosion prone banks which could provide suitable nesting habitat for bank swallows.

A potentially significant impact. Alteration of erodible bank material suitable for colonies of nesting bank swallows through the placement of riprap, or inundation of nesting habitat by construction of the screen extension and gradient facility alternative would occur with construction of the screen extension and gradient facility alternative. Vertical erodible banks could also be temporarily impacted through construction activities that would preclude use of the habitat but would not physically alter it. Although permanent impacts to bank swallows are considered potentially significant, any temporary impacts to suitable nesting habitat would be considered less than significant due to the transient nature of annual nest site selection by this species.

Impact 4.5-4 – Construction activities would result in a reduction in abundance of elderberry shrubs, which could affect VELB.

A significant impact. Permanent impacts would occur to these shrubs and their habitat within the footprint of the screen extension and gradient facility alternative where structures and access roads would be permanently placed. Field survey results (Figure 4.5-1) indicate that construction of the gradient facility would result in permanent impacts to approximately 289 stems 2.54 cm (1.0 inch) or greater in diameter at the base (JSA 1996). Construction of both the fish screen and gradient facility would result in cumulative impacts to approximately 442 stems 2.54 cm (1.0 inch) or greater in diameter at the base.

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Impact 4.5-5 – Construction would permanently impact wetland/freshwater marsh habitat on the eastern bank of the Sacramento River.

A significant impact. Construction of the gradient facility portion of the screen extension and gradient facility alternative would permanently alter the surface and subsurface functioning of a 2.3-acre wetland/fresh water emergent marsh on the east bank of the Sacramento River. This could impact the State species of concern and California Native Plant Society (CNPS) 1B Sanford's arrowhead and/or the CNPS 2 rose mallow, growing along the banks and near-shore shallow areas of this wetland. Additionally, alteration of this wetland could impact potential habitat for other plants, and foraging and/or nesting areas for the white-faced ibis and other marsh birds.

Alternative Gradient Facility Construction Methods

Impacts to terrestrial biological resources associated with the proposed four-phase, one-year alternative are detailed above. This section will discuss advantages and disadvantages associated with alternative construction scenarios and schedules for the gradient facility as described in Section 2.4.3 (Screen Extension with Gradient Facility Alternative).

In-River (Wet) Construction of the Gradient Facility

Advantages of wet construction include:

- Construction impacts to wildlife resources would be limited to one season;
- Reduced noise impacts to adjacent wildlife because the sheet pile driving associated with cofferdam construction would not occur;
- Reduction of total construction disturbance time through the elimination of cofferdam construction; and
- Dewatering would be unnecessary and thus the potential effects on shoreline riparian vegetation would be reduced. No additional negative impacts to terrestrial resources would be expected.

In general, overall construction disturbance impacts to terrestrial resources would be reduced with this alternative gradient facility construction method.

One-Phase (Dry) Construction of the Gradient Facility

Advantages to one-phase construction include:

- Construction and removal of cofferdams would occur only once, potentially limiting the total amount of time needed to complete construction and therefore reducing impacts to terrestrial resources;
- Noise impacts to wildlife would be reduced;
- Construction crews and equipment would have access to the entire gradient facility construction site from either the east or west bank of the Sacramento River, therefore impacts to terrestrial habitats due to storage of rock and equipment, and widened roadways required for construction vehicles, could be eliminated from one side of the river; and
- Construction disturbances to wildlife would be limited to one season.

One-phase construction could result in the following negative impacts to terrestrial resources:

- Desiccation of riparian plant root systems and subsequent damage to vegetation could occur to tree and shrub seedlings, annual grasses, and herbaceous species with shallow root systems dependent on a higher localized water table and moist soils;
- Excessive erosion of riparian areas could occur due to consistent high-water levels over an unusually protracted period of time that disallows establishment of grasses and herbaceous vegetation; and
- Inundation of the roots of certain riparian species, such as the Fremont cottonwood, during the spring and summer growing season could reduce their short-term viability. These species are adapted to inundation during winter high-flows but require a "dry period" during the growing season. Long-term year-round root inundation could result in the demise of these species.

One-phase construction of the gradient facility would result in potentially significant impacts to riparian habitat along the Sacramento River to be dewatered. Dewatering the Sacramento River during the riparian growing season would inhibit the establishment and growth of near-shore grasses and herbaceous vegetation, and inhibit the growth of riparian trees such as cottonwoods. The root systems of near-shore grasses and herbs serve to stabilize soils and their loss could result in increased erosion during subsequent high water periods. Additionally, low river flows during the growing season have been shown to inhibit Freemont cottonwood growth during the year of low water as well as have the residual effect of reducing growth potential in the year following the low water event (Stromberg 1995).

Conversely, prolonged high flow in the oxbow over the growing season would eliminate establishment of near-shore herbs and grasses, and inundate the root systems of shrubs and trees. Many riparian shrubs and trees, although adapted to winter flooding, require only moist subsurface soils during recruitment and growing season. Because all flows of the Sacramento River flow would be diverted into the oxbow under the one-phase scenario, the level of inundation would be greater than under the two- or four-phase alternatives. Reduced health of riparian shrubs and trees, as well as the loss of seedling recruitment could result in prolonged impacts to riparian systems in the project area.

Because this alternative would damage riparian systems in both the oxbow and the Sacramento River simultaneously for up to two years or more, this alternative construction method would present potentially significant impacts.

Two-Phase (Dry) Construction of the Gradient Facility

Advantages to two-phase construction include:

- A decrease in the duration of construction related disturbance to adjacent wildlife; and
- Potentially fewer access roads on the island and mainland could result in fewer impacts to terrestrial habitats.

Potential impacts for the two-phase construction method would be substantially similar to the four-phase construction method.

Two-Year Construction Schedule

This alternative may allow for more flexibility, due to its less stringent schedule, in working around the construction limitations potentially imposed by critical avoidance periods for various terrestrial and aquatic species. However, the two-year alternative would expose wildlife and habitat within the project area to construction disturbances for two consecutive seasons.

Construction monitoring for special-status species would need to be conducted in both years, as it would be possible that nesting activities would differ between the two years. Limited pre-construction surveys may also be necessary. From the above, potential impacts to terrestrial resources would likely be greater with a two-year construction schedule.

Operation

Operation of the screen extension with gradient facility alternative would result in inundation of areas upstream of the gradient facility. The degree of inundation would vary according to the final design of the gradient facility but would be similar to that experienced during construction. Habitats potentially affected by inundation would be riparian, freshwater marsh, and near-shore terraces. The most evident effect of this inundation would be expected to occur in an extant oxbow at the southeastern end of Snaden Island, and would shift wetland habitat upstream and slightly inland. This would serve to increase overall wetland habitat while potentially shifting riparian habitat inland along the slough. Operation would also result in potential impacts to 5.0 acres of ruderal habitat for stockpiling dredge materials at the project site, similar to that under the no-project alternative.

4.5.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass (to the Oxbow or River) Alternative Impacts

The impacts to terrestrial biological resources and acreage affected described for the fish screen extension with gradient facility alternative apply as well to the screen extension with gradient facility and internal fish bypass alternative.

Construction

The structures associated with the internal fish bypass (oxbow option) would impact the area immediately to the east of the fish screen structure on the southwest bank of the oxbow. All potential impacts to terrestrial features of this alternative, whether the outfall would be to the oxbow or to the Sacramento River, would be within the footprint of the screen extension alternative and would not constitute additional impacts.

Should the final design place the internal bypass outlet structure in the Sacramento River, the pipeline would be placed in an area already disturbed along the island bank of the lower oxbow. If considered separately, improvements to the lower oxbow would permanently impact 0.5 acre of riparian habitat and 0.4 acre of ruderal habitat. Temporary impacts would occur to 1.0 acre of ruderal habitat. (Note: For analysis, these lower oxbow acreage amounts are included in the acreage impacts for the screen extension portion of the project and are discussed separately here for the reader's information.) The combined acreage impacts for the screen extension with gradient facility and internal fish bypass to the oxbow or river alternative are provided in **Table 4.5-5.**

Operation

Potential terrestrial resources impacts from operation of this alternative would be the same as described for the screen extension with gradient facility alternative.

4.5.5 Mitigation

The following mitigation measures are recommended in addition to those incorporated in the project description in Section 2.4.2 (Screen Extension Alternative).

The primary means by which potentially significant and significant impacts would be mitigated is through avoidance. Many of the mitigation measures below describe avoidance. Avoidance can be spatial or temporal in nature. Temporal avoidance can be complex in design, depending

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Table 4.5-5 - Screen Extension with Gradient Facility and Internal Bypass to the Oxbow or River Alternative Impacts by Terrestrial Habitat Type					
Habitat Type	Total Acreage in the Project Vicinity[a]	Permanent Impact		Temporary Impact	
		Acreage[c]	% of Total	Acreage[c]	% of Total
Riparian[b]	227.0	10.2	4.5	0	--
Scrub Willow[b]	3.3	1.0	30.3	0	--
Grassland	~~60.7~~61.2	1.2	2.0	~~22.4~~22.9	~~36.9~~37.4
Wetland	8.6	2.3	26.7	0	--
Sand/Gravel Bar	26.3	2.3	8.7	8.9	33.8
Row Crops[c]	~~19.9~~22.1	0	--	~~0~~2.2	10.0
Orchard[c]	21.6[d]	7.1	32.9	0	--
Ruderal (Disturbed)	~~66.6~~68.7	7.1	10.7	~~13.0~~15.1	~~19.5~~22.0
Total	~~434.0~~438.8	31.2	7.2	~~42.7~~47.5	~~10.2~~10.8

[a] The project vicinity is defined as the area of habitat illustrated on Figure 3.5-1.
[b] Riparian vegetation includes Mixed Riparian Forest and Valley Oak Riparian Forest. For the purposes of mitigation calculation, scrub/willow is included with general riparian.
[c] Orchards and row crops lie immediately outside of the present river associated habitats on both banks of the Sacramento River and constitute most of the habitat types outside of the immediate vicinity of the river shoreline.
[d] Total orchard acreage includes only that acreage delineated on Figure 3.5-1 and the 50-foot wide corridors needed for access roads to pass through orchards.

on number, relative status, and biological requirements of the resources considered. Avoidance through either method would be subject to final design and construction plans. Potential impacts and mitigation requirements would be addressed as part of final design and construction scheduling. The program for tracking these and other final design and construction mitigation measures is described in Chapter 6, Environmental Commitments and Mitigation and Monitoring.

Table 4.5-6 provides a summary of the temporary and permanent impacts by alternative that have been determined to be either potentially significant or significant. Issues initially considered and dismissed as less than significant are provided in Section 2.6, Issues Identified and Considered in EIR/EIS Process.

Mitigation Measures for Impact 4.5-1 *– Construction activities would permanently alter riparian habitat.*

Final design of the project facilities, placement of staging and storage areas, and location of access roads would avoid riparian forest and scrub habitat to the greatest extent practicable. Avoidance measures could include construction of a buried trench fill revetment on the landward side of the local levee on the left bank of the Sacramento River. This would reduce impacts to riparian vegetation to those resulting from actual construction of the gradient facility and access and maintenance roads. All mitigation would consider conservation, restoration, and/or

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Table 4.5-6 - Summary of Terrestrial Resources Significant and Potentially Significant Impacts

	No-Project		Screen Extension		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass	
Resource Item	**Temp. Impacts**	**Perm. Impacts**	**Temp. Impacts**	**Perm. Impacts**	**Temp. Impacts**	**Perm. Impacts**	**Temp. Impacts**	**Perm. Impacts**
Riparian Habitat Impacts[a]	0	-0.5 (less than 0.1%)	0	-1.9 acres (0.8%)[b]	0	-10.2 acres (4.5%)[b]	0	-10.2 acres (4.5%)[b]
Scrub/ Willow Habitat Impacts[c]	0	0	0	0	0	-1.0 acre (30.3%)[b]	0	-1.0 acre (30.3%)[b]
Wetland Habitat Impacts	0	0	0	0	0	-2.3 acres (26.7%)[2]	0	-2.3 acres (26.7%)[b]
Elderberry Stems Potentially Impacted	0	0	0	-153 stems	0	-442 stems	0	-442 stems
Swainson's Hawk Nest Site	2 nest sites potentially disturbed	0	2 nest sites potentially disturbed	0	2 nest sites potentially disturbed	0	2 nest sites potentially disturbed	0
Bank Swallows Nesting Habitat	0	Potential Loss of 1 colonial nesting site	0	Potential Loss of 1 colonial nesting site	0	Potential loss of 2 colonial nesting sites	0	Potential loss of 2 colonial nesting sites

[a] Impacts to riparian habitat could be used as a relative measure of the potential to impact species associated with various resources associated with this habitat. Examples could be the yellow-billed cuckoo in dense thickets or Swainson's hawk in older trees and snags.

[b] The percentage given represents the percent of a habitat type affected within the area of terrestrial biological analysis as presented on Figure 3.5-1.

[c] For the purpose of analysis and mitigation, scrub willow habitat would be included with general riparian habitats.

enhancement of habitat specific to species of special concern such as the yellow-billed cuckoo. A 10-foot buffer zone would be established around all riparian areas to be avoided during construction. The buffer area would be clearly marked with temporary fencing or other suitable materials. Vehicles would be permitted to travel only along selected access routes and would remain outside the buffer area of access roads, staging areas, and construction zones at all times.

Whenever possible, construction activities would take place in a manner so as not to disturb riparian habitat. For placement of permanent features within the oxbow or river, features could be constructed to allow vehicle access from within the dewatered channel area rather than disturbing adjacent riparian vegetation.

Prior to construction, surveys would be conducted of all areas suitable for nesting yellow-billed cuckoos, including those areas on the south end of Montgomery Island and the east bank of the

Sacramento River as identified by Beak (1993). These surveys would include all dense riparian habitat potentially impacted by construction of the proposed project as well as riparian areas within 50 yards of construction (S. Laymon, pers. comm., 1996). Prolonged activity within 50 yards of an active nest could result in nest abandonment. Surveys would be conducted between mid-June and mid-July.

Yellow-billed cuckoo nest sites are difficult to precisely locate. Should cuckoos be determined to be potentially located in the area of project construction, the area of greatest activity could be assumed to encompass a nesting site. This area, and the area within a 50-yard radius (S. Laymon, pers. comm., 1996), must be clearly marked and construction personnel instructed to prevent disturbance of nesting birds during the avoidance period of early June through September 15 (J. Gustafson, pers. comm., 1996) or until the birds have fledged. Should yellow-billed cuckoos be found nesting, or potentially nesting, in an area that would be removed during construction, CDFG would be contacted to determine appropriate mitigation.

Concurrent to the above, representative surveys would be conducted of all riparian habitat potentially affected by project construction to determine the relative botanical composition (plant species) of the sites to be affected. From this, a species list would be constructed for use as a baseline in on- and off-site mitigation efforts. This survey would aid in providing mitigation that would effectively emulate the habitat impacted, thus maintaining the appropriate species diversity determined for this region. Where possible, impacts would be mitigated on-site.

A riparian revegetation and restoration plan would be developed and implemented through the Environmental Compliance and Mitigation Monitoring Program (Chapter 6, Environmental Commitments and Mitigation and Monitoring). As described in Section 2.4.2.3 (Screen Extension Mitigation), Parcel No. 037-100-002 south of and adjacent to the lower oxbow is proposed as the off-site mitigation location to compensate for riparian, SRA Cover, and other habitat impacts.

Parcel No. 037-100-002 would provide only limited SRA cover value. The lead agencies may also consider other sites in combination with Parcel No. 037-100-002 as options to compensate for habitat impacts. Parcel No. 037-100-002 would exceed compensation needed for project impacts to riparian habitat (including habitat of the valley elderberry longhorn beetle) and wetlands. Parcel No. 037-100-002 currently supports significant SRA Cover along the river as a result of natural colonization of vegetation along revetted portions of the riverbank. Existing SRA Cover values are already relatively high and are anticipated to improve with time as additional colonization occurs and vegetation matures. The plan to be developed for Parcel No. 037-100-002 would contain survey information, ~~from that collected above,~~ precise locations ~~on- and off-site capable of supporting~~ for riparian reforestation/revegetation, ~~in perpetuity,~~ implementation strategies, contingency plans, and monitoring criteria. This plan would take into consideration mitigation for impacts to SRA Cover as described in Section 4.2.5. Inclusion of SRA Cover and coordination of riparian mitigation with mitigation for VELB and wetlands would serve to create a diverse, self-sustaining, and fully functional riparian habitat. Specific habitat needs for listed species, such as the State listed yellow-billed cuckoo, would be considered. Annual monitoring reports would be prepared for a minimum of five years for both on- and off-site mitigation. Corrective recommendations would be included to ensure the success of mitigation. Long-term protection measures would be recommended. Implementation of these mitigation measures would result in a less-than-significant impact to the yellow-billed cuckoo and other riparian inhabitants and their habitat.

***Mitigation Measures for Impact 4.5-2** – Construction activities could affect the nesting habitat of predatory bird species of concern.*

Should impacts occur due to the loss of potential raptor nesting habitat, these would be primarily mitigated through measure 4.5-1 which provide for avoidance and revegetation/ restoration of riparian forest.

Prior to construction, a survey within a half-mile radius of all project facilities would be conducted by a qualified biologist to determine the location(s), if any, of active or potentially active nesting sites for the Swainson's hawk. Construction activities would be planned to avoid construction within a quarter- to half-mile of any active nest (dependent on site conditions) between March 1 and September 31 (R. Jurek, CDFG, pers. comm., 1996). This period could be shortened to extend through August 15 through a Management Authorization from CDFG.

Allowable construction windows for Swainson's hawk could come into competition for those species with Federal or State endangered status, such as winter-run chinook salmon. Following consideration and ranking of the relative potential harm which could befall those species in conflict, precedence would be given to those species with more pressing conservation requirements. Should significant impacts to Swainson's hawks be identified under this scenario, construction activities which could occur within half a mile of the active nest that would not be constrained by the construction window(s) of other species would be identified. These activities would be scheduled to occur prior to March 1 or after September 31 (or August 15, if authorized by CDFG). Final determinations on mitigation for impacts to Swainson's hawk would be made in consultation with CDFG. Implementation of these mitigation measures would result in a less-than-significant impact to Swainson's hawks and other raptors and their nesting habitat.

***Mitigation Measure for Impact 4.5-3** – Construction activities would permanently alter vertical erosion prone banks which could provide suitable nesting habitat for bank swallow.*

Prior to construction, surveys would be conducted by qualified biologist to determine if nesting bank swallows, or riverbanks suitable for nesting, would be present in the impacted area. When possible, project features and construction areas would be placed to avoid suitable nesting habitat for bank swallows. Measures would also be undertaken prior to construction and the nesting season to prevent nesting in suitable habitat within a quarter mile (CDFG 1991) of the construction site between April and August (R. Schlorff, pers. comm., 1997). Additional mitigation would be adopted as required in the CDFG Biological Opinion. Implementation of this mitigation measure would result in a less-than-significant impact to the bank swallow and its habitat.

Mitigation Measures for Impact 4.5-4 – Construction activities would result in a reduction in abundance of elderberry shrubs, which could affect VELB.

All mitigation for impacts to VELB would be conducted using the revised guidelines provided by the USFWS (1996b). Should initiation of project construction be delayed any later than October 1998, project riparian areas would be resurveyed for elderberry shrubs within two years prior to the start of construction. All shrubs would be mapped and the number of stems greater than 2.54 cm (1.0 inch) in diameter at ground level recorded and counted. During construction, all elderberry shrubs in the project vicinity would be flagged and fenced to provide a minimum 20-foot core avoidance area from the drip line, and a buffer avoidance area of 100 feet from the plant, when practicable. Signs would be required to be erected every 50 feet with avoidance information as stipulated in the revised guidelines (USFWS 1996b.) Both core and buffer area would continue to be protected after construction from unforeseen adverse effects of project operation and maintenance. This could be accomplished in conjunction with mitigation measure 4.5-1.

Inform all contractors and work crews through the Worker Education Program (Chapter 6, Environmental Commitments and Mitigation and Monitoring) on the status of VELB, the requirements to avoid damaging elderberry shrubs, rationale and background regarding their protection, and possible penalties for not complying with these provisions.

Unavoidable elderberry shrubs within the area of disturbance having a stem or stems with a diameter of 2.54 cm (1.0 inch) or greater would be transplanted when dormant (November 1 through February 15, unless otherwise specified by USFWS), and using USFWS guidelines (USFWS 1996b) to a mitigation area on- or off-site. The planting area would be at least 1,800 square feet for each elderberry transplant. As many as five elderberry seedlings and five associated riparian plantings would be planted within each 1,800 square foot area. Shrubs which are in poor condition or difficult to move could be exempted from transplant. All transplanting would be monitored by a qualified biologist on-site to avoid unnecessary take of VELB.

For each transplanted and/or destroyed stem greater than 2.54 cm (1.0 inch) in diameter, seedling elderberry plants would be planted from local stock at a ratio of 3:1, based on USFWS criteria (USFWS 1996b).

All restoration and revegetation would be conducted in conjunction with measures undertaken to mitigate for riparian habitat impacts (Mitigation Measure 4.5-1). This would provide an appropriate mix of native riparian plants associated with the elderberry shrubs at the project site. At least one specimen of a native tree and shrub species would be planted from local stock and monitored for every elderberry seedling planted. The mix of associate species shall be determined by surveys conducted to characterize riparian vegetation. All damage to buffer areas would be restored.

An elderberry revegetation and restoration plan would be developed as part of the Environmental Compliance and Mitigation Monitoring Program described in Chapter 6, Environmental Commitments and Mitigation and Monitoring. Aspects of the Terrestrial Habitat Mitigation Plan

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C-085734

dealing with VELB, in conjunction with VELB mitigation guidelines (USFWS 1996b) are presented as part of the Biological Assessment (Appendix A). Mitigation efforts would be coordinated with mitigation for losses of riparian habitat to the greatest extent practicable. Potential locations on- and off-site capable of harboring riparian reforestation/ revegetation, implementation strategies, contingency plans, and monitoring criteria would be included. Annual monitoring reports would be prepared for a minimum of 10 years for both on- and off-site mitigation (USFWS 1996b). Corrective recommendations would be included to ensure the success of mitigation per criteria provided by USFWS (1996b). Long-term management, funding, and protection measures would be recommended for protection of the mitigation area(s) in perpetuity. Final determinations on mitigation for impacts to VELB would be made in consultation with USFWS. Implementation of these mitigation measures would result in a less-than-significant impact to the VELB and its habitat.

***Mitigation Measure for Impact 4.5-5** – Construction would permanently impact wetland / freshwater marsh habitat on the eastern bank of the Sacramento River.*

Prior to construction, surveys would be conducted of plant species on the 2.3-acre emergent wetland/fresh water marsh site on the eastern bank of the Sacramento River within the footprint of the gradient facility. This survey would serve to develop a species list for use in mitigating the impacts to this wetland and to determine the presence or absence of Sanford's arrowhead and the rose mallow.

Should surveys identify individuals of Sanford's arrowhead and/or the rose mallow, these individuals would be collected and relocated to a site deemed appropriate by USFWS biologists. Should collection and transplantation be deemed potentially damaging to the plants or otherwise infeasible, seeds could be collected and dispersed at a site suitable for these species. Suitable mitigation sites in the vicinity of the proposed project including the possible use of the proposed off-site mitigation location (Parcel No. 037-100-002) would be identified with input from USFWS and CDFG.

Final determination of impacted acreage and mitigation would be made in conjunction with the Section 404 permitting process with the Corps, and input from USFWS and CDFG as appropriate. This plan would identify the specific location and acreage requirements of the mitigation as well the methodology and species to be incorporated. A mitigation monitoring program would include goals and success criteria. Specific monitoring provisions would be included along with a means to analyze and compensate for mitigation shortfalls, should that occur. Implementation of this mitigation measure would result in a less-than-significant impact to wetland species of concern and their habitat.

Potential Impacts of Mitigation

Impacts could occur due to the implementation of mitigation measures for impacts to terrestrial biological resources. Ecologically, these impacts, as described, are conceived to provide benefits to the species and habitats they are intended to enhance. For example, most of the sites currently under consideration for mitigation, including the proposed off-site mitigation location (Parcel

No. 037-100-002), have isolated patches of riparian habitat that could be connected through restoration efforts. The existing riparian habitat could also be enhanced to extend further from the river shoreline, thus increasing the density of that habitat. It is difficult, however, to quantify the exact beneficial impacts at this time due to the following:

- The mitigation measures are designed to benefit those species and habitats for which they are written, and to fully compensate for any loss incurred due to project construction and operation. To quantify these benefits at this time would be highly speculative.

- Although a variety of mitigation sites have been proposed, the exact area(s) where project mitigation would occur are, at present, undefined. Until these sites are selected and Parcel No. 037-100-002 is proposed (assuming the landowner is a willing seller) as the off-site mitigation location, until the land is secured for use in mitigation either through conservation easement or purchase, and specific habitat improvements are designed, impacts would be somewhat speculative. (potential Mmitigation sites that could serve as options to Parcel No. 037-100-002 are described in Section 2.4.2.3, Screen Extension Mitigation, and are presented in Chapter 6, Environmental Commitments and Mitigation and Monitoring.)

Impacts could occur to various species due to restoration at the mitigation sites and the associated construction activities. As stated, however, quantification of these impacts would be somewhat speculative. pending choice and procurement of a site, as well as surveying for existing biological resources at that site.

4.6 Visual Resources

4.6.1 Introduction

This section presents the criteria used to determine impact significance, the methods of analysis, the projected changes in visual resources from existing conditions, a discussion of the significance of expected impacts, and a discussion of measures recommended to mitigate potentially significant adverse impacts.

4.6.2 Impact Significance Criteria

There are no formal, specific regulations or criteria for analyzing visual resource impacts. Significance criteria for visual resources were developed using the California Environmental Quality Act Guidelines (i.e., the list of Significant Effects in Appendix G and the Environmental Checklist Form in Appendix I). The following impacts to visual resources would be considered significant:

- changes to the viewshed that result in the creation of an aesthetically offensive site open to public view; and
- the creation of areas of non-vegetated riprap or sheetpile that are visible from key viewpoints.

Impacts to visual resources would be considered less than significant if they do not meet these criteria.

4.6.3 Methods

The analysis addresses the immediate surroundings of the Hamilton City Pumping Plant (HCPP), the Sacramento River channel and banks from approximately River Mile (RM) 205 to RM 206, the oxbow channel, and Montgomery Island.

Effects on visual resources within the project area were evaluated considering expected changes in visual conditions resulting from the no-project and project alternatives. Attention was focused on expected changes in visual conditions at three key viewpoints (Section 3.6, Visual Resources) from which sensitive visual receptors (e.g., residents or recreationists) would be most likely to view the project area.

Future visual resources conditions within the project area are not expected to differ substantially from existing conditions. The following analysis discusses changes in existing conditions that would result from the construction and operation of fish screen improvements associated with the no-project and project alternatives.

C—085737

C-085737

4.6.4 Impacts

4.6.4.1 No-Project Impacts

New facilities that would be constructed under this alternative include 10 new or modified pump recapture stations and 50 new or modified groundwater wells. Each pump recapture station would be similar to existing stations and would likely contain two pumps and a 12-kilovolt power line (B. Pennock, pers. comm., 1997). These stations would be distributed throughout the region on existing canals. Each groundwater well would likely be located in areas currently farmed or disturbed. Because these new facilities would be relatively small and would require disturbance to only a small area of vegetation, they would not be expected to produce significant adverse impacts to visual resources.

The permanent placement of a total of 2,600 feet of new riprap along the southern bank of the lower oxbow and 150 feet of each side of the upper oxbow would represent a significant visual impact during construction. The riprap in the lower oxbow would be visible from Key Viewpoint #2.

Changes to the visual setting within the project area during operation could also include relocating dredge spoil piles from the north end of Montgomery Island to Glenn-Colusa Irrigation District's (GCID) lands at the corner of First Avenue and Cutler Avenue across from the pump station. Because this would not represent a substantial change in the visual setting of the HCPP vicinity, potentially significant adverse impacts to visual resources would not be expected to result.

No increase in the amount of dredging over what currently takes place is expected to result from this alternative. Therefore, potentially significant adverse impacts to visual resources would not be anticipated from continued dredging activities.

Construction

Impact 4.6-1 – Stockpiling and placement of riprap.

A significant impact. The placement of a total of 2,600 feet of riprap along the southern bank of the lower oxbow would represent a significant visual impact during construction. This and related construction activities in the lower oxbow would be visible from Key Viewpoint #2.

Operation

Impact 4.6-2 – Permanent presence of riprap in oxbow.

A significant impact. The placement of a total of 2,600 feet of riprap along the banks of the oxbow would represent a significant visual impact. The riprap in the lower oxbow would be visible from Key Viewpoint #2.

C-085738

C-085738

***Impact 4.6-3** – The potential creation of new dredge spoil stockpiling areas at the corner of First Avenue and Cutler Avenue.*

A less-than-significant impact. During operation, it would be expected that the gravel and sediment piles on the existing approximately five-acre site on Montgomery Island could reach up to 25 feet in height. Such stockpiling heights would not be a substantial change from existing conditions. As noted above and in Section 2.4.1 (No-Project Alternative), options exist for the removal and storage of spoil generated by the project on the approximately 13.7-acre parcel of GCID land immediately west of the pump station at the corner of First Avenue and Cutler Avenue. Spoil could also be screened on the island with material less than 3/4 inch to be trucked to the 13.7-acre parcel across from the HCPP. The larger material would be left on the island and allowed to return to the river naturally during winter.

The optional off-site dredge spoil stockpiling area would represent a new HCPP service yard activity that could be considered aesthetically disruptive. Spoil piles at the new site could range up to 25 feet in height, depending on dredge conditions. However, such spoil stockpiling would not represent a substantial change in the visual quality of the HCPP service yard area, nor would it be visible from a key viewpoint. Therefore, this change in use of the parcel would not be considered a potentially significant effect.

4.6.4.2 Screen Extension Impacts

The following changes would be expected in addition to those described for the no-project alternative. No other substantial changes would be expected to visual resources for the screen extension alternative.

Construction

Changes to the natural setting within the project area during construction would include soil and vegetation disturbance within the vicinity of the existing fish screens, an area that is currently disturbed. This would include an approximately 14-acre staging area across from HCPP at the intersection of First Avenue and Cutler Avenue, as described above.

Operation

No additional substantial changes to the natural setting of the project area would be expected to occur during operation of this alternative. The screen extension would not substantially change the local viewshed, nor would it be visible from a key viewpoint.

4.6.4.3 Screen Extension with Gradient Facility Impacts

The following impacts would be expected in addition to those discussed above for the screen extension alternative.

C-085739

C-085739

Construction

Impact 4.6-4 – Soil and vegetation disturbance and removal on the banks of Sacramento River.

A potentially significant impact to visual resources. Short-term changes to the visual setting within the project area during construction would include soil and vegetation disturbance within the two staging areas and on either side of the Sacramento River in the vicinity of the gradient facility. The staging area on the east side of the Sacramento River would be visible from all three key viewpoints. The staging area on the west side of the Sacramento River would be visible from Key Viewpoints #1 and #2. This impact could be considered potentially significant because relatively large areas of riparian vegetation could be removed from the river banks and staging areas, substantially changing the visual quality of the area.

Impact 4.6-5 – Soil and vegetation disturbance and removal on Montgomery Island during construction.

A potentially significant impact to visual resources. Short-term changes to the visual setting within the project area during construction would include disturbance to soil and vegetation adjacent to the river on Montgomery Island. The soil and vegetation disturbance on Montgomery Island would likely be visible from Key Viewpoints #1 and #2.

This impact would be considered potentially significant because relatively large areas of riparian vegetation could be removed from the construction areas, substantially changing the visual quality of the area.

Alternative Gradient Facility Construction Methods

This section discusses advantages and disadvantages associated with alternative construction scenarios and schedules for the gradient facility (Section 2.4.3, Screen Extension with Gradient Facility Alternative) that could differ from the four-phase, one-year alternative.

In-River (Wet) Construction of the Gradient Facility

This alternative would involve in-water construction using barges, pile drivers, rock berms, cranes, and large draglines to construct the gradient facility. Impacts to visual resources resulting from this construction method would differ from the four-phase (dry) construction method in that barges would be visible from all three key viewpoints in the Sacramento River during construction. However, the presence of additional vessels on the Sacramento River during the short-term construction period would not lead to a substantial change in the visual character of the project area. Significant adverse impacts in addition to those described above for the four-phase, one-year alternative would not be expected to result from this construction method.

One-Phase (Dry) Construction of the Gradient Facility

This alternative would involve damming off the Sacramento River and diverting all of its flow through the oxbow. Because the construction of multiple cofferdams would not be necessary, construction of the gradient facility under this alternative is anticipated to be ~~approximately three months, possibly~~ up to approximately six months. Impacts to visual resources resulting from this construction method would differ from the four-phase (dry) construction method in that the cofferdams and dewatered construction site of the gradient facility would likely be visible from Key Viewpoints #1 and #3. Significant adverse impacts in addition to those described above for the four-phase, one-year alternative would not be expected to result from this construction method.

Two-Phase (Dry) Construction of the Gradient Facility

Impacts to visual resources resulting from the two-phase, dry construction method would not be expected to be substantially different than those described above for the four-phase, dry construction method. Significant adverse impacts in addition to those described above for the four-phase, one-year alternative would not be expected to result from this construction method.

Two-Year (Dry) Construction Schedule

Impacts to visual resources resulting from the two-year (dry) construction method would not be expected to be substantially different than those described above for the four-phase, dry construction period. However, construction equipment and activities would be visible for a two-year period. This would not differ substantially from the one-year schedule, except for the duration of work activities. Significant adverse impacts in addition to those described above for the four-phase, one-year alternative would not be expected to result from this construction method.

Operation

***Impact 4.6-6** – Presence of riprap along banks of Sacramento River and Montgomery Island.*

A significant impact to visual resources. Riprap would be placed on the low water banks of the Sacramento River for approximately 3,600 feet for river channel protection and along approximately 4,400 feet of the river for high water river bank protection (Figure 2.4-7) The riprap around the gradient facility anchorages and along the banks on Montgomery Island would be visible from Key Viewpoints #1 and #3. The riprap around the gradient facility anchorages and along the eastern bank of the Sacramento River would be visible from all three key viewpoints. This impact would be considered significant.

4.6.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass Impacts

The following impacts would be expected in addition to those discussed for the screen extension with gradient facility alternative.

C-085741

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Construction

Impact 4.6-7 – Placement of cofferdams for construction of the underground bypass pipeline and outlet structure in the Sacramento River.

A potentially significant impact to visual resources. Changes to the visual setting during construction would include cofferdams along an approximately 50 feet wide by 500 feet long area from the island side of the lower oxbow and into the middle of the river. This disturbance would be associated with the construction of the underground bypass pipeline and return to river outlet structure in the Sacramento River.

The construction of the bypass pipeline and the outlet structure in the river would be visible from Key Viewpoints #1 and #2 (Figure 3.6-2). This impact would not be mitigable and would be considered potentially significant.

Operation

No impacts would be expected in addition to those discussed for the screen extension with gradient facility alternative.

4.6.5 Mitigation

The following mitigation measures are recommended in addition to those incorporated in the project description as described in Section 2.4.2 (Screen Extension Alternative).

Mitigation Measure for Impacts 4.6-1, 4.6-2, and 4.6-6 *– Stockpiling and placement of riprap and the permanent presence of riprap along banks of Sacramento River, the oxbow, and Montgomery Island.*

The riprap to be placed along banks and in other areas within the project area initially would represent an unnatural visual feature. However, success in natural revegetation of riprapped areas has been demonstrated within the project area and the region (K. Nelson, GCID, pers. comm., 1996; JSA 1996a). Natural revegetation has been shown to result in substantial willow and other riparian plant growth within one year of riprap placement (K. Nelson, GCID, pers. comm., 1996).

To mitigate visual impacts resulting from the placement of riprap, vegetation would be allowed to establish itself in and around riprapped areas. Revegetation of areas in and adjacent to the riprap would also be encouraged by seeding with native riparian groundcovers, including grasses, and, where feasible, native trees and shrubs. This mitigation would reduce long-term impacts to a less-than-significant level. Short-term impacts would remain significant and unavoidable.

C-085742

C-085742

***Mitigation Measure for Impacts 4.6-4 and 4.6-5** – Soil and vegetation disturbance and removal along banks of the Sacramento River and on Montgomery Island.*

To mitigate the disturbance to soils and vegetation, GCID would minimize the amount of clearing and grading; vary the edges of cleared areas to blend in with existing riparian vegetation; and revegetate graded areas with native riparian groundcovers, in addition to, where feasible, native trees and shrubs. Natural recruitment of vegetation would also be allowed to occur. GCID would implement the revegetation component of the mitigation plan for the project as discussed in Chapter 6, Environmental Commitments and Mitigation and Monitoring. Implementation of this mitigation measure would reduce these impacts to visual resources to a less-than-significant level.

4.7 Land Use

4.7.1 Introduction

This section presents the criteria used to assess impact significance, the methods of analysis, and impact conclusions for land use.

4.7.2 Impact Significance Criteria

The evaluation of land use impacts is generally qualitative in nature. This is especially true for the evaluation of regional land use impact categories, which involves speculation of future community response to changing water availability or quality. The Bureau of Reclamation's (1996i) PROSIM model for hydrologic analyses includes a projection (Appendix B, Hydrology and Water Resources Technical Report) of future (2020) hydrology and land use. Under the 2020 assumptions, no substantial changes in water demands or land use are projected for the Glenn-Colusa Irrigation District (GCID) service area. Some minor reductions in water deliveries are shown for certain water year conditions.

The following impacts to land use would be considered significant:

- regional land use patterns would be changed substantially; and
- the project would conflict with local land use plans and policies (e.g., General Plan and zoning requirements).

4.7.3 Methods

Evaluation of regional land use changes is somewhat speculative. Substantial changes in cropping patterns could result from changes in water quality and deliveries as a result of regulatory or physical limitations. Such changes could include conversion from existing crops to less water-dependent and salinity-resistant crops and substantial reductions in total regional water availability. Future land use conditions under the future (2020) no-project alternative could differ from existing land use conditions.

A review of recent GCID and community responses to pumping restrictions at HCPP provides some insight into possible future changes that could occur due to possible future increased restrictions at Hamilton City Pumping Plant (HCPP). In general, it is expected that future responses would be similar to past responses, with GCID and its customers seeking alternative water conveyance methods and supplies as opposed to changing land use. This is consistent with the description of actions presented in Section 2.4.1 (No-Project Alternative). However, depending on the severity and duration of restrictions and changes to water supply quality, some cropping pattern changes could be expected at a minimum. This expected local response is applied not only to GCID customers, but also to those whose water supply is affected by GCID operations, such as Tehama-Colusa Canal (TCC) water users (as described in Appendix B, GCID has prior right to natural Stony Creek flows that are currently utilized by Reclamation to serve

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C-085744

the TCC Authority service area) and lower Colusa Basin water users that rely, at least in part, on GCID service area outflows (Section 3.1, Hydrology and Water Resources).

Proposed facilities and actions were also evaluated for consistency with local General Plan and zoning regulations to determine if any conflicts exist. Local land use regulations are not expected to change for affected lands; therefore, land use regulations under the future (2020) no-project alternative are expected to be the same as existing conditions.

4.7.4 Impacts

4.7.4.1 No-Project Impacts

The reduced availability of Sacramento River water envisioned under the no-project alternative could change regional cropping patterns because of the water needs of existing crops. New drainage recapture facilities would be constructed in GCID's service area to help offset reduced water availability; however, increased water recapture would likely increase salinity levels as a result of recirculation through the service area (Section 4.1, Hydrology and Water Resources). A foreseeable response among growers in the service area would be to replace high water use crops (e.g., rice) with crops requiring less water and possessing higher salinity tolerance (e.g., cotton). GCID could help offset salinity problems by increasing its use of Stony Creek water; however, this incremental supply would not substantially offset HCPP reductions and may lead to impacts for TCC water users.

The reduced water availability expected under the no-project alternative could be worsened by a change in river gradient, which could occur in the future without a gradient facility. Depending on GCID's ability to respond, this reduced water availability associated with a change in gradient could potentially further impact regional cropping patterns.

***Impact 4.7-1** – Changes in existing cropping patterns as a result of reduced water availability and increased salinity.*

A potentially significant impact. It is not possible to quantify or accurately predict landowner responses to changes in water quantity and quality, or to forecast when, if ever, major drops in river gradient would occur similar to events in 1935, 1970 and 1984 (Figure 1.5-5). Therefore, this indirect effect of the no-project alternative is speculative. For purposes of an example, if rice lands are converted into cotton, the farming practices and supporting industry associated with the change in cropping pattern would be substantially different. A substantial change in cropping patterns could be a potentially significant impact because of its potential disruption of regional social and economic conditions.

With regard to local land use consistency, facilities envisioned under the no-project alternative (e.g., improvements to the lower oxbow, runoff recapture facilities) would be constructed entirely within Glenn and Colusa counties. All HCPP-area facilities are zoned Exclusive Agricultural, and most off-site facilities would likely be constructed in this or a similar zoning district. Public

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facility uses may require issuance of a conditional use permit prior to construction. Such permits and environmental review would be subject to a subsequent CEQA process.

4.7.4.2 Screen Extension Impacts

Although HCPP diversion capacity would largely be restored with the screen extension alternative, the risk of future limitations as a result of gradient changes would still exist. Such limitations on diversion would not likely occur to the same degree as the no-project alternative due to the screen area. However, water availability could be sufficiently limited to prompt similar changes in cropping patterns as described under the no-project alternative.

An additional consideration is project consistency with local land use plans and policies. Under the screen extension alternative, new facilities (e.g., expanded screen and forebay, bank improvements) would be constructed entirely within Glenn County in areas zoned Exclusive Agricultural. According to the requirements of the Exclusive Agricultural zone, public facility uses may require issuance of a conditional use permit prior to construction.

Impact 4.7-2 *– Potential conflicts with the Glenn County zoning code due to construction of public facility uses.*

A less-than-significant impact. Under the screen extension alternative, GCID may be required to obtain a conditional use permit from Glenn County to construct fish screen improvement facilities. Granting of the permit, if necessary, would effectively resolve any inconsistency.

4.7.4.3 Screen Extension with Gradient Facility Impacts

Under the screen extension with gradient facility alternative, the proposed action would have beneficial effects on regional water supplies. In addition, the gradient facility would minimize the risk of gradient changes and associated water supply limitations, therefore preserving local land use patterns.

With regard to local land use regulations, potential impacts associated with the screen extension activity would be the same as described under the screen extension alternative above. Construction of additional project features under the screen extension with gradient facility alternative would also occur within the land use jurisdiction of Tehama and Butte Counties. Construction of public facility improvements is listed as a permitted use in Butte County zoning ordinance; therefore, construction of project features under the screen extension with gradient facility alternative appears consistent with the local land use regulations of Butte County. However, the Tehama County zoning ordinance allows only limited public facilities (e.g., pipelines) in the Primary Floodplain zone as permitted uses. Accordingly, issuance of a conditional use permit may be required for Tehama County as well as Glenn County.

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Impact 4.7-3 – Potential conflicts with the Glenn County and Tehama County zoning code due to construction of public facility uses.

A less-than-significant impact. GCID may be required to obtain a conditional use permit from Glenn County and Tehama County to construct fish screen improvement facilities. Granting of the permit, if necessary, will effectively resolve any inconsistency. The lead agencies have committed to working cooperatively with local governments to help ensure consistency with land use regulations. No further mitigation is required.

Alternative Gradient Facility Construction Methods

Impacts to land use resulting from the wet construction method, the one- and two-phase dry construction methods; and the two-year construction method would not be expected to have substantially different impacts on land use.

4.7.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass Impacts

Similar to the screen extension with gradient facility alternative, the screen extension with gradient facility and internal fish bypass alternative would have beneficial effects on regional water supplies, and would therefore likely preserve existing land use patterns.

With regard to local land use regulations, construction of project facilities under the screen extension with gradient facility and internal fish bypass alternative would result in the same potential impacts as described above under the screen extension with gradient facility alternative. Potential Glenn County use permit requirements would apply also to construction of a new fish bypass system, under either the return to oxbow or river options.

4.7.5 Mitigation

No potentially significant impacts have been identified for the project alternatives; therefore, no mitigation is recommended.

4.8 Noise

4.8.1 Introduction

This section presents the criteria used in determining impact significance, the methods of analysis, impact conclusions, and a discussion of the significance of noise impacts.

4.8.2 Impact Significance Criteria

Noise impacts are largely subjective, primarily because of the wide variation in individual thresholds of tolerance. One way of assessing a subjective reaction to a new noise source is to compare project-related noise to the existing ambient environment. As described in Section 3.8 (Noise), the ambient noise levels at sensitive receptor locations is estimated to be about 48 decibels (dBA). In general, the more the new noise sources would exceed existing ambient noise levels, the less acceptable the new noise would be judged by sensitive receptors. Sensitive receptors are defined as private residences near the site of construction activities or along major access routes, and are illustrated on **Figure 4.8-1**. A new noise source is noticeable if it increases ambient conditions by 3 dBA or more.

In accordance with California Environmental Quality Act guidelines (Appendices G and I), the following noise impacts would be considered significant:

- the ambient noise levels for residential areas would be substantially increased; and
- people would be exposed to severe noise levels.

Under the first criterion, a substantial noise increase is defined as prolonged exposure to noise levels in excess of 60 dBA. This criterion would allow increases in noise that would be clearly perceptible to existing residents, but sets its upper limit at a level that would not exceed generally acceptable residential noise standards, or 60 dBA. As described in Chapter 3 (Affected Environment), the 60 dBA residential noise standard is a daily average. Although it is ~~possible~~ expected that certain project activities (e.g., impact sheet pile driving) would ~~may~~ exceed 60 dBA at any one time, it is less likely that the standard would be exceeded on an average daily basis due to the complete lack of nighttime construction noise. Under the second criterion, severe noise levels are defined as noise in excess of 80 dBA. An increase to noise levels above 80 dBA would be significant at all times.

4.8.3 Methods

Impacts of construction activities were determined by estimating the amount of noise generated by specific construction equipment. As shown in **Table 4.8-1**, most construction activities associated with the proposed project (e.g., bulldozer, vibratory sheet pile drivers, and excavator operation) generate about 75 dBA when fitted with appropriate noise-attenuating

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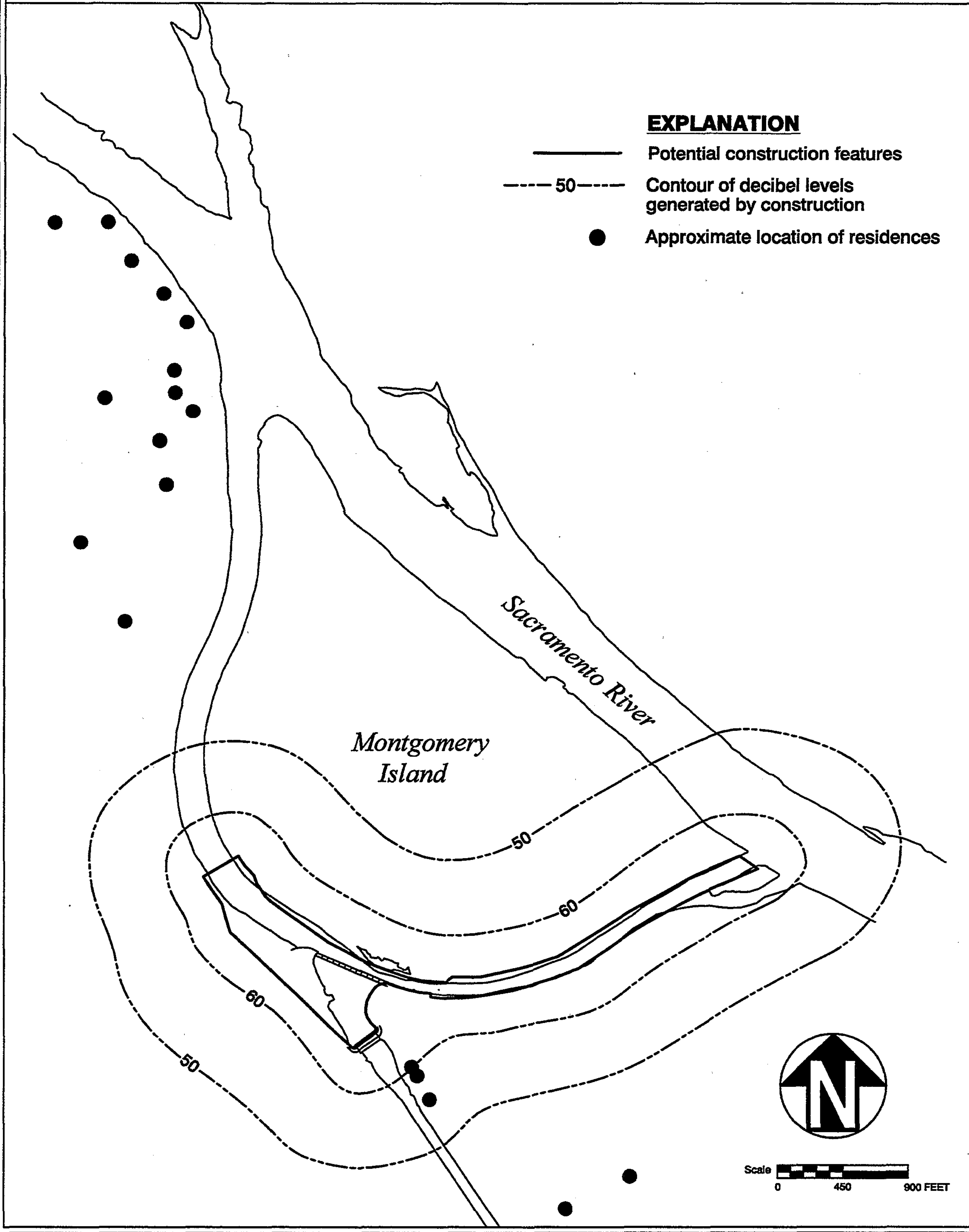
FIGURE 4.8-1. ESTIMATED NOISE LEVELS DURING CONSTRUCTION - NO-PROJECT AND SCREEN EXTENSION ALTERNATIVES



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devices (e.g., mufflers). Impact pile drivers, which generate peak noise levels of about 95 dBA, would be used intermittently (Section 2.4.2.1, Screen Extension Construction Activities and Schedule) in constructing the fish screen extension and gradient facility.

Table 4.8-1- Construction-Generated Noise Levels

Equipment Type	Peak Noise Level in dBA at 50 Feet	
	Without Noise Control	With Noise Control
Earthmoving		
Front Loaders	79	75
Backhoes	85	75
Dozers	80	75
Trucks (Diesel)	91	75
Material Handling		
Crane	83	75
Stationary		
Pumps	76	75
Generators	78	75
Other		
Vibrating Pile Drivers	na	75[a]
Impact Pile Drivers	101	95

a Vibrating pile drivers lack the impact noise associated with hammer-type pile drivers, which can be as much as 1010 dBA. The primary noise source from vibrating pile drivers is their gasoline engines, which, when properly attenuated, are expected to generate a maximum noise level of 75 dBA at 50 feet.

na Not available.

Source: EPA 1971.

Using ~~this~~ a typical construction noise ~~generation~~ estimate of 75 dBA at 50 feet, 60 dBA contours were drawn around construction sites, based on the rule-of-thumb that noise levels decrease by 6 dBA for each (unobstructed) doubling of distance. Areas within the 60 dBA contour were considered potentially noise-impacted. Additional consideration was given to impact pile drivers, and the associated higher noise levels over and above the impacts of typical construction activities. As described in Section 2.4 (Alternatives), impact pile driver use could vary substantially during construction of the project features. Vibratory sheet pile drivers would be used to the extent feasible, and then impact pile drivers would be used intermittently. Extent of use could range from a couple of hours each day to one full day of each week, to one continuous week at a time (interspersed with weeks of vibratory hammer use). Actual extent of use would be dependent upon the construction contractor performing the work.

Construction noise levels expected under the no-project alternative would differ from existing conditions because of anticipated construction activities (e.g., improvements to the lower oxbow channel). With regard to operations-phase noise sources (i.e., maintenance dredging), the no-project noise condition would be the same as existing conditions.

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4.8.4 Impacts

4.8.4.1 No-Project Impacts

The no-project alternative (e.g., improvements to the lower oxbow) would be expected to generate noise of 75 dBA at 50 feet. Higher noise levels could be expected if impact pile drivers would be required to install cofferdams. As shown on Figure 4.8-1, noise levels generated by these construction activities would not be expected to exceed 60 dBA at the site of the nearest sensitive receptors (i.e., residents of parcels 24 and 25 along Montgomery Avenue), and would likely not exceed ambient levels. The homes in the vicinity of the Hamilton City Pumping Plant (HCPP) provide housing for operations staff, and sensitivity to noise would not be as significant. Accordingly, construction noise impacts associated with the no-project alternative would be considered less than significant.

Dredging of the intake channel and upper oxbow would occur under the no-project alternative in the same manner as existing conditions. Dredging activities would occur for two months during the spring, and could occur for up to 12 hours a day. Existing noise levels are shown on **Figure 4.8-2.**

4.8.4.2 Screen Extension Impacts

Construction Impacts

Most ~~C~~construction activities~~of project facilities~~ under the screen extension alternative would be expected to generate noise of 75 dBA at 50 feet, with the occasional use of impact pile drivers generating peak noise levels of 95 dBA during construction of the cofferdams for the fish screen extension. These construction activities would have varying levels of impact; noise impacts to sensitive receptors were considered in terms of type of equipment used and proximity of this equipment to sensitive receptors. The extent of most construction noise impacts (i.e., without the use of impact pile drivers) under the screen extension alternative would be expected to be about the same as under the no-project alternative. However, the duration of potential noise effects would be expected to be greater, as new facilities under the screen extension alternative would be expected to require ~~15~~25 months of construction rather than six months under the no-project alternative. As shown on Figure 4.8-1, noise levels generated by most construction activity under this alternative would not be expected to exceed 60 dBA at the site of the nearest sensitive receptors (i.e., residents of parcels 24 and 25 along Montgomery Avenue), and would likely not exceed ambient levels. The homes in the vicinity of the HCPP provide housing for operations staff, and sensitivity to noise would not be as significant. ~~Accordingly, construction noise impacts associated with the screen extension alternative would be considered less than significant.~~

Greater noise levels would be generated when impact pile drivers would be used, therefore causing the 60-dBA contour to extend greater distances than shown on Figure 4.8-1. Residents along Montgomery Avenue (i.e., parcels 24 and 25) would experience noise levels in excess of 60 dBA due to impact pile driver use; however, these residents would not be exposed to severe

C-085751

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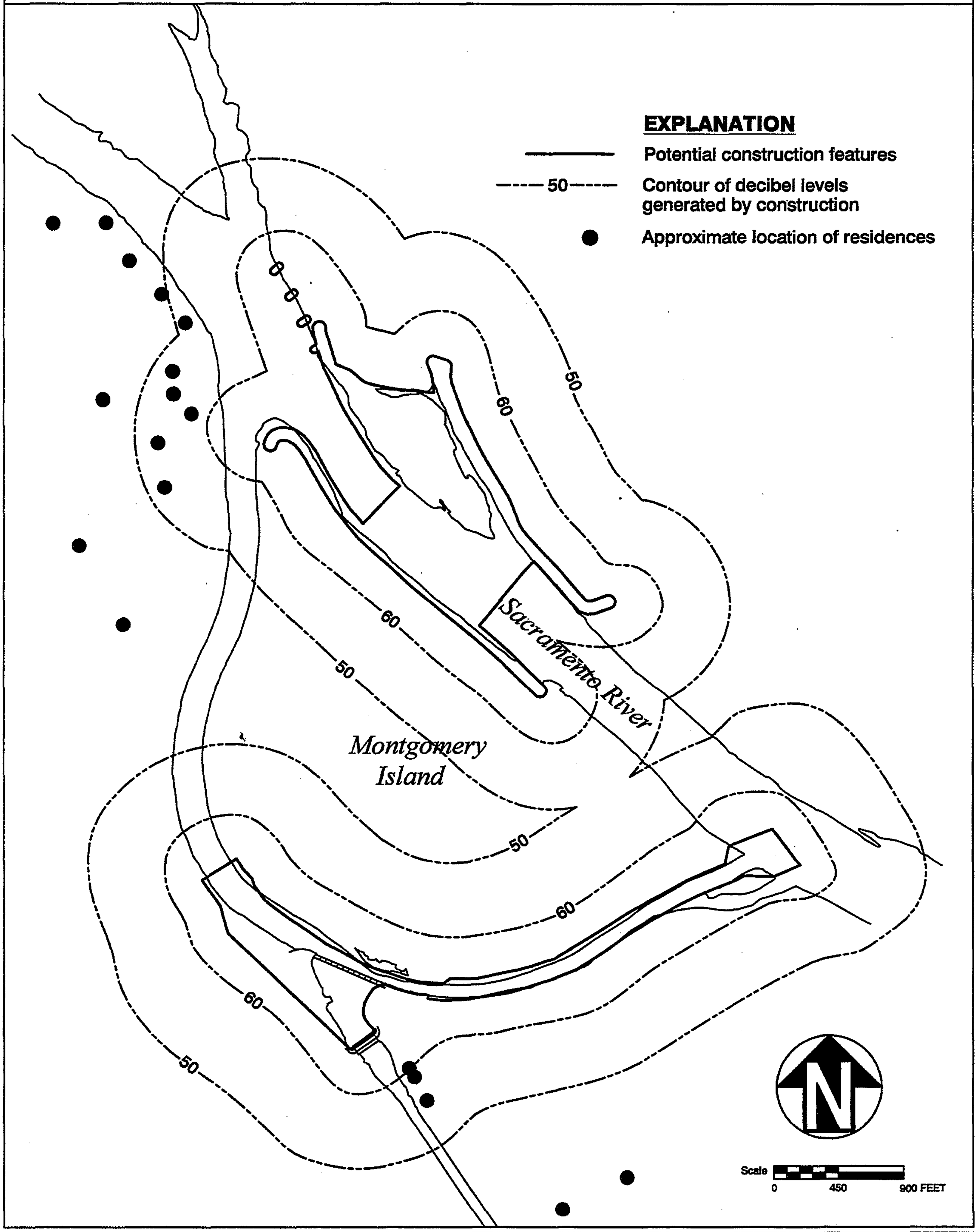
FIGURE 4.8-2. ESTIMATED NOISE LEVELS DURING CONSTRUCTION - SCREEN EXTENSION WITH GRADIENT FACILITY AND INTERNAL FISH BYPASS ALTERNATIVES



C-085752

C-085752

noise levels. Noise levels on these parcels would be expected to be about 65 dBA during impact pile driver use.

Impact 4.8-1 - Exposure of two Montgomery Avenue residences to noise levels in excess of 60 dBA.

A less-than significant impact. Although noise levels would exceed 60 dBA, the duration of the impact is not expected to be excessive. Preliminary assessment of the need for impact pile drivers is limited to a maximum of about 2 to 3 hours per day, possibly one full day out of each week, or possibly up to one continuous week (interspersed with weeks of vibratory hammer use). Due to this limited duration, construction noise impacts for the Screen Extension Alternative would be less-than-significant.

Operation Impacts

Operations-phase noise would occur as a result of yearly dredging activities. Noise impacts from dredging operations would be substantially similar to existing conditions (Figure 4.8-2).

Impact 4.8-~~1~~2 *– Exposure of up to five Tehama County residences abutting the upper oxbow to noise levels in excess of 60 dBA.*

A less-than-significant impact. Noise generated by dredging would exceed normally acceptable noise levels for residential areas (i.e., 60 dBA) during periods when dredging was occurring next to these residences. However, the duration of this impact would not be expected to be long, as this area occupies a small part of the total area that would be dredged over the two-month period, and is located in the far northern section of the dredging area. Due to these considerations, the noise impact associated with dredging activities would be considered less than significant.

4.8.4.3 Screen Extension with Gradient Facility Impacts

Noise impacts associated with fish screen construction and lower oxbow improvements would be the same as described under the screen extension alternative above. Additional noise impacts would be expected from construction of the gradient facility.

Construction Impacts

Construction of the gradient facility would occur in closer proximity to Capay district residences than other project features. As shown on **Figure 4.8-3**, noise levels at the site of these residences (parcels 3-13, 15) due to most gradient facility construction activities could increase over ambient conditions; however, noise levels generally would not be expected to exceed 60 dBA. This noise would be expected to last for a six-month period from May to November, and would overlap with construction processes associated with the screen extension alternative. Although these residents would likely experience increases in noise due to project construction, it would

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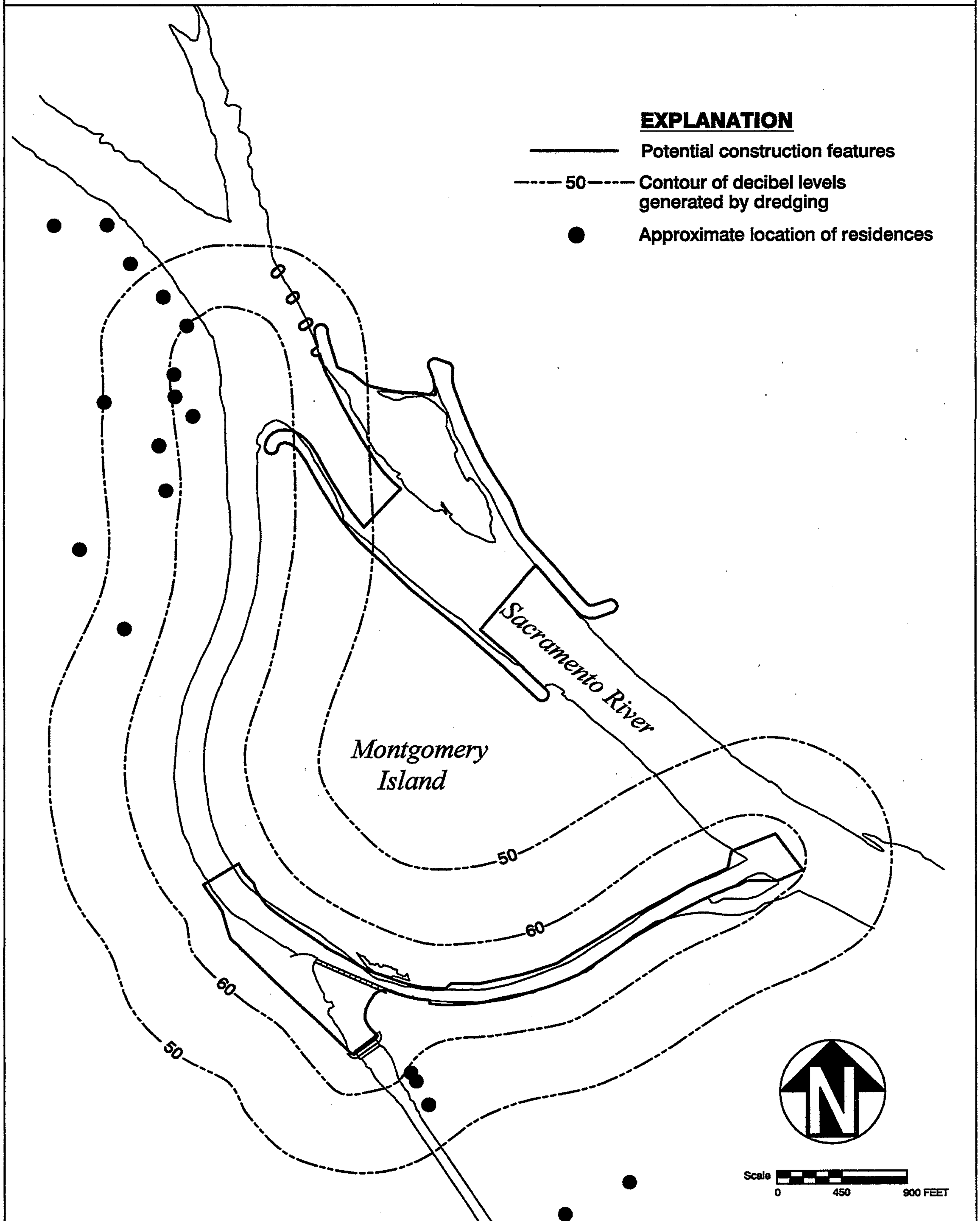
FIGURE 4.8-3. ESTIMATED NOISE LEVELS DURING MAINTENANCE DREDGING



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not be expected that noise levels would exceed 60 dBA for most construction activities. ~~Accordingly, noise impacts associated with gradient facility construction would be considered less-than-significant.~~

Greater noise levels would be generated when impact pile drivers would be in use, thus causing the 60-dBA noise contour to shift outward. Residents of the Capay district, especially those closest to the river, would experience noise levels in excess of 60 dBA when impact pile drivers would be in use; however, the residences would not be exposed to severe noise levels. Noise levels in this area would be expected to be about 70 dBA when impact pile drivers would be in use.

***Impact 4.8-3** - Exposure of Capay district residents to noise levels in excess of 60 dBA.*

A less-than significant impact. Although impact pile driver use for the gradient facility would be greater than and in addition to (separate year) impact pile driving for the screen extension alternative, the duration of impact pile driver operations would not be expected to be excessive. Accordingly, construction noise impacts for the Screen Extension with Gradient Facility Alternative would be less-than-significant.

Alternative Gradient Facility Construction Methods

The modifications in noise level and duration with any of the alternative gradient facility construction schedules and methods would not be expected to alter the level of significance reported above. Impact pile driver use for the gradient facility would be substantially reduced for wet construction methods because cofferdams would not be required.

The implementation of the alternative construction schedules or methods described in Section 2.4.3 (Screen Extension with Gradient Facility) could affect impacts identified above in the following manner:

- Noise impacts on Capay district residents caused by impact pile driver operation would be reduced with the in-water (wet) construction method due to the reduced amount of sheet-pile driving (in-water construction does not require cofferdams).
- Noise associated with placement of riprap in the gradient facility would be reduced under the in-water (wet) construction method.
- The duration of construction noise would be affected by the choice of gradient facility construction method, with the one-phase method likely producing noise for the shortest duration, and the two-phase method producing noise for a slightly shorter time than the four-phase method. A two-year schedule would shorten the duration of the noise in any one year, but would cause noise disturbances to occur over a cumulatively longer period of time.

C-085755

Operation Impacts

Noise impacts from dredging operations in the upper oxbow would be substantially the same as Impact 4.8-1 under the screen extension alternative, and as illustrated on Figure 4.8-2.

The operations and maintenance requirements of the gradient facility could include dredging in the gradient structure and immediately upstream of the structure in the vicinity of River Mile (RM) 206 (Section 2.4.3, Screen Extension with Gradient Facility Alternative). Final design studies are underway to assess the extent of dredging, if any, that could be necessary. If necessary, dredging in this area would represent a new source of noise for residents near RM 206, which could represent a potentially significant impact. Although dredging duration and noise levels would be expected to be similar to dredging activities in the upper oxbow, GCID would evaluate potential noise impacts to local residents and implement appropriate mitigation to help ensure that impacts would be minimized.

4.8.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass Impacts

Noise impacts would be essentially the same as the screen extension with gradient facility alternative except for increased duration of noise in the lower oxbow during construction of the bypass pipelines and outfall.

Construction Impacts

Construction activities under this alternative would be similar to those for the screen extension with gradient facility alternative, except that the extent and duration of construction would be greater in the lower oxbow. As shown on Figure 4.8-3, noise contours generated by construction activities in the lower oxbow would not be expected to encompass any sensitive receptors under either the "oxbow return" or "river return" options. Therefore, there would be no ~~potentially significant~~ impacts ~~would be expected~~in addition to those identified under the Screen Extension with Gradient Facility Alternative.

Operations Impacts

Operations-phase noise would occur as a result of yearly dredging activities in the same manner as in the screen extension with gradient facility alternative, and as illustrated on Figure 4.8-3.

4.8.5 Mitigation

No significant noise impacts were identified; therefore, no mitigation is recommended.

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4.9 Cultural Resources

4.9.1 Introduction

This section identifies and analyzes the potential impacts that the proposed project could have on significant cultural resources within the Area of Potential Effect (APE). It also outlines appropriate measures that would be taken to avoid, minimize, or mitigate such impacts. Presented below are discussions on impact significance criteria, analysis methods, the results of the impact analysis, and recommended mitigation for cultural resources.

4.9.2 Impact Significance Criteria

"Impacts" refers to changes in the environment, present or future, caused by a proposed action or undertaking. Appendix K of the California Environmental Quality Act (CEQA) and Section 106 of the National Historic Preservation Act require that "impacts" be considered in any undertaking that could affect known or suspected cultural resources. The term "undertaking" is formally defined in 36 CFR 800.2 as meaning:

> "...any project, activity, or program that can result in changes in the character or uses of historic properties, if any such historic properties are located in the area of potential effects. The project, activity, or program must be under the direct or indirect jurisdiction of a Federal agency or licensed or assisted by a Federal agency...."

An undertaking has an impact on a historic property when the undertaking would alter characteristics of the property that would qualify the property for inclusion in the National Register. For the purpose of determining impacts, alteration to features of the property's location, setting, or use could be relevant, depending on a property's significant characteristics. An undertaking is considered to have an adverse impact on a historic property if it would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling or association. Adverse effects on historic properties would include, but not be limited to:

- physical destruction, damage, or alteration of all or part of the property;
- isolation of the property from or alteration of the character of the property's setting when that character contributes to the property's qualification for the National Register;
- introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting;
- neglect of a property resulting in its deterioration or destruction; and
- transfer, lease, or sale of the property (36 CFR 800-9).

Impacts could also be either direct or indirect; that is, they could occur as an immediate consequence of a particular action or activity (direct), or they could be the result of a direct activity but removed from that direct activity in time and/or distance (indirect).

For some types of historic properties, significance with regards to CEQA or eligibility for the National Register could derive from traditional cultural values, as determined through consultation with Native American groups. No such sites or qualities have been identified within or adjacent to the present project area, therefore no impacts to traditional cultural values are anticipated from the proposed undertaking.

4.9.3 Methods

The relationships between artifacts, soils, and flora and fauna remains at an archaeological site constitute the raw data from which inferences about past human behavior are derived. The spatial setting and relationships must remain in a context approximating that which existed when the material was first deposited to maximize their research value. Impacts to archaeological sites can disrupt these spatial relationships horizontally and vertically within a site, as well as compact cultural deposits, fracture artifacts, and even change the chemical make-up of the soil matrix of the site so that specialized studies no longer yield reliable results.

The methodology for evaluating impacts to cultural resources involved examining the relationship between the issues identified during consultation and field studies, the site types that were ultimately documented within the project area, and the impact criteria selected to assess potential project effects.

Survey Strategy

In view of variable terrain and sensitivity zones present within the project area, a mixed survey strategy was employed involving both surface and subsurface study.

Intensive-Level Surface Survey was undertaken in the highest sensitivity areas, including:

- naturally elevated spots within the project area located between meanders in the Sacramento River and possibly defining earlier levee systems;
- areas depicted on historic plats as containing historic period structures, Rancheria lands, or historic transportation routes; and
- the eroded face and margins of the Sacramento River, since a section of the River could be impacted by constructed features.

Within these areas, survey transects were maintained at approximately 50-foot intervals.

General-Level Surface Survey was undertaken in the remainder of the project area, which includes planted fields, areas of dense, impenetrable vegetation, areas not shown on historic maps as containing historic features, and low lands. General-level survey coverage was achieved by walking non-systematic zig-zag transects spaced at approximately 100-foot meter intervals.

In conducting surface survey, the surveyors took into account the results of background research, and were alert for any unusual contours, soil changes, distinctive vegetation patterns, exotic materials, artifacts, feature or feature remnants, and other possible markers of cultural sites.

Subsurface Survey was undertaken along the west bank of the upper oxbow within the APE. This work involved excavation of 20 subsurface probes using a backhoe operated by a Glenn-Colusa Irrigation District employee and supervised by a qualified archaeologist. Subsurface probes were excavated with a three-foot wide bucket in six-inch increments to a maximum depth of three to four feet. The objective of this approach was to further evaluate this potentially sensitive area in the vicinity of the fish screen extensions and forebay expansion (Section 2.3.2, Screen Extension Alternative) for possible buried cultural materials (e.g., midden, human remains, buried features).

Field Work

Surface survey work was undertaken between July 28 and August 19, 1996. Subsurface evaluation (backhoe trenching) was undertaken on November 19, 1996. No special problems were encountered during the course of the field work, and all survey objectives are considered to have been satisfactorily achieved.

Analysis

Analysis involved assessing the types of cultural resources identified in the APE with relation to areas of proposed construction and other impacts. As documented elsewhere in this document, four historic properties have been identified within the project area, two of which are prehistoric sites with buried components, and two which are historic structures. Detailed evaluation of location indicates that all four sites would be outside of the area of direct construction-related impacts for any of the project alternatives. Nevertheless, analysis of available data involved a number of considerations in deciding appropriate treatment and mitigation, including the effects of the following:

- walking and driving (vehicular traffic) on or near the sites;
- environmental management;
- waste disposal and digging;
- the need for repair, stabilization or restoration of any of these sites;
- archaeological and historical research;
- modification, use and maintenance of these sites for ceremonial or other cultural purposes;
- educational site visits and site interpretation programs; and
- transfer, sale or lease of the property.

Consultation

Based on the results of the investigations, the lead agencies consulted with the State Office of Historic Preservation to seek concurrence on a finding of no effect for the proposed action. By letter dated May 13, 1997 (Widell 1997), such concurrence was received.

4.9.4 Impacts

4.9.4.1 No-Project Impacts

Construction

No construction disturbance from continued operation of the existing fish screen would occur. Potential effects on unidentified resources could occur from installation of pump recapture stations and groundwater wells. Impacts would be unlikely due to the siting of these facilities in areas of existing disturbance. Subsequent final design and site reviews would confirm whether or not impacts could be expected.

4.9.4.2 Project Alternatives Impacts

Cultural resources located within the project area could potentially be impacted by construction or maintenance of potential features for this project. Two historic structures are located approximately 200 feet west of proposed project features, as is prehistoric site PA-94-7 which is situated along the upper oxbow.

***Impact 4.9-1** – Potential construction-related impacts to all four documented sites.*

A less-than-significant impact. Proposed avoidance of all four sites, in consideration of potential eligibility to the National Register of Historic Places, would ensure potential effects would be minimized during construction activities.

***Impact 4.9-2** – Potential construction-related disturbance (e.g., fish screen extension) and compaction to yet undocumented and unidentified cultural resources.*

A potentially significant effect. The possibility exists that potentially significant unidentified cultural materials could be encountered below the surface during the course of construction activities.

Alternative Gradient Facility Construction Methods

Impacts to cultural resources resulting from the wet construction method; the one- and two-phase dry construction methods; and the two-year construction schedule would not be expected to be substantially different than those described above.

4.9.5 Mitigation

The following mitigation measures are recommended in addition to those incorporated in the project description as described in Section 2.4.2 (Screen Extension Alternative).

Mitigation Measure for Impact 4.9-1 *– Potential construction-related impacts to all four documented sites.*

To ensure that potential effects remain less-than-significant, the location of all four documented properties would be identified as avoidance zones on final design and construction maps and plans. Construction foremen would be notified of the location of the four documented sites. Workers would be instructed as part of the work education program (Chapter 6, Environmental Commitments and Mitigation and Monitoring) on the importance of avoiding parking or driving equipment across the sites, or utilizing the areas for equipment storage or as materials landing areas. Also, periodic monitoring would occur under the Environmental Compliance and Mitigation Monitoring Program (Chapter 6) to ensure the documented sites would not be impacted. This would ensure potential impacts remain less than significant.

Mitigation Measure for Impact 4.9-2 *– Potential construction-related disturbance (e.g., fish screen extension) and compaction to yet undocumented and unidentified cultural resources.*

If previously unidentified cultural materials are encountered, construction in that area would be halted and a qualified archaeologist would be consulted immediately. This would minimize the potential for significant adverse effects to currently unidentified but potentially significant historic properties.

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4.10 Socioeconomics

Potential socioeconomic issues associated with the project are addressed in Section 2.6 (Issues Identified and Considered in EIR/EIS Process). Certain economic effects of existing HCPP restrictions are described in Section 3.10 (Socioeconomics). No potentially significant adverse impacts would occur from the project alternatives. Potentially significant adverse impacts could result from the no-project alternative (Section 4.7, Land Use) and would be even more significant if future drops in river gradient were to occur. Such changes and impacts would be speculative because numerous factors, which are difficult to predict, would influence the type and magnitude of impacts. These factors include availability and cost of alternative supplies, farming community response to water supply shortages, fishery agency requirements for Hamilton City Pumping Plant (HCPP) operations under emergency conditions, and the extent of and requirements to reestablish lost gradient for HCPP operations.

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4.11 Transportation and Traffic Safety

4.11.1 Introduction

This section presents the criteria used to assess impact significance, the analysis methods, a discussion of the significance of impacts, and a discussion of measures to mitigate potentially significant adverse impacts for transportation and traffic safety.

4.11.2 Impact Significance Criteria

During the construction phase, the project would be expected to generate traffic due to material delivery, equipment mobilization, and employee trips. Depending on the alternative, these trips could be significant in relation to the existing traffic conditions in the context of traffic levels and safety.

In accordance with the California Environmental Quality Act Guidelines, the following impacts to transportation and traffic safety would be considered significant:

- an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system; and
- unsafe road conditions for vehicles, pedestrians, or bicyclists.

4.11.3 Methods

Potential traffic impacts were evaluated based on comparing the expected trip generation to existing traffic levels on nearby roads. From a safety perspective, this evaluation considered roadway conditions and the proximity of nearby land uses. Traffic levels under the no-project alternative would differ from existing conditions in that construction activities (e.g., improvements to the lower oxbow) would also occur under the no-project alternative. Substantial changes in traffic conditions would only be expected with construction activities.

4.11.4 Impacts

4.11.4.1 No-Project Impacts

Traffic on Canal Street would be expected to increase under the no-project alternative due to worker trips and materials delivery to the job site. Specific traffic levels are not known. For the major activity involving lower oxbow improvements, traffic levels could increase a maximum of about 100 trips per day. This would be small relative to the 1,378 trips per day that are currently made on Canal Street.

Impact 4.11-1 – Increase in short-term traffic levels on Canal Road due to construction trips associated with improvements to the lower oxbow.

A less-than-significant impact. Canal Street is a well-maintained, two-lane county road which is expected to easily accommodate higher traffic levels. One residence is located along Canal Road, and three or four others are located along Montgomery Avenue. A school site is located at the intersection of Highway 32 and Canal Road. Access from the residential areas onto Canal Road is good because of low traffic levels and good visibility. Because no substantial changes would be expected and road capacity could accommodate the increase, no potentially significant impacts would occur.

4.11.4.2 Screen Extension Impacts

Traffic on Canal Street would increase under the screen extension alternative due to worker trips and material delivery to the job site. Specific traffic levels are not known. For the major activities involving lower oxbow improvements, screen extension, and forebay expansion excavation, traffic levels could increase a maximum of about 150 trips per day. This increase would be small relative to the 1,378 trips per day that are currently made on Canal Street.

Impact 4.11-2 – Increase in short-term traffic levels on Canal Road due to construction trips associated with the fish screen extension and related improvements.

A less-than-significant impact. Canal Street is a well-maintained, two-lane county road which is expected to easily accommodate higher traffic levels. Residences and a school site are in the vicinity as noted above. Access from the residential areas onto Canal Road is good because of low traffic levels and good visibility. Because no substantial changes would be expected and road capacity could accommodate the increase, no potentially significant impacts would occur.

4.11.4.3 Screen Extension with Gradient Facility Impacts

In addition to increased traffic associated with the screen extension, construction of facilities associated with the gradient facility would also generate traffic. Construction of the gradient facility would require up to about 60 construction-related personnel at the job site (RCE 1994b), or a maximum of about 120 trips per day. During the peak activity period when riprap is being placed in the gradient facility, an additional 40 trucks per day could be delivering riprap material to the job site (RCE 1994b). This is about 80 trips per day. Construction activities would occur on both the east and west sides of the river, with west-side activity based on Montgomery Island and accessed by Canal Road. West side staging activities would include employee and equipment parking, and assembly of barges to be used for cofferdam installation. The gradient facility construction office would be located on Montgomery Island. East side staging areas would be reached by Wilson Landing Road and private access roads, and would include equipment and employee parking (RCE 1994b). Over 200 trips per day are expected during the peak of construction activity, including workers and delivery trucks. The distribution of these trips with regard to east-side and west-side construction activity is not known, but would switch back and forth between sides due to the phasing of gradient facility construction. Because some overlap of

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screen extension and west-side gradient facility construction activities would be expected, the levels of traffic on Canal Road under this alternative would be added to the traffic levels expected under the screen extension alternative. At this time, it is estimated that peak construction traffic levels could increase total trips on Canal Road by up to 200 per day.

Project-related traffic accessing construction sites on the west side of the Sacramento River would likely use Canal Road and have impacts greater than Impact 4.11-2. Despite the increases over the screen extension alternative, residents along Canal Road and Montgomery Avenue would not likely experience significant delays or hazardous conditions when accessing Canal Road because of existing low traffic levels and good visibility. This would be a less-than-significant impact.

Impact 4.11-3 *– Local access road conditions on parcel 047-400-003 would not support access to gradient facility construction staging areas.*

A potentially significant impact. Access from Wilson Landing Road to east-side staging and construction areas would likely cross parcel 047-400-003, using unpaved private access roads. A likely route would be to follow an existing gravel road along the first levee from Wilson Landing Road to a transfer facility located on the parcel. Road conditions are generally good in this segment; although a gravel road, it is well maintained and appears to support a high amount of truck traffic associated with orchard operations. Road conditions deteriorate after the transfer facility, and do not appear suitable for accommodating truck traffic to the east bank of the river. Because truck traffic could not access construction staging areas along the east side of the Sacramento River without substantial road improvements, this would be considered a potentially significant impact.

Impact 4.11-4 *– Increased traffic in front of residences located on Wilson Landing Road west of Hamilton Nord Cana Highway could pose safety problems for residents.*

A potentially significant impact. Construction traffic accessing east-side construction areas would likely use Wilson Landing Road as a primary access route. Access to Wilson Landing Road west of Hamilton Nord Cana Highway would likely come either from the north (from Highway 99) or south (from Highway 32), or from Wilson Landing Road east of Hamilton Nord Cana Highway (from Highway 99 near Chico). These roads have minor but not significant limitations. Road conditions on Wilson Landing Road west from Hamilton Nord Cana Highway to the first levee crossing would likely support anticipated truck traffic; however, the road passes close to at least one residence. This would be a traffic safety concern. Because of the importance of maintaining public safety and the increase in traffic (including heavy truck traffic) on a road that currently carries only 380 vehicles per day, this would be a potentially significant impact.

Alternative Gradient Facility Construction Methods

The level of traffic would be the same under the alternative schedules or methods as described above. However, changes in the duration of construction traffic anticipated under the alternative schedules and methods could affect the impacts identified above. Construction traffic would likely occur for the least amount of time under the one-phase gradient facility schedule, with construction traffic under the two-phase schedule occurring for a slightly shorter period of time than the four-phase schedule. Under a two-year schedule, traffic in any one year would occur for the shortest duration compared to the other alternatives; however, the traffic would occur in two years rather than one.

4.11.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass Impacts

Construction traffic levels would be expected to be slightly greater under this alternative than under the above alternatives. For this alternative, traffic levels on the east side of the river (e.g., Wilson Landing Road) would not be affected relative to the screen extension with gradient facility; construction of internal fish bypass facilities would occur on the west side only. However, the increase in traffic associated with the internal fish bypass system would be small. As described under Impact 4.11-2, residents along Canal Road and Montgomery Avenue would not likely experience significant delays or hazardous conditions when accessing Canal Road because of existing low traffic levels and good visibility. This would be a less-than-significant impact.

4.11.5 Mitigation

The following mitigation measures are recommended in addition to those incorporated in the project description as described in Section 2.4.2 (Screen Extension Alternative).

Mitigation for Impacts 4.11-3 and 4.11-4 *– Local access road conditions on parcel 047-400-003 would not support access to gradient facility construction areas and increased traffic in front of residences located on Wilson Landing Road west of Hamilton Nord Cana Highway could pose safety problems for residences.*

To promote efficient, safe access to construction staging areas on the east bank of the Sacramento River, an Access Management Plan would be prepared and implemented prior to the initiation of construction activities. The following would be considered in this plan.

- The ability of proposed access routes to accommodate high levels of construction vehicle and truck traffic. Factors would include road width, surface conditions, and vertical clearance.

- Securing necessary easements for roads and staging areas, including consideration of improvement and maintenance costs, construction traffic signs, restoration activities, and damage provisions.

- Ensuring the safety of all people potentially affected by construction traffic. Affected people would be informed about the expected changes in traffic levels, and reasonable accommodations to help ensure safety (e.g., temporary fencing and slower construction speed limits would be considered).

Implementation of this mitigation measure would reduce the potential impacts to a less-than-significant level.

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4.12 Air Quality

4.12.1 Introduction

This section presents the criteria used to determine impact significance, the methods of analysis, an analysis of impacts, a discussion of the significance of expected impacts, and a discussion of measures proposed to mitigate potentially significant adverse impacts for air quality.

4.12.2 Impact Significance Criteria

The following impact significance criteria for air quality were derived from Federal and State air quality regulatory standards and from the California Environmental Quality Act Guidelines (i.e., the list of Significant Effects in Appendix G and the Environmental Checklist Form in Appendix I).

The following impacts to air quality would be considered significant:

- the substantial contribution to an existing or projected air quality violation within the project area, including increases in PM_{10} and ozone precursors (i.e., Nitrous Oxides (NO_x) and Reactive Organic Gas (ROG)); and

- the exposure of sensitive receptors to substantial pollutant concentrations.

Impacts to air quality would be considered less than significant if they do not meet these criteria.

4.12.3 Methods

Effects on air quality within the project area were evaluated by comparing expected changes in pollutant emissions that would result from each of the project alternatives and considering whether these changes could violate State and Federal ambient air quality standards.

Future air quality resource conditions within the project area are not expected to differ substantially from existing conditions. Therefore, it is assumed in the following analysis that future no-project and existing air quality conditions are equivalent.

4.12.4 Impacts

4.12.4.1 No-Project Impacts

Construction

Limited, less-than-significant, short-term air quality impacts would be expected to result from construction of the pump recapture stations, groundwater wells, and lower oxbow and screen improvements associated with the no-project alternative.

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Operation

No potentially significant adverse impacts to air quality would be expected to result during operation of this alternative.

4.12.4.2 Screen Extension Impacts

Construction

Construction vehicles and equipment and construction employee commute vehicles would emit exhaust at the construction site, thereby increasing pollutant emissions in the region. The exact type, number, and scheduling of pieces of major construction equipment to be used are not currently known, therefore estimates of the increase of pollutant emissions cannot be made. However, these potential increases in air pollutants could contribute to air quality violations within the project area, especially for ozone.

As identified in Section 2.4.2 (Screen Extension Alternative), emission control devices to reduce construction vehicle emissions would be required by Reclamation as a standard condition of the construction contract. With the implementation of this standard condition, potential construction equipment emissions impacts would be expected to be less than significant.

Construction activities, including vehicle traffic on unpaved roads and wind erosion of disturbed ground, would also result in the creation of dust and PM_{10}. Because the exact type, number, and scheduling of pieces of major construction equipment to be used are not currently known, estimates of the increase of PM_{10} emissions cannot be made. However, these potential increases in PM_{10} could contribute to air quality violations within the project area and could create substantial PM_{10} concentrations within the vicinity of local residences.

As with vehicle emissions control, Reclamation has standard construction practices that would reduce particulate emissions. With the implementation of this standard condition, potential increases in dust and particulate matter would be expected to be less than significant.

Operation

No potentially significant adverse impacts to air quality would be expected to result during operation of this alternative.

4.12.4.3 Screen Extension with Gradient Facility Impacts

The following impacts would be expected in addition to those discussed for the screen extension alternative.

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Construction

Impacts to air quality would be similar to those for the screen extension alternative, but more emissions would be expected because of the greater impact area and greater number of construction vehicles. Emission control devices and the use of water would be expected to reduce potential impacts to a less-than-significant level.

Operation

No potentially significant adverse impacts to air quality are expected to result during operation of this alternative.

Alternative Gradient Facility Construction Methods

The alternative methods and schedules that have been proposed for constructing the gradient facility are discussed in detail in Section 2.4.2 (Screen Extension with Gradient Facility). Impacts to air quality resulting from the wet construction method; the one- and two-phase dry construction methods; and the two-year construction schedule would not be expected to be substantially different than those described above for the four-phase, dry construction method.

4.12.4.4 Screen Extension with Gradient Facility and Internal Fish Bypass Impacts

Impacts would be expected to be substantially similar to those discussed earlier for the screen extension with gradient facility alternative.

4.12.5 Mitigation

No potentially significant impacts would occur, therefore, no mitigation is recommended.

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C-085770

4.13 Indian Trust Assets

None of the alternatives would have any known adverse impacts on an Indian reserved water right, hunting and fishing right, or other Indian Trust Asset. See Section 3.13 (Indian Trust Assets) for additional information.

4.14 Environmental Justice

No significant or potentially significant impacts have been identified for environmental justice. See Section 3.14 (Environmental Justice) for additional information.

4.15 International Impacts

No significant or potentially significant impacts have been identified for international impacts. See Section 3.15 (International Impacts) for additional information.

4.16 Cumulative Impacts

4.16.1 Introduction

This section analyzes the cumulative environmental impacts of the Hamilton City Pumping Plant (HCPP) Fish Screen Improvement Project and other related past, present, and reasonably foreseeable future actions (Federal or non-Federal) in accordance with California Environmental Quality Act Guidelines Section 15130 and National Environmental Policy Act regulations (40 CFR 1508.7). The cumulative analysis addresses impacts to the Sacramento River system, areas benefiting from waters delivered through the HCPP, and the immediate area of the HCPP.

4.16.2 Methods

The cumulative impacts analysis is based on two evaluations. The first is the results of the hydrologic modeling performed for the Sacramento River system and Glenn-Colusa Irrigation District (GCID) service area as described in Section 4.1 (Hydrology and Water Resources) and in Appendix B (Hydrology and Water Resources Technical Report). The second evaluation is a qualitative review of other reasonably foreseeable actions in the study area that are not addressed in the hydrologic model.

The hydrologic modeling includes Bureau of Reclamation (Reclamation) (1996i) assumptions for existing (1995) and future (2020) Central Valley Project (CVP) operations. The 1995 and 2020 hydrologic analyses incorporate other past, present and reasonably foreseeable actions related to operation of the CVP system, including other actions considered as part of the Central Valley Project Improvement Act (CVPIA), such as the HCPP fish screen improvements. Reclamation (1997e) ~~is preparing a~~ has prepared and released for public review its Draft Programmatic EIS that ~~will~~ addresses impacts of all proposed actions under the CVPIA.

The potential for cumulatively significant impacts related to the project would be anticipated only for Sacramento River-dependent resources. No substantive issues have been identified for other resources in the project area.

4.16.3 Analysis

The hydrology and water resources analyses for the proposed project include an analysis of anticipated changes to the CVP system by the year 2020 (Section 4.1, Hydrology and Water Resources). The conditions predicted for the year 2020 incorporate region-wide effects on land use, development, and changes in the distribution and management of water. The analysis, which shows that the HCPP would have some effects on Sacramento River flows and temperatures, indicates that such flow and temperature changes would be beneficial to aquatic resources between the Red Bluff Diversion Dam (RBDD) and HCPP, to water quality in the GCID service area and lower Colusa Basin, and to agricultural and terrestrial (National Wildlife Refuges) uses of the water supplies. These benefits cumulatively contribute to benefits anticipated from other fisheries restoration efforts, including the draft Anadromous Fish Restoration Program (AFRP) (USFWS 1995b).

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C-085772

Table 4.16-1 summarizes reasonably foreseeable actions along with projections of positive or negative impacts on Sacramento River-dependent resources. No cumulatively significant adverse impacts have been identified as a result of the project.

Table 4.16-1 Summary of Activities Impacting Sacramento River-Dependent Resources

Activity	Anticipated Impact
Screening Projects	Positive
Conjunctive Use	Positive
Water Transfers	Positive
Gravel Mining	Negative
Spring Creek/Iron Mountain Source Control	Positive
River Channel Stabilization	Negative
Senate Bill 1086 Program	Positive
Stony Creek Management Plan	Positive
Stony Creek Siphon	Positive
CVPIA	Positive
Sacramento Valley Water Management Programs	Positive

4.16.3.1 Screening Projects

Numerous screen actions are being taken to improve fish protection and survival on the Sacramento River. One of the most recently completed efforts was by Reclamation. In 1990, new fish screens and a new bypass facility were completed at RBDD (USFWS 1993), which is the headworks for the Tehama-Colusa Canal.

There are more than 300 unscreened or inadequately screened diversions taking water from the Sacramento River system (Reclamation 1991). The cumulative effect of these unscreened diversions on fisheries is unknown, but is very likely to be negative. Four screening projects have been considered recently on diversions for irrigation districts downstream of the HCPP. Of these, the diversion for the Maxwell Irrigation District is currently screened. Screening of the diversions for the Provident and Princeton-Codora-Glenn Irrigation Districts are scheduled for completion in ~~implementation in 1997/~~1998 (G. Stern, pers. comm., 1997). A fourth project at Reclamation District 108 at Wilkins Slough is in the environmental review phase and would begin construction later this year. These screening projects would have beneficial effects for fishery resources in the Sacramento River system. The proposed project would further contribute to positive cumulative effects of these projects.

4.16.3.2 Conjunctive Use

Conjunctive use involves pumping water from a groundwater basin for use in combination with surface water to increase the total water supply availability. When properly managed, a groundwater basin is recharged during above average to high runoff years, making stored water available during below normal years. Conjunctive use programs generally increase the efficiency of water supply systems through appropriate management and use of ground and surface waters. When designed and managed properly, these programs generally cause few negative

C-085773

environmental impacts relative to impacts associated with the sole use of surface or groundwater sources. The proposed project would increase opportunities for conjunctive use programs due to the increased flexibility of water management operations through the HCPP.

4.16.3.3 Water Transfers

Transfers of water to other districts could potentially impact water quality in the Colusa Basin. Water quality in the Colusa Basin faces two issues: increasing electrical conductivity levels in irrigation water, and exceedances of pesticide performance goals in the Colusa Basin Drain during the rice growing season. The return of operational capacity to the HCPP with the proposed project could mitigate these problems if increased diversions result in increased outflow to the Colusa Basin Drain. Decreasing dependence of GCID customers on recaptured water could also help to dilute pesticides and salinity in the Colusa Basin Drain. However, if transfers of water to other districts would result in less water in the Colusa Basin Drain, then these water quality issues would remain.

4.16.3.4 Gravel Mining

Gravel mining occurs primarily in the tributaries of the upper Sacramento River. This activity removes potential sources of spawning material from both the tributaries and mainstem of the Sacramento River. Provisions of the Federal Clean Water Act make control of these sources possible, but it is likely that gravel mining restrictions will have to be developed and enforced at the local agency level. Impacts of gravel mining on fishery resources in the Sacramento River are negative at this time. The proposed project would neither substantially increase nor decrease sources of spawning gravel because most spawning occurs upstream of the HCPP.

4.16.3.5 Spring Creek/Iron Mountain Source Control

These actions are ongoing and scheduled for completion by 2002. The actions will involve source control measures, stream diversions, tailings removal, capping seepage areas into the mine, and the possible enlargement of the Spring Creek Debris Dam. These diversion activities have begun and will have immediate positive effects on water quality and fisheries habitats in the Sacramento River as the measures are implemented. The proposed project would further contribute to long-term fisheries enhancements in the Sacramento River as described in Section 4.2, Aquatic Resources.

4.16.3.6 River Channel Stabilization

The last river bank stabilization project under the Chico to Red Bluff Landing Project was completed in 1985. Further river channel stabilization in the vicinity of the gradient facility using riprap would incrementally impact riparian corridor, gravel and sandbar communities. The proposed project would have some negative impact on riparian vegetation, including federally-designated critical habitat for winter-run chinook salmon and habitat of the federally-listed valley elderberry longhorn beetle. Such impacts would be substantially mitigated and not significantly contribute to past cumulative impacts.

4.16.3.7 Senate Bill 1086 Program

The Upper Sacramento River Fisheries and Riparian Habitat Management Plan (SB 1086) includes 22 restoration proposals; the first 2 deal with protection and restoration of riparian habitat on the mainstem and its tributaries, and the other 20 deal with actions to resolve fishery problems on the mainstem and its tributaries. The purpose of riparian habitat planning through SB 1086 is to preserve remaining riparian habitat and reestablish a continuous riparian ecosystem along the upper Sacramento River. Management would allow necessary channel migration while also protecting towns, cities, bridges, and flood control works and enhancing riparian habitat. These projects would have beneficial effects for fishery and riparian resources along the Sacramento River system.

The fisheries protection and restoration projects include HCPP fish screen improvements and gradient restoration. The proposed project would therefore be consistent with specific provisions of the SB 1086 plan and contribute to region-wide fisheries restoration efforts.

4.16.3.8 Stony Creek Management Plan

Reclamation, U.S. Fish and Wildlife Service (USFWS), GCID, and others have been working on a water management option that will improve aquatic, riparian, and upland habitats along Stony Creek. Enhancements along Stony Creek would contribute positive, cumulative effects to regional aquatic and riparian habitats along the Sacramento River. The proposed project could provide additional water management options along Stony Creek and therefore have potentially beneficial impacts to aquatic and riparian resources due to increased water management flexibility.

4.16.3.9 Stony Creek Siphon

Construction of a siphon for the Glenn-Colusa Canal to pass under Stony Creek is being planned. An environmental assessment analyzing potential impacts has been prepared by Reclamation (1995a). Installation of the siphon would improve fishery habitat conditions on this major tributary to the Sacramento River.

4.16.10 CVPIA

On October 30, 1992, President Bush signed into law the Reclamation Projects Authorization and Adjustment Act (Public Law 102-575), including Title XXXIV, the CVPIA. The CVPIA amends the authorization of the Department of the Interior's 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 purpose equal to power generation.

Section 3406(b)(1) of the CVPIA directs the Secretary of Interior "to develop and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis,

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C-085775

at levels not less than twice the average levels attained during the period of 1967-1991." This restoration plan was developed to work toward the above goal. This program is known as the AFRP. This project would add to the cumulative beneficial effects of the AFRP.

The HCPP fish screen improvements are a specific component of the CVPIA. As noted in Section 1.5.2 (History of Fish Screens), Reclamation was specifically authorized by Congress as part of the CVPIA to assist the State and other Federal agencies with implementing the fish screen improvements.

4.16.3.11 Sacramento Valley Water Management Programs

As described for conjunctive use, water transfers, and Stony Creek Management Plan, water managers in the Sacramento Valley are considering a number of future programs to improve water management practices, meet increasing demands, and enhance special-status species habitats and other environmental resources. This includes projects under CVPIA as well as CALFED programs. The proposed project would further increase water management options for meeting the objectives of these programs, in particular the potential increased capacity for non-irrigation season diversions. Specific examples include potential use of the HCPP and Glenn-Colusa Canal for Level 4 refuge water deliveries (defined as optimum water supplies for management of national wildlife refuges (Reclamation 1989)), and consideration of region-wide (as opposed to GCID-wide) water management plans for water users, resource agencies, and industries that could potentially realize mutual benefits from joint planning of future operations.

4.17 Growth Inducing Impacts

Construction and operation of the fish screen improvements would re-establish diversion capacity and reliability for Glenn-Colusa Irrigation District (GCID) to meet its water delivery obligations. The re-established capacity from Hamilton City Pumping Plant (HCPP) would allow for the reduction in use of other water supply sources, including runoff, recapture, and groundwater, with no substantial net change in total regional use. Demands for GCID water deliveries have been unchanged by the restrictions imposed on HCPP operations, and no new regional demands or growth-inducing activities (e.g., irrigated agricultural or residential or industrial developments) would be anticipated as a result of the project. GCID demands are projected to remain unchanged in the foreseeable future as analyzed under future conditions in Section 4.1, Hydrology and Water Resources. Thus, no growth-inducing impacts are expected to occur.

4.18 Relationship Between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

The proposed project would have short-term negative effects to fisheries, visual resources, and local terrestrial species and associated habitats due to construction, but would result in long-term increased protection of fisheries passing the HCPP diversion on the Sacramento River. The long-term benefits of the project would substantially increase emigrating chinook salmon survival and contribute to the long-term restoration of salmon populations in the upper Sacramento River system. In addition, river gradient stabilization with the preferred alternative would help ensure the viability of the fish screen structure and thus, long-term productivity of agricultural lands in Glenn and Colusa counties.

4.19 Irreversible or Irretrievable Commitments of Resources

Irreversible commitments of resources would result from implementing any of the project alternatives. These resources include:

- construction materials;
- labor; and
- energy needed for construction, operation, and maintenance.

Projected losses of wetland, riparian and special-status species habitats, including up to approximately ~~1.7~~1.5 acres of SRA Cover, would be mitigated to the extent feasible by creating new and/or ~~enhancing~~ improving existing habitats.

C-085777

4.20 Significant and Unavoidable Impacts

Significant and potentially significant, short-term unavoidable impacts would result from all project alternatives. The short-term, unavoidable impacts would be to special-status, downstream migrating juvenile salmonids, Shaded Riverine Aquatic Cover (SRA Cover), and visual resources. In addition, potentially significant long-term, unavoidable impacts would result from the permanent displacement of SRA Cover.

Special-status juvenile fish would become trapped during the installation of cofferdams. Mitigation measures to minimize entrapment would reduce impacts to the extent feasible, but some unavoidable impact to juvenile special-status fish species would still occur.

SRA Cover is classified by the U.S. Fish and Wildlife Service as a Resource Category 1 habitat. Approximately ~~1.7~~1.5 acres (about ~~7,200~~6,500 feet of an assumed 10-foot wide river front strip) of SRA Cover habitat would be permanently impacted by project facilities. Mitigation to compensate for SRA Cover losses would include ~~enhancing~~ improving existing riparian habitat and converting orchard lands to riparian habitat that could contribute to SRA Cover habitat values. While identified mitigation measures would substantially offset losses to SRA Cover, the impacted lands would be considered a permanent, net loss of SRA Cover habitat.

The project area is on a portion of the Sacramento River that is characterized by dense riparian vegetation with occasional gravel bars. The viewshed from the main river channel and nearby residences includes little evidence of Hamilton City Pumping Plant operations except for periods of the year when Glenn-Colusa Irrigation District is dredging the oxbow or performing maintenance activities related to the dredge spoils on Montgomery Island. The project alternatives would include substantial placement of riprap along the lower oxbow to the point where it rejoins the river. Project alternatives including the gradient facility would also include substantial placement of riprap along the main river channel and banks for a distance of approximately one-half mile. The extent of this change in the visual character of the area would represent a significant, short-term unavoidable impact until revegetation occurs in the area.

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CHAPTER 5
COMPARISON OF ALTERNATIVES

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5.0 COMPARISON OF ALTERNATIVES

Chapter 4 (Impact Analyses) presented an alternative-by-alternative analysis of the changes and impacts associated with the project and no-project alternatives for each resource area. The purpose of this chapter is to compare the differences in impacts between alternatives and generally discuss how the alternatives meet the project objectives discussed in Chapters 1 and 2.

Alternatives are first compared within the context of each resource category (Section 5.1). Next, Section 5.2 addresses key environmental differences between alternatives and identifies the environmentally superior alternative. Section 5.3 identifies the Agency Preferred Alternative.

5.1 Comparison of Impacts Among Alternatives

Tables 5.1-1 and **5.1-2** summarize the analyses presented in Chapter 4 (Impact Analyses). Table 5.1-1 compares the impacts among the alternatives, including the no-project alternative, by presenting the changes from existing conditions to each alternative. Using information presented in Table 5.1-1 to establish the no-project alternative condition, Table 5.1-2 summarizes the incremental differences in impacts from the no-project alternative to each of the project alternatives. Unless otherwise indicated in the text or shown in Table 5.1-2, impacts of the project alternatives are the same relative to both existing conditions and no-project conditions. The significance of the impacts before and after mitigation are also presented in Tables 5.1-1 and 5.1-2. Due to their length, these tables are located at the end of the chapter.

For those alternatives that include a gradient facility, the EIR/EIS impact analyses assume a one-year, four-phase gradient facility construction process (dry construction method) in the mainstem of the Sacramento River. Project engineers and resource specialists are evaluating options that could better satisfy construction sequencing and environmental objectives, including minimizing adverse effects on special-status fish species. It is uncertain at this time whether the proposed one-year, four-phase dry construction method could be accomplished in one year. The potential impacts of alternative methods and schedules, including the in-river wet construction method, are discussed in this EIR/EIS. Either the dry or wet construction method, or some combination of the methods, could ultimately be implemented.

For this EIR/EIS, short-term and long-term impacts from implementing the alternatives are determined for existing conditions and future (2020) baseline conditions. The future (2020) baseline represents the future condition of the resources without the project. The no-project alternative under 2020 hydrology conditions serves as the baseline for assessing future changes from implementing the project alternatives.

For all topics except hydrology and water resources and aquatic resources, future baseline conditions are not expected to differ substantially from existing conditions. For hydrology and water resources, information was available indicating reasonably foreseeable changes in the future regardless of decisions on this project. Reclamation (1996i), as described in Appendix B (Hydrology and Water Resources Technical Report), provides information regarding projected river flows and water demands in 2020. Aquatic resources are indirectly affected by changes to hydrology and water resources.

Presented below is a summary of the analyses described in Chapter 4. Unless otherwise indicated in the text or highlighted in bold in Table 5.1-2, impacts are the same relative to both existing conditions and no-project conditions.

5.1.1 Hydrology and Water Resources

Potentially significant impacts to hydrology and water resources would result from the no-project alternative. Mostly beneficial impacts would result from the project alternatives.

Relative to existing conditions (Table 5.1-1), potentially significant adverse impacts could result from the no-project alternative due to reductions in Hamilton City Pumping Plant (HCPP) diversions, local declines in the groundwater table, continued increases in salinity concentrations, and reduced drainage outflow for diluting water pesticide levels. No potentially significant adverse impacts would result to hydrology and water resources with the project alternatives. Beneficial effects would result from the project alternatives due to opportunities to improve and possibly stabilize salinity levels in the lower Glenn-Colusa Irrigation District (GCID) service area and lower Colusa Basin. This applies to changes to both existing and future conditions and would result from increases in HCPP diversions.

Relative to no-project conditions (Table 5.1-2), no potentially significant adverse impacts would result to hydrology and water resources with the project alternatives. Beneficial impacts of increased HCPP diversions would result from the project alternatives due to reduced groundwater pumping, possible stabilization of salinity in the Colusa Basin Drain, and reduced frequencies of pesticide concentration exceedances.

Relative to existing conditions (Table 5.1-1), changes to Sacramento River flows and diversions would result under each alternative. Under the no-project alternative, flows downstream of the Red Bluff Diversion Dam (RBDD) would decrease, due to GCID's increased reliance (as capacity is available) on deliveries via the Tehama-Colusa Canal (TCC) and increased reliance on groundwater and recaptured water. One exception would be August when river flows would increase slightly due to increased capacity of GCID irrigation recapture facilities under the no-project alternative. Under the project alternatives, Sacramento River flows between RBDD and Hamilton City would consistently increase because historical diversion capacity would be restored at the HCPP causing a greater percentage of GCID water supplies to remain in the Sacramento River (instead of being diverted at RBDD and delivered via the TCC). While flow changes would be substantial in summer months, river water temperature changes associated with the changes in flow would be small.

Relative to no-project conditions (Table 5.1-2), changes to Sacramento River flows and diversions would result under each project alternative. Sacramento River flows between RBDD and Hamilton City would increase because diversion capacity would be restored at the HCPP causing a greater percentage of GCID water supplies to remain in the Sacramento River (instead

C-085781

C-085781

of being diverted at the RBDD and delivered via the TCC). While flow changes would be substantial in summer months, and even more so relative to existing conditions, river water temperature changes associated with the changes in flow would still be small.

The potential for the river to meander or flood would not be substantially affected by the presence of any project features including the gradient facility. However, the alternatives including a gradient facility minimize the potential for future gradient losses and local river meander, thereby making the fish screen improvements and HCPP operations more reliable over the 50-year project life.

Construction activities in the river for the gradient facility would not be expected to increase the risk of flooding, as construction would take place during relatively low flow periods.

Table 2.4-3 shows how the no-project and project alternatives relate to the project objectives. For hydrology and water resources objectives, the no-project alternative would not provide peak pumping capability (within existing HCPP capacity), would not minimize risks of river gradient changes, and would not maximize the long-term reliability of HCPP operations. The screen extension alternative would nearly restore peak pumping capability at HCPP, but would not minimize risks of river gradient changes or maximize long-term reliability of HCPP operations. Both the screen extension with gradient facility alternative and screen extension with gradient facility and internal fish bypass alternative would meet all three of the hydrology and water resources project objectives.

5.1.2 Aquatic Resources

Potentially significant, unavoidable short-term impacts and beneficial long-term impacts would result from the no-project and project alternatives.

Relative to existing conditions (Table 5.1-1), the no-project alternative would result in both beneficial and significant adverse impacts to fish. The beneficial effects would include the reduced numbers of fish that would be exposed to the existing fish screen (due to reduced flows into the oxbow) and a reduction in predator habitat associated with increased flow velocities in the lower oxbow. The potentially significant adverse effect of the no-project alternative would include loss of Shaded Riverine Aquatic Cover (SRA Cover) habitat.

Relative to existing conditions, the project alternatives would have varying levels of mostly beneficial, but also some short-term adverse effects on fishery resources. Short-term, significant adverse effects would occur to downstream juvenile migration due to delays and/or blockage (i.e., loss of juveniles stranded behind the cofferdams) caused by in-water construction activities and equipment. In addition, losses of SRA Cover habitat would also occur. Relative to existing conditions, long-term impacts of the project alternatives would be beneficial to fishery resources except for the permanent displacement of some SRA Cover habitat. The beneficial impacts would include reduced losses of juvenile fish at the fish screen due to improvements in uniformity of approach and sweeping velocities at the screen, and reduced predation in the oxbow.

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C-085782

Relative to no-project conditions (Table 5.1-2), long-term impacts of the project alternatives would include additional permanent displacement of some SRA Cover habitat. Long-term improvements in uniformity of approach and sweeping velocities at the screen would also result from the project alternatives.

The screen extension alternative would also have potentially significant, adverse impacts to juvenile fish during construction (cofferdam installation). Beneficial impacts to juvenile fish would occur during operation due to improved screen performance and reduced predator holding areas. These impacts would be similar relative to the existing condition or the no-project condition.

The project alternatives would have potentially significant, adverse impacts to juvenile fish during construction (cofferdam installation). The screen extension with gradient facility alternative would require substantially more cofferdams than the screen extension alternative. The gradient facility would also require installation of cofferdams during peak migration of special-status fish species. The beneficial impacts for juvenile fish during operation would be greater for the screen extension with gradient facility alternative than the screen extension alternative. This would be due to improved approach and sweeping velocities at the fish screen (due to increased gradient and flow control), as well as long-term reliability of fish screen performance.

Operation of the screen extension with gradient facility and internal fish bypass (return to oxbow) alternative would have the same impacts as the screen extension with gradient facility alternative, but would also provide a means of reducing screen exposure time and associated potential for impingement of chinook salmon fry. Operation of the screen extension with gradient facility and internal fish bypass (return to river) alternative would have similar impacts as the return to oxbow alternative, with the exception of predation. The return to river alternative would have predator holding habitat in the vicinity of the bypass outfall in the river, and could increase stress of juvenile fish due to a longer transport time in the internal bypass system. The combined effects of increased travel time in bypass, potential hydraulic effects of the pipeline configuration, and a bypass outfall near a large predator holding area in the Sacramento River could result in potentially significant impacts to juvenile fish.

Relative to no-project conditions, impacts from the project alternatives would be similar to impacts relative to existing conditions, but would occur to a lesser degree.

SRA Cover would be removed under both no-project and project alternatives, but the area disturbed would increase substantially for those alternatives with a gradient facility. Impacts to SRA Cover would be considered potentially significant, because of its classification under U.S. Fish and Wildlife Service (USFWS) Mitigation Policy (1992) (Resource Category 1).

Table 2.4-3 shows how the no-project and project alternatives relate to the project objectives. For fish protection objectives, the no-project alternative would not provide state-of-the-art protection, would not minimize fish losses, and would not minimize risk of screen failure. The

C-085783

C-085783

screen extension alternative would provide substantial fishery resource protection beyond the existing fish screen system. However, it would not reduce the risk of screen failure nor minimize fish losses to the degree of alternatives that include a gradient facility and internal bypass. The screen extension alternative would not be expected to minimize fish losses because screen exposure time would be greater relative to existing conditions. The long-term viability of the no-project alternative and screen extension alternative is uncertain due to the potential for future river gradient changes and associated risk of screen failure.

5.1.3 Geology and Soils

No potentially significant impacts would be associated with either the no-project or project alternatives.

For the project alternatives, project design would minimize the risk of constructed slope or structure failure should a seismic event occur. Final plans and designs for all alternatives would comply with building standards that take into consideration the potential for liquefaction, settlement, and other geologic hazards.

5.1.4 Recreation and Navigation

Potentially significant and significant, but mitigable, impacts to recreation and navigation would be associated with the no-project and project alternatives.

Recreational boating and navigation would be able to continue in the project area during construction under all three project alternatives with limited restrictions. However, the presence of construction equipment and facilities such as cofferdams could interfere with recreational boating and would represent boating hazards. More hazards would be expected for the alternatives that include the gradient facility on the Sacramento River. Significant, but mitigable, impacts would result during operation due to the placement of new structures in the oxbow and the placement of in-river rock features for the alternatives that include a gradient facility. Posting of signs, a boater information program, and other measures would warn recreationists of potential hazards and mitigate impacts to recreation and navigation to a less-than-significant level.

5.1.5 Terrestrial Biology

Potentially significant and significant, but mitigable, impacts would be expected to terrestrial biological resources with both the no-project and project alternatives.

New facilities to increase groundwater pumping and/or irrigation runoff recapture would be constructed under the no-project alternative. Recapture facilities along existing canals and drains could have the potential to impact giant garter snake habitat. Improvements to the lower oxbow could also have potentially significant impacts to riparian habitat in general, including the nesting habitat of predatory bird species and bank swallow habitat. Scrub willow and wetland habitat would not be affected by construction or operation of the no-project alternative.

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Extension of the fish screen under the project alternatives would result in the permanent loss of riparian habitat. These losses would be substantially greater for the alternatives that include a gradient facility. Acreages would be small and considered potentially significant due to the scarcity of riparian habitat along the Sacramento River relative to historical levels. Riparian habitat impacts would be mitigated to a less-than-significant level.

Wetland impacts would result from alternatives that include the gradient facility. All wetland impacts would be significant but mitigable to less-than-significant levels.

The project alternatives would result in significant, but mitigable, impacts to the valley elderberry longhorn beetle (VELB) habitat. Those alternatives including a gradient facility would have substantially more impacts to VELB than the screen extension alternative.

For all species where potentially significant impacts would occur, final site surveys would be conducted to assess impacts, ~~mitigation would be finalized, and~~ avoidance measures would be implemented where feasible, and final habitat impacts would be quantified to determine habitat mitigation requirements. All impacts would be mitigated to less-than-significant levels through a combination of proposed avoidance, relocation, on-site habitat restoration, and on- and off-site habitat ~~enhancement~~ improvement measures.

On- and off-site mitigation measures are proposed that would, to the extent feasible, restore disturbed areas and compensate for net habitat losses through the acquisition and improvement of riparian lands. This Final EIR/EIS describes the proposed acquisition (assuming landowner willingness to sell) of orchard land south of the lower oxbow (Parcel No. 037-100-002) for riparian, SRA Cover, and other habitat mitigation.

5.1.6 Visual Resources

Short-term significant, unmitigable impacts would result from the project alternatives due to the permanent placement of riprap along the lower oxbow and along the Sacramento River for alternatives including a gradient facility. Potentially significant, but mitigable, impacts would result from soil and vegetation disturbance during construction under all alternatives.

5.1.7 Land Use

The no-project alternative could have a potentially significant impact on land use. The increased reliance on recaptured water (and associated potential increases in salinity) could lead to changes in cropping patterns, and increased salinity in GCID service area recaptured water and in drainage water outflow from the GCID service area to the lower Colusa Basin. No potentially significant impacts would result from the project alternatives.

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5.1.8 Noise

No potentially significant noise impacts would be anticipated for either the no-project or project alternatives. However, occasional use of impact pile drivers would generate intermittent noise levels for residents along Montgomery Avenue and in the Capay district over and above the noise impacts of other construction activities. Noise levels at the residences could occasionally reach 70 dBA. Vibratory pile drivers would be used to the extent feasible to minimize noise impacts. ~~The decibel (dBA) levels during construction would not be expected to exceed 75 dBA at 50 feet and 60 dBA at nearby residences for any of the alternatives.~~

5.1.9 Cultural Resources

No significant impacts would be expected to cultural resources for either the no-project or project alternatives. On-site surveys and subsurface testing indicate an expected absence of resources in the immediate vicinity of screen extension construction activities. Previously identified resources in the area would be avoided through on-site flagging and worker education. The lead agencies have obtained concurrence from the State Historic Preservation Office on a finding of no effect to significant historic resources.

5.1.10 Socioeconomics

Increased restrictions at the HCPP, and subsequent increased use of groundwater and recaptured water, substantially increased (approximately doubled) water delivery costs in the early 1990s for GCID water users. Increases in water delivery costs above those experienced in the early 1990s would be expected for the no-project alternative. Increased reliance on recaptured water under the no-project alternative could cause growers to switch to more salinity-tolerant and less water-intensive crops. Changes would be a function of market conditions, government farm programs, local infrastructure, regional farm management practices, and extra-regional changes in cropping patterns.

5.1.11 Transportation and Traffic Safety

No potentially significant impacts to transportation and traffic safety would be expected under the no-project alternative. Under the project alternatives with a gradient facility, local access roads and private lands on the east side of the river (e.g., Wilson Landing Road) would not be expected to support construction traffic and would experience potentially significant impacts. Impacts would be mitigated to less-than-significant levels with an access management plan that would be developed in consultation with affected landowners.

5.1.12 Air Quality

No potentially significant effects would be expected with either the no-project or project alternatives. Emissions from construction equipment and dust from staging areas and roads would result under all project alternatives, but would be mitigated through vehicle emissions control and dust control measures.

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C-085786

5.2 Environmentally Superior Alternative

The environmentally superior alternative is the alternative that minimizes substantial, or potentially substantial, changes in the physical environment and meets the project objectives to the extent possible. The proposed project represents fisheries mitigation for GCID's diversions on the Sacramento River at HCPP. The proposed project would have substantial, long-term beneficial impacts to fisheries. Significant and potentially significant, short-term adverse impacts to other resources would occur from construction activities, including short-term adverse impacts to aquatic resources. On balance, the significant long-term beneficial impacts of increased fish protection would substantially outweigh the significant and potentially significant short-term adverse impacts to aquatic and other resources.

Protection of fishery resources at the HCPP includes reliability in the long-term performance of the fish screen. The history of local river gradient changes indicates that such future river changes are likely within the 50-year life of the project. The need to minimize the potential water surface gradient changes in the project vicinity is just as critical to long-term fish protection as other considerations such as screen mesh density and approach velocity.

Some level of environmental risk is associated with each of the alternatives, since it is impossible to predict with certainty the future of regional river meander and water surface gradient changes that could affect the proposed project. With such changes, the screen extension alternative could fail as previous screens have failed. Alternatives that include a gradient facility would provide substantial additional certainty to the long-term success and performance of the fish screen extension alternative. Despite the increased impacts to other environmental resources, alternatives that include a screen extension and gradient facility would be considered environmentally superior to the screen extension alternative and no-project alternative because of the significant improvements in long-term fish screen performance and protection.

Another issue in evaluating alternatives is the uncertainty in the scientific community regarding the anticipated impact of screen exposure time on juvenile chinook salmon. There is insufficient data available to reliably assess the impact trade-offs between increased screen exposure time and diverting chinook salmon fry through an internal bypass system to reduce screen exposure. The uncertainty of the relative benefits of an internal fish bypass system indicates a need for flexibility in screen design that would allow for monitoring and then operation of the fish screens with or without an internal bypass system. Alternatives including a fish bypass with the ability to open and close the internal bypass system would provide this flexibility and be environmentally superior to alternatives without this feature.

An unresolved issue is the effect of prolonged travel time on juvenile fish passing through an enclosed fish bypass system. Experts disagree on what constitutes excessive amounts of time for juvenile fish in a bypass system. The two bypass options for this project (return to oxbow and return to river) would involve substantial differences in transport time. Because of concerns that the return to river option would have longer transport times and place the fish in a location of the

C-085787

C-085787

river where predation can be expected, the return to oxbow option has been identified as the environmentally superior option.

In summary, a gradient facility provides additional certainty to long-term fish screen performance and fish protection, and an internal fish bypass system provides flexibility to assess performance trade-offs between increased screen exposure time and routing fish through a closed bypass system. For these reasons, the screen extension with gradient facility and internal fish bypass (return to oxbow) is considered the environmentally superior alternative.

5.3 Agency Preferred Alternative

Since 1988, technical advisory groups (Section 1.7, Public and Agency Consultation and Coordination) for the project have worked toward a design that meets the project objectives (Section 1.4, Project Objectives). Alternatives considered by the group have covered a broad range of screen and non-screen options (Section 2.5, Alternatives Considered and Eliminated from Further Analysis). Extensive fishery resources, design feasibility, and HCPP operation studies have been completed. Existing fish screen facilities throughout the western United States have also been investigated to assess successes and failures.

In parallel with project planning activities, an Agency Management Group (AMG), consisting of management-level representatives from agencies cooperating in the planning and design of the project, has met regularly to review progress, receive briefings on key design considerations, and address policy issues. At times, the AMG has served as a forum to resolve differences in agency policies. At other times, special work groups have assembled to address differences in expert opinions on resource protection issues. Examples include the differing California Department of Fish and Game and National Marine Fisheries Service policies for exposure time of juvenile fish to screens, and agency staff expert opinions on the definition of special-status Resource Category 1 SRA Cover habitat that would be affected by all alternatives. Addressing and resolving these types of issues among the technical staff and decision-makers has made the design selection and impact evaluation process more difficult and time consuming than what normally is required for lead agencies to independently complete.

In December 1996, after eight years of study, the Technical Advisory Group (TAG) and AMG addressed the question concerning what would constitute state-of-the-art, reliable fish protection at HCPP. With the support of a TAG recommendation and results of technical, economic and environmental studies performed over the years, the AMG unanimously identified the screen extension with gradient facility and internal fish bypass as the agency preferred alternative. Of the return to oxbow and return to river options, the AMG endorsed the return to oxbow design as its preferred option.

C—085788

C-085788

C-085789

Table 5.1-1 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions

Impact Topic		No Project[a]		Screen Extension[a]		Screen Extension With Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River	
		Change	Signif.	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Hydrology and Water Resources											
Simulated Average	October	0	LS	0	LS	0	LS	0	LS	0	LS
Monthly Flow	November	0	LS	0	LS	0	LS	0	LS	0	LS
(Percent Change)	December	0	LS	0	LS	0	LS	0	LS	0	LS
in the Sacramento	January	0	LS	0	LS	0	LS	0	LS	0	LS
River Downstream	February	0	LS	0	LS	0	LS	0	LS	0	LS
of RBDD	March	0	LS	0	LS	0	LS	0	LS	0	LS
Existing	April	0	LS	0	LS	0	LS	0	LS	0	LS
Hydrology (cfs) [c]	May	-262 (-2.6%)	LS	+78 (0.8%)	LS	+79 (0.8%)	LS	+79 (0.8%)	LS	+79 (0.8%)	LS
	June	-649 (-6.5%)	LS	+386 (3.8%)	LS	+387 (3.8%)	LS	+387 (3.8%)	LS	+387 (3.8%)	LS
	July	-583 (-5.1%)	LS	+205 (1.8%)	LS	+205 (1.8%)	LS	+205 (1.9%)	LS	+205 (1.9%)	LS
	August	+100 (1.1%)	LS	+761 (8.3%)	LS	+765 (8.3%)	LS	+765 (8.3%)	LS	+765 (8.3%)	LS
	September	0	LS	0	LS	0	LS	0	LS	0	LS
Simulated Average	October	NA	NA	0	LS	0	LS	0	LS	0	LS
Monthly Flow	November			0	LS	0	LS	0	LS	0	LS
(Percent Change)	December			0	LS	0	LS	0	LS	0	LS
in the Sacramento	January			0	LS	0	LS	0	LS	0	LS
River Downstream	February			0	LS	0	LS	0	LS	0	LS
of RBDD	March			0	LS	0	LS	0	LS	0	LS
2020 Hydrology	April			0	LS	0	LS	0	LS	0	LS
(cfs) [c]	May			+356 (3.6%)	LS	+356 (3.6%)	LS	+356 (3.6%)	LS	+356 (3.6%)	LS
	June			+1041(11%)	LS	+1047(11%)	LS	+1047(11%)	LS	+1047(11%)	LS
	July			+788 (6.7%)	LS	+788 (6.7%)	LS	+788 (6.7%)	LS	+788 (6.7%)	LS
	August			+691 (6.9%)	LS	+694 (6.9%)	LS	+694 (6.9%)	LS	+694 (6.9%)	LS
	September			0	LS	0	LS	0	LS	0	LS

B = Beneficial impact
LS = Less-than-significant impact
PS = Potentially significant impact
S = Significant impact

NA = Not applicable
na = Not available
ND = Not detectable, less than 1% change

C-085790

Table 5.1-1 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

Impact Topic		No-Project[a]		Screen Extension[a]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River	
		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Hydrology and Water Resources (Continued)											
Simulated Average	October	0.0	LS	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Monthly	November	0.0	LS	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Temperature in the	December	0.0	LS	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Sacramento River	January	0.0	LS	0.0	LS	0.0	LS	0.0	LS	0.0	LS
at Vina	February	0.0	LS	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Existing	March	0.0	LS	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Hydrology (°F)[c]	April	0.0	LS	0.0	LS	0.0	LS	0.0	LS	0.0	LS
	May	+0.1	LS	0.0	LS	0.0	LS	0.0	LS	0.0	LS
	June	+0.2	LS	-0.1	LS	-0.1	LS	-0.1	LS	-0.1	LS
	July	+0.2	LS	0.0	LS	0.0	LS	0.0	LS	0.0	LS
	August	0.0	LS	-0.2	LS	-0.2	LS	-0.2	LS	-0.2	LS
	September	0.0	LS	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Simulated Average	October	NA	NA	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Monthly	November			0.0	LS	0.0	LS	0.0	LS	0.0	LS
Temperature in the	December			0.0	LS	0.0	LS	0.0	LS	0.0	LS
Sacramento River	January			0.0	LS	0.0	LS	0.0	LS	0.0	LS
at Vina	February			0.0	LS	0.0	LS	0.0	LS	0.0	LS
2020 Hydrology	March			0.0	LS	0.0	LS	0.0	LS	0.0	LS
(°F)[c]	April			0.0	LS	0.0	LS	0.0	LS	0.0	LS
	May			0.0	LS	0.0	LS	0.0	LS	0.0	LS
	June			-0.4	LS	-0.4	LS	-0.4	LS	-0.4	LS
	July			-0.2	LS	-0.2	LS	-0.2	LS	-0.2	LS
	August			-0.2	LS	-0.2	LS	-0.2	LS	-0.2	LS
	September			0.0	LS	0.0	LS	0.0	LS	0.0	LS
Simulated GCID	HCPP[c]	-137	PS	+80	B	+80	B	+80	B	+80	B
Average Annual	Stony Creek[c]	+14	LS	0	LS	0	LS	0	LS	0	LS
Deliveries by	Recapture[c]	+18	LS	-3	LS	-3	LS	-3	LS	-3	LS
Supply Source -	TCC[c]	+83	LS	-65	LS	-65	LS	-65	LS	-65	LS
Existing	Groundwater	+23	PS	-10	B	-10	B	-10	B	-10	B
Hydrology (1000s ac-ft)											

C-085791

Table 5.1-1 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

Impact Topic		No-Project[a]		Screen Extension[a]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River	
		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Hydrology and Water Resources (Continued)											
Simulated GCID Average Annual Deliveries by Supply Source - **2020 Hydrology** (1000s ac-ft)	HCPP[c]	NA	NA	+220	B	+220	B	+220	B	+220	B
	Stony Creek[c]			-14	LS	-14	LS	-14	LS	-14	LS
	Recapture[c]			-21	LS	-21	LS	-21	LS	-21	LS
	TCC[c]			-152	LS	-152	LS	-152	LS	-152	LS
	Groundwater			-31	B	-31	B	-31	B	-31	B
Electrical Conductivity (Salinity) in the Colusa Basin Drain		Potential for Increase	PS	Potential to stabilize	B	Potential to stabilize	B	Potential to stabilize	B	Potential to stabilize	B
Pesticide Exceedances		Potential for Increase	PS	Potential to stabilize	B	Potential to stabilize	B	Potential to stabilize	B	Potential to stabilize	B
River Channel Stability		Continued risk of meander	PS	Continued risk of meander	PS/PS	Reduced risk of meander	B	Reduced risk of meander	B	Reduced risk of meander	B
Flooding Potential During Construction		None		None		Low risk	LS	Low risk	LS	Low risk	LS
Aquatic Resources											
Maximum Approach Velocity	12/1 - 4/30[d]	-0.27	B	-0.27	B	-0.27	B	-0.27	B	-0.27	B
	5/1 - 5/15[d]	-0.07	B	-0.07	B	-0.07	B	-0.07	B	-0.07	B
	5/15 - 8/1[d]	-0.27	B	-0.27	B	-0.27	B	-0.27	B	-0.27	B
	8/1 - 11/30[d]	0	LS	0	LS	0	LS	0	LS	0	LS
Average Approach Velocity (ft/s)[e]	5,000 cfs[e]	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Decrease	B
	7,000 cfs[f]	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Decrease	B
	10,000 cfs[f]	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Decrease	B
	20,000 cfs[f]	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Decrease	B
Average Sweeping Velocity	5,000 cfs	na	na	No difference	LS	Increase	B	Increase	B	Increase	B
	7,000 cfs	na	na	No difference	LS	Increase	B	Increase	B	Increase	B
	10,000 cfs	na	na	No difference	LS	Increase	B	Increase	B	Increase	B
	20,000 cfs	na	na	No difference	LS	Increase	B	Increase	B	Increase	B
Proportion of River Flow Diverted Into the Oxbow[g]	5,000 cfs	Decrease	B	Increase	PS/PS	+2%	PS/PS	+1%	PS/PS	+1%	PS/PS
	7,000 cfs	Decrease	B	Increase	PS/PS	+5%	PS/PS	+5%	PS/PS	+5%	PS/PS
	10,000 cfs	Decrease	B	Increase	PS/PS	+5%	PS/PS	+4%	PS/PS	+4%	PS/PS
	20,000 cfs	Decrease	B	Increase	PS/PS	+6%	PS/PS	+6%	PS/PS	+5%	PS/PS

C-085792

Table 5.1-1 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

		No-Project[a]		Screen Extension[a]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
								Return to Oxbow		Return to River	
Impact Topic		**Change**	**Signif.[b]**	**Change**	**Signif.[b]**	**Change**	**Signif.[b]**	**Change**	**Signif.[b]**	**Change**	**Signif.[b]**
Aquatic Resources (Continued)											
Changes in Water Quality (Aquatic Habitat)	Construction	Decrease	LS	Decrease	LS	Decrease	LS	Decrease	LS	Decrease	LS
Maximum Screen Exposure Time Between Bypasses (minutes)[h]		No Change		+7	PS/PS	+7	PS/PS	+1	LS	+1	LS
Impingement		Somewhat Improve	B	Improve	B	Improve	B	Improve	B	Improve	B
Entrainment		Somewhat Improve	B	Improve	B	Improve	B	Improve	B	Improve	B
Time of Transport in Internal Bypass System (minutes)[i]		na	na	No bypass		No bypass		-1 to +1	LS	+8 to +17	PS/PS
Internal Bypass Hydraulic Performance		Improved[j]	B	No bypass		No bypass		Improved[j]	B	Improved[j]	B
Percent of Lower Oxbow Greater Than 2 ft/s[k]	5,000 cfs	na	na	na	na	+100	B	+66	B	+28	B
	7,000 cfs	na	na	na	na	+55	B	+57	B	0	S
	10,000 cfs	na	na	na	na	+100	B	+86	B	+64	B
	20,000 cfs	na	na	na	na	+100	B	+100	B	+100	B
Percent of Upper Oxbow Greater Than 2 ft/s[k] (percent change)	5,000 cfs	na	na	na	na	0	LS	0	LS	0	LS
	7,000 cfs	na	na	na	na	-10(11%)	PS/PS	-10(11%)	PS/PS	-10(11%)	PS/PS
	10,000 cfs	na	na	na	na	-2 (2%)	PS/PS	-16(18%)	PS/PS	-16(18%)	PS/PS
	20,000 cfs	na	na	na	na	+34(64%)	B	+17(32%)	B	+17(32%)	B
Predation	Construction	Negligible Increase	LS	Increase	LS	Increase	LS	Increase	LS	Increase	LS
	Operations										
	5,000 cfs	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
	7,000 cfs	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
	10,000 cfs	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
	20,000 cfs	Decrease	B	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
Acres of Aquatic (Riverine) Habitat	Temporary	-3.7	LS	-3.7	LS	-5.4	LS	-5.4	LS	-5.4	LS
	Permanent	-8.9	LS	-8.9	LS	-22.3	LS	-22.3	LS	-24.1	LS

C-085793

Table 5.1-1 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

Impact Topic		No-Project[a] Change	No-Project[a] Signif.[b]	Screen Extension[a] Change	Screen Extension[a] Signif.[b]	Screen Extension with Gradient Facility Change	Screen Extension with Gradient Facility Signif.[b]	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow Change	Return to Oxbow Signif.[b]	Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River Change	Return to River Signif.[b]
Aquatic Resources (Continued)											
SRA Cover[l]	Acres/ Linear Feet	-0.55/2,412	PS	-0.72/3,127	PS/PS	-1.5/6,522	PS/PS	-1.5/6,522	PS/PS	-1.5/6,522	PS/PS
Natural Erodible Shoreline	Acres/ Linear Feet	-0.61/2,677	LS	-0.78/3,392	LS	-1.22/5,329	LS	-1.22/5,329	LS	-1.22/5,329	LS
Chinook Salmon Percent Change in Rearing Habitat between RBDD and HCPP (Juveniles/Fry)[m] **Existing Hydrology**	April May June July August September	0 ND/+2 -1/-11 ND/-2 ND/ND 0	LS LS LS LS LS LS	0 ND/+2 ND/+2 ND/+2 +2/+7 0	LS B B B B LS	0 ND/+2 ND/+2 ND/+2 +2/+7 0	LS B B B B LS	0 ND/+2 ND/+2 ND/+2 +2/+7 0	LS B B B B LS	0 ND/+2 ND/+2 ND/+2 +2/+7 0	LS B B B B LS
Chinook Salmon Percent Change in Rearing Habitat between RBDD and HCPP (Juveniles/Fry)[m] **2020 Hydrology**	April May June July August September	NA	NA	0 +4/+2 +1/+14 +3/+12 -2/+22 0	LS B B B B LS	0 +4/+2 +1/+14 +3/+12 -2/+22 0	LS B B B B LS	0 +4/+2 +1/+14 +3/+12 -2/+22 0	LS B B B B LS	0 +4/+2 +1/+14 +3/+12 -2/+22 0	LS B B B B LS
Estimated Early Life Stage Mortality for Chinook Salmon in the Upper Sacramento River[n]	All Four Runs Chinook Salmon	No change	LS	Potential to decrease	B	Potential to decrease	B	Potential to decrease	B	Potential to decrease	B
Downstream Migration of Juvenile Fish	Construction Operations	Some change Improved	BLS B	Disrupt Improved	PS/PS B	Disrupt Improved	S/S B	Disrupt Improved	S/S B	Disrupt Improved	S/S B
Upstream Migration of Adult Fish	Construction Operations	No change No change	LS LS	Potential to disrupt Potential to disrupt	LS LS	Potential to disrupt Potential to disrupt	LS LS	Potential to disrupt Potential to disrupt	LS LS	Potential to disrupt Potential to disrupt	LS LS

C-085793

C-085794

Table 5.1-1 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

		No-Project[a]		Screen Extension[a]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
								Return to Oxbow		Return to River	
Impact Topic		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Geology and Soils											
Seismic Events	Lateral Deformation	Constructed slopes	LS	Constructed slopes	LS	Constructed slopes	LS	Constructed slopes	LS	Constructed slopes	LS
	Settlement of Soils	Low to moderate potential	LS	Low to moderate potential	LS	Low to moderate potential	LS	Low to moderate potential	LS	Low to moderate potential	LS
Recreation and Navigation											
Months of Disruption to Recreational Boating	Construction	3	PS	18	PS/LS	23	S/LS	23	S/LS	23	S/LS
Hunting and Fishing Opportunities	Construction	Somewhat reduced	LS	Reduced	LS	Reduced	LS	Reduced	LS	Reduced	LS
	Operation	Somewhat reduced	LS	Reduced	LS	Reduced	LS	Reduced	LS	Reduced	LS
Potential Boating Hazards in River	Construction	No change	LS	No change	LS	Increase	S/LS	Increase	S/LS	Increase	S/LS
	Operation	No change	LS	No change	LS	Increase	S/LS	Increase	S/LS	Increase	S/LS
Potential Boating Hazards in Oxbow	Construction	Increase	PS	Increase	PS/LS	Increase	PS/LS	Increase	PS/LS	Increase	PS/LS
	Operation	Increase	LS	Increase	LS	Increase	LS	Increase	LS	Increase	LS
Terrestrial Biology											
Riparian Habitat (acres) [o,p]	Permanent	-0.5	LS	-1.9	PS/LS	-10.2	PS/LS	-10.2	PS/LS	-10.2	PS/LS
Wetland Habitat (acres) [o,p]	Permanent	No change	LS	No change	LS	-2.3	S/LS	-2.3	S/LS	-2.3	S/LS
Scrub/Willow Habitat (acres) [o,p]	Permanent	No change	LS	No change	LS	-1.0	PS/LS	-1.0	PS/LS	-1.0	PS/LS
Elderberry Stems (Lost or Trans-planted) [o]	Permanent	No change	LS	-153	S/LS	-442	S/LS	-442	S/LS	-442	S/LS
Swainson's Hawk Nests [o]	Temporary	2 nest sites potentially affected	PS	2 nest sites potentially affected	PS/LS	2 nest sites potentially affected	PS/LS	2 nest sites potentially affected	PS/LS	2 nest sites potentially affected	PS/LS

C-085794

C-085795

Table 5.1-1 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

Impact Topic		No-Project[a]		Screen Extension[a]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River	
		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Terrestrial Biology (Continued)											
Bank Swallow Nesting Sites [o]	Permanent	1 potential site affected	PS	1 potential site affected	PS/LS	2 potential sites affected	PS/LS	2 potential sites affected	PS/LS	2 potential sites affected	PS/LS
Visual Resources											
New Dredge Spoil Stockpile Area	Operation	5 acres up to 25 feet high	LS	5 acres up to 25 feet high	LS	5 acres up to 25 feet high	LS	5 acres up to 25 feet high	LS	5 acres up to 25 feet high	LS
Soil and Vegetation Disturbance (# of Key Viewpoints)	Oxbow	1	PS	1	PS/LS	1	PS/LS	1	PS/LS	1	PS/LS
	Sacramento River	0	LS	0	LS	3	PS/LS	3	PS/LS	3	PS/LS
	Montgomery Island	0	LS	0	LS	2	PS/LS	2	PS/LS	2	PS/LS
Riprap (linear ft)	Sacramento River	0	LS	0	LS	8,000	S/S [q]	8,000	S/S [q]	8,000	S/S [q]
	Lower Oxbow	2,600	S	2,600	S/S [q]	2,600	S/S [q]	2,600	S/S [q]	2,600	S/S [q]
Land Use											
Change in Land Use	Operation	Shift to Salt-Tolerant Crops	PS	No change	LS	No change	LS	No change	LS	No change	LS
Potential Conflict with County Zoning	Construction	No change	NA	Zoning change	LS	Zoning change	LS	Zoning change	LS	Zoning change	LS
Noise											
Construction Activity Noise	Construction	75 dB at 50 ft.	LS	75 dB at 50 ft.	LS	75 dB at 50 ft.	LS	75 dB at 50 ft.	LS	75 dB at 50 ft.	LS
Cultural Resources											
Documented Sites	Construction	None	LS	None	LS	None	LS	None	LS	None	LS
Undocumented Sites	Construction	Potential disturbance	PS	Potential disturbance	PS/LS	Potential disturbance	PS/LS	Potential disturbance	PS/LS	Potential disturbance	PS/LS

C—085795

C-085796

Table 5.1-1 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions (Continued)

		No-Project[a]		Screen Extension[a]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to Oxbow		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River	
Impact Topic		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Transportation and Traffic Safety											
Traffic Volume on Public Roads During Construction (trips/day)	Canal Road	+100	LS	+150	LS	+200	LS	+200	LS	+200	LS
	Wilson Landing Road	No change	LS	No change	LS	+200	PS/LS	+200	PS/LS	+200	PS/LS
Traffic Volume on Private Roads (trips/day)	Parcel 047-400-003	No change	LS	No change	LS	+200	PS/LS	+200	PS/LS	+200	PS/LS
Air Quality											
Emissions	Construction	Somewhat increase	LS	Increase	LS	Increase	LS	Increase	LS	Increase	LS
Dust and Particulate Matter (PM_{10})	Construction	Somewhat increase	LS	Increase	LS	Increase	LS	Increase	LS	Increase	LS

C—085796

C-085797

Footnotes to Table 5.1-1 - Comparison of No-Project and Project Alternatives Relative to Existing Conditions

B = Beneficial impact	NA = Not applicable
LS = Less-than-significant impact	na = Not available
PS = Potentially significant impact	ND = Not detectable, less than 1% change
S = Significant impact	

[a] The impacts shown under this alternative are based on current river gradient. If the river gradient were to lower substantially, further changes would be expected. No-project design, impacts, and mitigation would be considered in a separate CEQA review process if none of the project alternatives are selected for implementation.

[b] Impact significance before/after mitigation. Where impacts would be less than significant (LS), no mitigation is recommended. Certain impact designations represent consideration of two or more impact conclusions as presented in Chapter 4, Impact Analyses.

[c] Changes shown for indirect impact assessment. Impacts from flow and temperature are described in the Aquatic Resources section.

[d] Based on physical model studies (Reclamation 1996e).

[e] 1,000 cfs diversion rate.

[f] 3,000 cfs diversion rate.

[g] Based on data provided by Ayres Associates (1996d and 1997a). Quantitative data for the no-project and screen extension alternatives are not available.

[h] This estimate is based on a river flow of 7,000 cfs and a diversion rate of 3,000 cfs.

[i] These estimates assume a 3-10 ft/s bypass flow.

[j] The bypass system would have improved hydraulics at the bypass bays, within the bypass pipe, and at the outfall.

[k] Calculations shown are based on data provided by Ayres Associates (1997b). Data shown for percentage of oxbow greater than 2 ft/s were used to make the impact determination under "predation."

[l] Shoreline impacts were analyzed under two categories: Resource Category 1 SRA Cover and natural erodible shoreline.

[m] Based on change in weighted usable area (WUA) (DWR 1993).

[n] Based on modeled temperature decreases in the upper Sacramento River.

[o] These numbers and the actual occurrence of a species in question would be verified during final site surveys based on final design.

[p] For the purposes of this analysis, all riparian and wetland impacts are considered permanent. In the development of mitigation, scrub/willow habitat would be combined with riparian habitat.

[q] Significance shown for short-term impacts. Long-term impacts would be less than significant after natural revegetation.

C-085797

Table 5.1-2 - Comparison of Project Alternatives Relative to No-Project Conditions
(Data in bold represent differences from Table 5.1-1)

	No-Project			Screen Extension[a]		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
								Return to Oxbow		Return to River	
Impact Topic	Condition	Impact		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Hydrology and Water Resources											
Simulated Average	7,089	0	October	0	LS	0	LS	0	LS	0	LS
Monthly Flow	8,401	0	November	0	LS	0	LS	0	LS	0	LS
(Percent Change)	13,152	0	December	0	LS	0	LS	0	LS	0	LS
in the Sacramento	15,119	0	January	0	LS	0	LS	0	LS	0	LS
River below RBDD	18,150	0	February	0	LS	0	LS	0	LS	0	LS
No-Project	14,139	0	March	0	LS	0	LS	0	LS	0	LS
Hydrology (cfs) [c]	10,913	0	April	0	LS	0	LS	0	LS	0	LS
	9,896	-262	May	**+340 (3.4%)**	LS	**+341 (3.4%)**	LS	**+341 (3.4%)**	LS	**+341 (3.4%)**	LS
	9,414	-649	June	**+1035 (11.0%)**	LS	**+1036 (11.0%)**	LS	**+1036 (11.0%)**	LS	**+1036 (11.0%)**	LS
	10,879	-583	July	**+788 (7.2%)**	LS	**+788 (7.2%)**	LS	**+788 (7.2%)**	LS	**+788 (7.2%)**	LS
	9,285	+100	August	**+661 (7.1%)**	LS	**+665(7.2%)**	LS	**+665(7.2%)**	LS	**+665(7.2%)**	LS
	7,821	0	September	0	LS	0	LS	0	LS	0	LS
Simulated Average	6,059	NA	October	0	LS	0	LS	0	LS	0	LS
Monthly Flow	8,278	NA	November	0	LS	0	LS	0	LS	0	LS
(Percent Change)	12,947	NA	December	0	LS	0	LS	0	LS	0	LS
in the Sacramento	15,224	NA	January	0	LS	0	LS	0	LS	0	LS
River below RBDD	18,537	NA	February	0	LS	0	LS	0	LS	0	LS
2020 Hydrology	14,413	NA	March	0	LS	0	LS	0	LS	0	LS
(cfs) [c]	11,023	NA	April	0	LS	0	LS	0	LS	0	LS
	9,773	NA	May	+356 (3.6%)	LS	+356 (3.6%)	LS	+356 (3.6%)	LS	+356 (3.6%)	LS
	9,436	NA	June	+1041(11%)	LS	+1047(11%)	LS	+1047(11%)	LS	+1047(11%)	LS
	11,765	NA	July	+788 (6.7%)	LS	+788 (6.7%)	LS	+788 (6.7%)	LS	+788 (6.7%)	LS
	9,976	NA	August	+691 (6.9%)	LS	+694 (6.9%)	LS	+694 (6.9%)	LS	+694 (6.9%)	LS
	6,531	NA	September	0	LS	0	LS	0	LS	0	LS

B = Beneficial impact
LS = Less-than-significant impact
PS = Potentially significant impact
S = Significant impact

NA = Not applicable
na = Not available
ND = Not detectable, less than 1% change

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C-085798

C-085799

Table 5.1-2 - Comparison of Project Alternatives Relative to No-Project Conditions (Continued)
(Data in bold represent differences from Table 5.1-1)

	No Project			Screen Extension		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
								River to Oxbow		Return to River	
Impact Topic	**Condition**	**Impact**		**Change**	**Signif.[b]**	**Change**	**Signif.[b]**	**Change**	**Signif.[b]**	**Change**	**Signif.[b]**
Hydrology and Water Resources (Continued)											
Simulated Average	55.7	0	October	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Monthly	51.4	0	November	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Temperature in the	46.7	0	December	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Sacramento River	44.5	0	January	0.0	LS	0.0	LS	0.0	LS	0.0	LS
at Vina	47.9	0	February	0.0	LS	0.0	LS	0.0	LS	0.0	LS
No-Project	51.8	0	March	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Hydrology (°F)	55.6	0	April	0.0	LS	0.0	LS	0.0	LS	0.0	LS
	58.3	+0.1	May	**-0.1**	LS	**-0.1**	LS	**-0.1**	LS	**-0.1**	LS
	60.6	+0.2	June	**-0.3**	LS	**-0.3**	LS	**-0.3**	LS	**-0.3**	LS
	61.1	+0.2	July	**-0.2**	LS	**-0.2**	LS	**-0.2**	LS	**-0.2**	LS
	61.4	0	August	**-0.2**	LS	**-0.2**	LS	**-0.2**	LS	**-0.2**	LS
	58.7	0	September	0.0	LS	0	LS	0.0	LS	0.0	LS
Simulated Average	56.2	NA	October	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Monthly	51.3	NA	November	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Temperature in the	46.6	NA	December	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Sacramento River	44.5	NA	January	0.0	LS	0.0	LS	0.0	LS	0.0	LS
at Vina	47.8	NA	February	0.0	LS	0.0	LS	0.0	LS	0.0	LS
2020 Hydrology	51.8	NA	March	0.0	LS	0.0	LS	0.0	LS	0.0	LS
(°F)	55.6	NA	April	0.0	LS	0.0	LS	0.0	LS	0.0	LS
	58.3	NA	May	0.0	LS	0.0	LS	0.0	LS	0.0	LS
	60.7	NA	June	-0.4	LS	-0.4	LS	-0.4	LS	-0.4	LS
	60.4	NA	July	-0.2	LS	-0.2	LS	-0.2	LS	-0.2	LS
	60.9	NA	August	-0.2	LS	-0.2	LS	-0.2	LS	-0.2	LS
	60.0	NA	September	0.0	LS	0.0	LS	0.0	LS	0.0	LS
Simulated GCID	452	-137	HCPP[c]	**+217**	B	**+217**	B	**+217**	B	**+217**	B
Average Annual	26	+14	Stony Creek[c]	**-14**	LS	**-14**	LS	**-14**	LS	**-14**	LS
Deliveries by	145	+18	Recapture[c]	**-21**	LS	**-21**	LS	**-21**	LS	**-21**	LS
Supply Source	149	+83	TCC[c]	**-149**	LS	**-149**	LS	**-149**	LS	**-149**	LS
No-Project	33	+23	Groundwater	**-33**	B	**-33**	B	**-33**	B	**-33**	B
Hydrology (1000s											
ac-ft)											

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C-085800

Table 5.1-2 - Comparison of Project Alternatives Relative to No-Project Conditions (Continued)
(Data in bold represent differences from Table 5.1-1)

	No Project			Screen Extension		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass: River to Oxbow		Screen Extension with Gradient Facility and Internal Fish Bypass: Return to River	
Impact Topic	**Condition**	**Impact**		**Change**	**Signif.[b]**	**Change**	**Signif.[b]**	**Change**	**Signif.[b]**	**Change**	**Signif.[b]**
Hydrology and Water Resources (Continued)											
Simulated GCID Average Annual Deliveries by Supply Source - **2020 Hydrology** (1000s ac-ft)	450 26 145 152 31	NA NA NA NA NA	HCPP[c] Stony Creek[c] Recapture[c] TCC[c] Groundwater	+220 -14 -21 -152 -31	B LS LS LS B	+220 -14 -21 -152 -31	B LS LS LS B	+220 -14 -21 -152 -31	B LS LS LS B	+220 -14 -21 -152 -31	B LS LS LS B
Electrical Conductivity (Salinity) in the Colusa Basin Drain	Increased	Potential to Increase		**Potential to decrease**	B	**Potential to decrease**	B	**Potential to decrease**	B	**Potential to decrease**	B
Pesticide Exceedances	Exceeds	Potential to Increase		**Potential to decrease**	B	**Potential to decrease**	B	**Potential to decrease**	B	**Potential to decrease**	B
River Channel Stability	Continued Risk of Meander	Risk of Meander		No difference	PS	Reduced risk of meander	B	Reduced risk of meander	B	Reduced risk of meander	B
Flooding Potential During Construction	None	None		None		Low risk	LS	Low risk	LS	Low risk	LS
Aquatic Resources											
Maximum Approach Velocity (ft/s)	0.33 0.33 0.33 0.33	Improve Improve Improve Improve	12/1 - 4/30[d] 5/1 - 5/15[d] 5/15 - 8/1[d] 8/1 - 11/30[d]	**No difference** **No difference** **No difference** **No difference**	**LS** **LS** **LS** LS	**No difference** **No difference** **No difference** **No difference**	**LS** **LS** **LS** LS	**No difference** **No difference** **No difference** **No difference**	**LS** **LS** **LS** LS	**No difference** **No difference** **No difference** **No difference**	**LS** **LS** **LS** LS
Average Sweeping Velocity	na	na	5,000 cfs 7,000 cfs 10,000 cfs 20,000 cfs	No difference No difference No difference No difference	LS LS LS LS	Increase Increase Increase Increase	B B B B	Increase Increase Increase Increase	B B B B	Increase Increase Increase Increase	B B B B

C—085800

C-085801

Table 5.1-2 - Comparison of Project Alternatives Relative to No-Project Conditions (Continued)
(Data in bold represent differences from Table 5.1-1)

	No Project			Screen Extension		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
								River to Oxbow		Return to River	
Impact Topic	**Condition**	**Impact**		**Change**	**Signif.[b]**	**Change**	**Signif.[b]**	**Change**	**Signif.[b]**	**Change**	**Signif.[b]**
Aquatic Resources (Continued)											
Proportion of River Flow Diverted Into the Oxbow [g]	Decreased	Improve	5,000 cfs	**Increase**	PS/PS	**Increase**	PS/PS	**Increase**	PS/PS	**Increase**	PS/PS
			7,000 cfs	**Increase**	PS/PS	**Increase**	PS/PS	**Increase**	PS/PS	**Increase**	PS/PS
			10,000 cfs	**Increase**	PS/PS	**Increase**	PS/PS	**Increase**	PS/PS	**Increase**	PS/PS
			20,000 cfs	**Increase**	PS/PS	**Increase**	PS/PS	**Increase**	PS/PS	**Increase**	PS/PS
Water Quality (Aquatic Resources)	Decreased	Increase Turbidity	Construction	Decrease	LS	Decrease	LS	Decrease	LS	Decrease	LS
Maximum Screen Exposure Time Between Bypasses [h] (minutes)	2	Negligible		+7	PS/PS	+7	PS/PS	+1	LS	+1	LS
Impingement	na	Improve		**Somewhat improve**	**LS**	Improve	B	Improve	B	Improve	B
Entrainment	na	Improve		**Somewhat improve**	**LS**	Improve	B	Improve	B	Improve	B
Time of Transport in Internal Bypass System (minutes) [i]	na	na		No bypass		No bypass		-1 to +1	LS	+8 to +17	PS/PS
Internal Bypass Hydraulic Performance	Somewhat Improved	Somewhat Improve		No bypass		No bypass		Improve	B	Improve	B
Predation	Negligible		Construction	Increase	LS	Increase	LS	Increase	LS	Increase	LS
	Somewhat Decreased	Somewhat Improve	Operations 5,000 cfs	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
			7,000 cfs	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
			10,000 cfs	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
			20,000 cfs	Decrease	B	Decrease	B	Decrease	B	Increase	PS/PS
Acres of Aquatic (Riverine) Habitat	118.1	3.7	Temporary	**No difference**	LS	**-1.7**	LS	**-1.7**	LS	**-1.7**	LS
	118.1	8.9	Permanent	**No difference**	LS	**-13.4**	LS	**-13.4**	LS	**-13.4**	LS
SRA Cover [l]	2.77/12,029	.55/2,412	Acres/ Linear Feet	**-0.16/715**	PS/PS	**-0.94/4,110**	PS/PS	**-0.94/4,110**	PS/PS	**-0.94/4,110**	PS/PS

C-085802

Table 5.1-2 - Comparison of Project Alternatives Relative to No-Project Conditions (Continued)
(Data in bold represent differences from Table 5.1-1)

	No Project			Screen Extension		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
								River to Oxbow		Return to River	
Impact Topic	Condition	Impact		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Aquatic Resources (Continued)											
Natural Erodible Shoreline	2.34/10,185	.61/2,677	Acres/ Linear Feet	**-0.16/715**	LS	**0.80/3,517**	LS	**-0.80/3,517**	LS	**-0.80/3,517**	LS
Chinook Salmon Percent Change in Rearing Habitat Between RBDD and HCPP [m] (Juveniles/Fry) (1000s sq. ft.) **No-Project Hydrology**	174/245 174/230 169/210 171/245 170/210 149/180	0 ND/+2 -1/-11 ND/-2 ND/ND 0	April May June July August September	**0** **-1/ ND** **+1/+14** **ND/+4** **+2/+7** **0**	LS LS B B B LS	**0** **-1/ ND** **+1/+14** **ND/+4** **+2/+7** **0**	LS LS B B B LS	**0** **-1/ ND** **+1/+14** **ND/+4** **+2/+7** **0**	LS LS B B B LS	**0** **-1/ ND** **+1/+14** **ND/+4** **+2/+7** **0**	LS LS B B B LS
Chinook Salmon Percent Change in Rearing Habitat Between RBDD and HCPP [m] (Juveniles/Fry) (1000s sq. ft.) **2020 Hydrology**	173/250 165/230 169/210 186/250 174/230 153/165	NA NA NA NA NA NA	April May June July August September	0 +4/+2 -1/+14 +3/+12 -2/+22 0	LS B B B B LS	0 +4/+2 -1/+14 +3/+12 -2/+22 0	LS B B B B LS	0 +4/+2 -1/+14 +3/+12 -2/+22 0	LS B B B B LS	0 +4/+2 -1/+14 +3/+12 -2/+22 0	LS B B B B LS
Estimated Early Life Stage Mortality for Chinook Salmon in the Upper Sacramento River [n]	9 1 15 12	0 0 0 0	All Four Runs of Chinook Salmon	Potential to decrease	B	Potential to decrease	B	Potential to decrease	B	Potential to decrease	B
Downstream Migration of Juvenile Fish	Potentially Disrupted	Negligible Disruption Reduce Disruption	Construction Operations	Disrupt Improved	PS/PS B	Disrupt Improved	S/S B	Disrupt Improved	S/S B	Disrupt Improved	S/S B

C-085803

Table 5.1-2 - Comparison of Project Alternatives Relative to No-Project Conditions (Continued)
(Data in bold represent differences from Table 5.1-1)

	No Project			Screen Extension		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
								River to Oxbow		Return to River	
Impact Topic	Condition	Impact		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Aquatic Resources (Continued)											
Upstream Migration of Adult Fish	No Change		Construction	Potential to disrupt	LS	Potential to disrupt	LS	Potential to disrupt	LS	Potential to disrupt	LS
	No Change		Operations	Potential to disrupt	LS	Potential to disrupt	LS	Potential to disrupt	LS	Potential to disrupt	LS
Geology and Soils											
Seismic Events	NA		Lateral Deformation	Constructed slopes	LS	Constructed slopes	LS	Constructed slopes	LS	Constructed slopes	LS
	NA		Settlement of Soils	Low to moderate potential	LS	Low to moderate potential	LS	Low to moderate potential	LS	Low to moderate potential	LS
Recreation and Navigation											
Months of Disruption to Recreational Boating	Disruption	3	Construction	**15**	PS/LS	**20**	S/LS	**20**	S/LS	**20**	S/LS
Hunting and Fishing Opportunities	Somewhat Reduced	Reduced Access	Construction	Reduced	LS	Reduced	LS	Reduced	LS	Reduced	LS
			Operation	Reduced	LS	Reduced	LS	Reduced	LS	Reduced	LS
Potential Boating Hazards in River	No Change		Construction	No change	LS	Increase	S/LS	Increase	S/LS	Increase	S/LS
	No Change		Operation	No change	LS	Increase	S/LS	Increase	S/LS	Increase	S/LS
Potential Boating Hazard in Oxbow	Increased	Increase in Obstructions	Construction	Increase	PS/LS	Increase	PS/LS	Increase	PS/LS	Increase	PS/LS
	Increased	Increase in Obstructions	Operation	Increase	LS	Increase	LS	Increase	LS	Increase	LS
Terrestrial Biology											
Riparian Habitat (acres)[o,p]	226.5	-0.5	Permanent	**-1.4**	PS/LS	**-9.7**	PS/LS	**-9.7**	PS/LS	**-9.7**	PS/LS
Wetland Habitat (acres)[o,p]	8.6	0	Permanent	No change	LS	-2.3	S/LS	-2.3	S/LS	-2.3	S/LS

C—085803

C-085804

Table 5.1-2 - Comparison of Project Alternatives Relative to No-Project Conditions (Continued)
(Data in bold represent differences from Table 5.1-1)

	No Project			Screen Extension		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
								River to Oxbow		Return to River	
Impact Topic	Condition	Impact		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Terrestrial Biology (Continued)											
Scrub/Willow Habitat (acres)[o,p]	3.3	0	Permanent	No change	LS	-1.0	PS/LS	-1.0	PS/LS	-1.0	PS/LS
Elderberry Stems (Lost or Trans-planted)[o]	na	0	Permanent	-153	S/LS	-442	S/LS	-442	S/LS	-442	S/LS
Swainson's Hawk Nests[o]	2	2	Temporary	**No change**	**LS**	**No change**	**LS**	**No change**	**LS**	**No change**	**LS**
Bank Swallow Nesting Sites[o]	2	1	Permanent	**No change**	**LS**	**1 potential site affected**	PS/LS	**1 potential site affected**	PS/LS	**1 potential site affected**	PS/LS
Visual Resources											
Optional Dredge Spoil Stockpile Area	5 acres up to 25 feet high	5 acres up to 25 feet high	Operation	**No change**	LS	**No change**	LS	**No change**	LS	**No change**	LS
Soil and Vegetation Disturbance (# of Key Viewpoints)	1 3 3	1 0 0	Oxbow Sacramento River Montgomery Island	**0** 0 0	**LS** LS LS	**0** 3 2	**LS** PS/LS PS/LS	**0** 3 2	**LS** PS/LS PS/LS	**0** 3 2	**LS** PS/LS PS/LS
New Riprap (linear ft)	0 3,600	0 2,600	Sacramento River[q] Lower Oxbow[q]	0 **0**	LS **LS**	8,000 **0**	S/S[q] **LS**	8,000 **0**	S/S[q] **LS**	8,000 **0**	S/S[q] **LS**
Land Use											
Change in Land Use	Increase in Salt-Tolerant Crops	Increase in Salt-Tolerant Crops	Operation	**Decrease in salt-tolerant crops**	**B**	**Decrease in salt-tolerant crops**	**B**	**Decrease in salt-tolerant crops**	**B**	**Decrease in salt-tolerant crops**	**B**
Potential Conflict with County Zoning	No Conflicts		Construction	Zoning change	LS	Zoning change	LS	Zoning change	LS	Zoning change	LS

C—085804

C-085805

Table 5.1-2 - Comparison of Project Alternatives Relative to No-Project Conditions (Continued)
(Data in bold represent differences from Table 5.1-1)

	No Project			Screen Extension		Screen Extension with Gradient Facility		Screen Extension with Gradient Facility and Internal Fish Bypass			
								River to Oxbow		Return to River	
Impact Topic	Condition	Impact		Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]	Change	Signif.[b]
Noise											
Construction Activity Noise	75 dB at 50 ft.	75 dB at 50 ft	Construction	**No change**	LS	**No change**	LS	**No change**	LS	**No change**	LS
Cultural Resources											
Documented Sites	4	0	Construction	None	LS	None	LS	None	LS	None	LS
Undocumented Sites	na	Potential disturbance	Construction	Potential disturbance	PS/LS	Potential disturbance	PS/LS	Potential disturbance	PS/LS	Potential disturbance	PS/LS
Transportation and Traffic Safety											
Traffic Volume on Public Roads During Construction (trips/day)	1,478	100	Canal Road	**+50**	LS	**+100**	LS	**+100**	LS	**+100**	LS
	380	0	Wilson Landing Road	No change	LS	+200	PS/LS	+200	PS/LS	+200	PS/LS
Traffic Volume on Private Roads	na	0	Parcel 047-400-003	No change	LS	+200	PS/LS	+200	PS/LS	+200	PS/LS
Air Quality											
Emissions	Somewhat Increased	Somewhat Increase	Construction	Increase	LS	Increase	LS	Increase	LS	Increase	LS
Dust and Particulate Matter (PM_{10})	Somewhat Increased	Somewhat Increase	Construction	Increase	LS	Increase	LS	Increase	LS	Increase	LS

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C-085806

Footnotes to Table 5.1-2 - Comparison of Project Alternatives Relative to No-Project Conditions

B = Beneficial impact	NA = Not applicable
LS = Less-than-significant impact	na = Not available
PS = Potentially significant impact	ND = Not detectable, less than 1% change
S = Significant impact	

[a] The impacts shown under this alternative are based on current river gradient. If the river gradient were to lower substantially, further changes would be expected. No-project design, impacts, and mitigation would be considered in a separate CEQA review process if none of the project alternatives are selected for implementation.

[b] Impact significance before/after mitigation. Where impacts would be less than significant (LS), no mitigation is recommended. Certain impact designations represent consideration of two or more impact conclusions as presented in Chapter 4, Impact Analyses.

[c] Changes shown for indirect impact assessment. Impacts from flow and temperature are described in the Aquatic Resources section.

[d] Based on physical model studies (Reclamation 1996e).

[e] 1,000 cfs diversion rate.

[f] 3,000 cfs diversion rate.

[g] Based on data provided by Ayres Associates (1996d and 1997a). Quantitative data for the no-project and screen extension alternatives are not available.

[h] This estimate is based on a river flow of 7,000 cfs and a diversion rate of 3,000 cfs.

[i] These estimates assume a 3-10 ft/s bypass flow.

[j] The bypass system would have improved hydraulics at the bypass bays, within the bypass pipe, and at the outfall.

[k] Calculations shown are based on data provided by Ayres Associates (1997b). Data shown for percentage of oxbow greater than 2 ft/s were used to make the impact determination under "predation."

[l] Shoreline impacts were analyzed under two categories: Resource Category 1 SRA Cover and natural erodible shoreline.

[m] Based on change in weighted usable area (WUA) (DWR 1993).

[n] Based on modeled temperature decreases in the upper Sacramento River.

[o] These numbers and the actual occurrence of a species in question would be verified during final site surveys based on final design.

[p] For the purposes of this analysis, all riparian and wetland impacts are considered permanent. In the development of mitigation, scrub/willow habitat would be combined with riparian habitat.

[q] Significance shown for short-term impacts. Long-term impacts would be less than significant after natural revegetation.

C-085806

Chapter 6
Mitigation and Monitoring

C-085807
C-085807

6.0 ENVIRONMENTAL COMMITMENTS AND MITIGATION AND MONITORING

This chapter describes the Environmental Commitments, mitigation, and monitoring and evaluation programs that could be implemented to minimize adverse environmental effects and ensure compliance with permit conditions. Environmental Commitments are included in the alternatives description in Chapter 2 and are summarized in Section 6.1.

Two distinct monitoring and evaluation programs are described in Section 6.3 and Section 6.4. The Environmental Compliance and Mitigation Monitoring Program (ECMMP) (Section 6.3) is the master program for tracking the requirements, implementation schedule, and responsibility for mitigation measures adopted for the approved project. The ECMMP would also assess the success of mitigation activities as required by Public Resources Code (California Environmental Quality Act (CEQA) Statutes) Section 21081.6 and Council on Environmental Quality (CEQ) Regulations Sections 1505.2(c) and 1505.3. It would further ensure that the project is in compliance with conditions of permits issued.

The second monitoring program, the Fish Protection Evaluation and Monitoring Program (FPEMP), is presented in Section 6.4 and would specifically focus on the performance of the fish screen, gradient facility and fish bypass system. The FPEMP would evaluate the success of project features with regard to meeting project objectives (i. e., minimizing losses of all fish in the vicinity of the pumping plant diversion, and re-establishing reliability in Glenn-Colusa Irrigation District's (GCID) ability to divert its full allocation of water.)

Scheduling of ECMMP and FPEMP tasks would be coordinated by the lead agencies. **Table 6.1-1** shows the implementing responsibilities for ECMMP and FPEMP tasks relative to project phase. **Figure 6.1-1** shows the linkages between the major components of the proposed mitigation and monitoring tasks and project planning and construction phases.

Reporting to lead and permitting agencies would be an important component of the monitoring programs. Information gathered through implementation of the ECMMP and the FPEMP regarding construction, mitigation, restoration, and performance of the fish screen and associated structures would be regularly summarized and distributed to lead and permitting agencies.

6.1 Environmental Commitments

Environmental Commitments are measures incorporated into the project design to avoid or minimize project impacts and include those measures described in Section 2.3 (Project Design Considerations) and Section 2.4 (Alternatives). These commitments specify mitigation measures for the selected alternative and must be carried out by a lead agency or delegated to another party via written agreement (Reclamation 1996h). The Environmental Commitments for the project include the following:

C-085808

C-085808

Table 6.1-1 - Preliminary Schedule and Responsibilities for Environmental Commitments, Compliance and Mitigation Monitoring

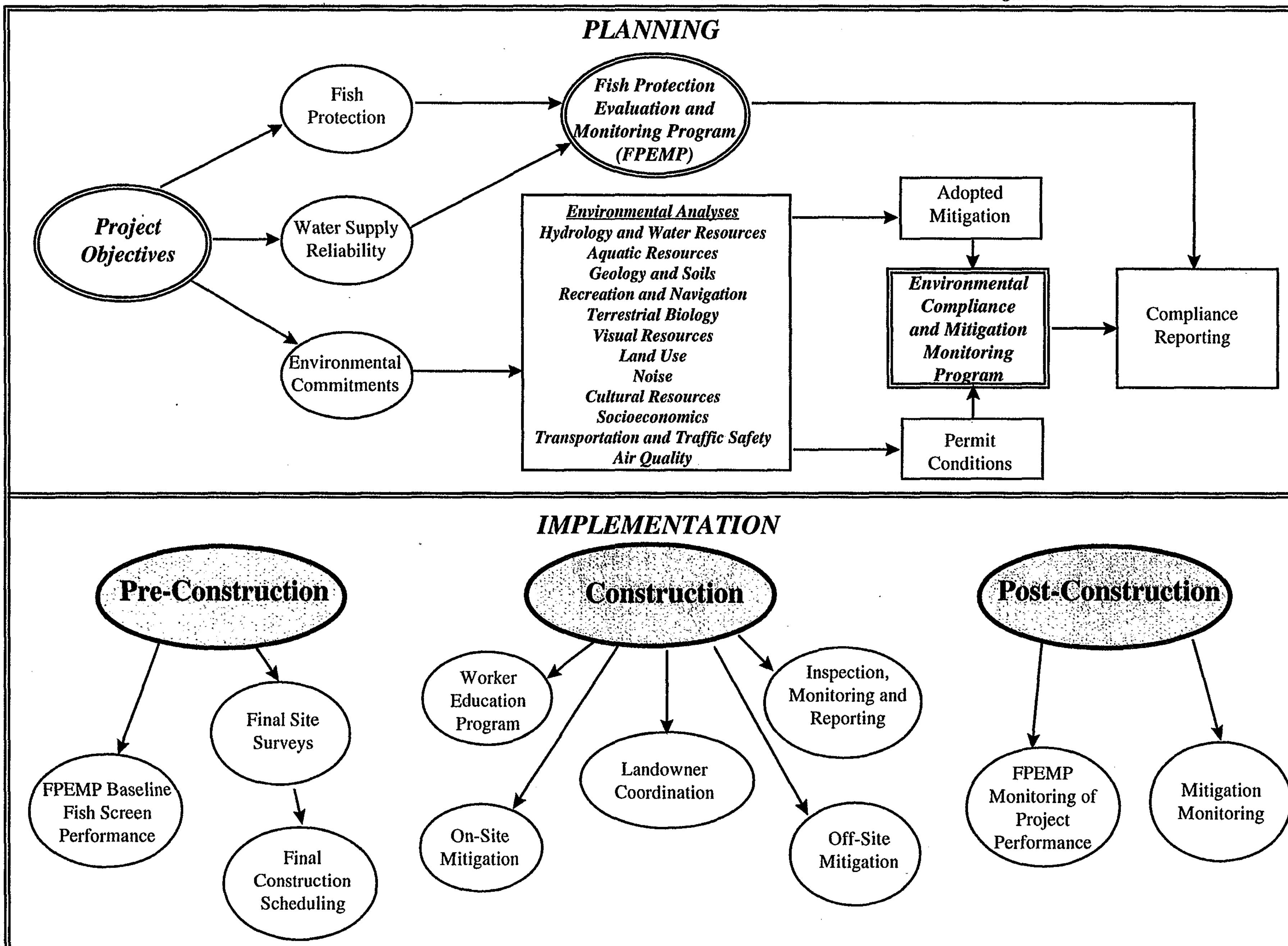
Project Phase	Task	Implementing Responsibility[a]
Pre-Construction Planning	Identify Environmental Commitments.	GCID
	Develop mitigation measures.	U.S. Bureau of Reclamation
• EIR/EIS Process	Develop Environmental Compliance and Mitigation Monitoring Program (ECMMP).	(Reclamation) California Department of
• Project Final Design and Scheduling	Develop Access Management Plan.	Fish and Game (CDFG) U.S. Army Corps of Engineers
	Develop Fish Protection Evaluation and Monitoring Program (FPEMP).	(Corps) ~~GCID~~
	~~Implement FPEMP for baseline data collection on existing fish protection features.~~	~~Reclamation~~
	Prepare on-site terrestrial mitigation plan.	
	Perform site surveys for mitigation lands and for project impact area species of concern.	~~GCID~~
	Consult with U.S. Fish and Wildlife Service (USFWS) regarding avoidance zones and periods for species of concern.	~~CDFG~~
	Coordinate construction schedules with avoidance zones and periods for species of concern.	~~GCID~~ ~~Reclamation~~
	Finalize mitigation measures and the ECMMP as part of the Final EIR/EIS.	~~GCID~~ ~~Reclamation~~
• NOD/ROD • Biological Opinions	Update mitigation requirements and ECMMP to conform with project approvals and permitting requirements.	~~CDFG~~
• Permits	Prepare off-site mitigation plan based on final project design.	GCID Corps
	Develop and implement boater information program.	
	Incorporate provisions of Environmental Commitments and mitigation measures into ~~draft~~ contractor bid documents.	~~GCID~~ ~~Reclamation~~
Construction Planning and Monitoring	Implement Access Management Plan.	
	Initiate worker education program.	GCID
	Implement construction reporting and compliance measures of ECMMP.	Reclamation Corps
	Initiate FPEMP for evaluation of project features as they are completed.	
Post-Construction Documentation and Monitoring	Post-construction environmental compliance summary.	
	Long-term mitigation and habitat ~~enhancement~~improvement/restoration monitoring.	GCID
	Continued monitoring of project feature performance under the FPEMP.	

[a] ~~Final determination of all responsibilities will be identified in Final EIR/EIS. Responsibilities for items related to the gradient facility are yet to be determined by the Corps.~~

C-085809

C-085809

FIGURE 6.1-1 - PLANNING AND IMPLEMENTATION OF MITIGATION AND COMPLIANCE MONITORING MEASURES FOR THE HAMILTON CITY PUMPING PLANT FISH SCREEN IMPROVEMENT PROJECT



C-085810
C-085810

- project design measures to maximize fish protection;
- standard construction contract specifications to minimize impacts to all resources;
- construction vehicle access management to promote efficient, safe access to construction areas and minimize public safety hazards;
- a mitigation measure tracking and reporting program (Section 6.3, Environmental Compliance and Mitigation Monitoring Program) to help ensure compliance with conditions of project approvals;
- on-site and/or off-site terrestrial habitat ~~enhancement~~ improvements, including riparian, wetland, and SRA Cover habitats, to compensate for project impacts; and
- the FPEMP described in Section 6.4 to confirm the success of the fish screen improvements.

6.2 Mitigation Measures Recommended for Project Features

In addition to the general environmental commitments identified above, the lead agencies (GCID, CDFG, Corps, and Reclamation) propose to minimize environmental impacts and to restore disturbed lands using all practicable means. Where avoidance would not be possible, specific measures are recommended in Chapter 4 (Impact Analyses) to protect environmental resources and to mitigate to a less-than-significant level when feasible.

Lead agency project approvals would include specific mitigation requirements based on preliminary design plans. Upon final design, mitigation measures and compensation requirements would be finalized based on final impact acreage, construction methods, and design features. Mitigation measures would also be modified to include commitments and conditions for permits, memoranda of agreement, and correspondence with other agencies and private entities.

The approach adopted for terrestrial habitat mitigation planning for this project included identifying specific mitigation options for categories of impacts. This included local and off-site mitigation areas (Figures 2.4-5 and 2.4-6). Further information on off-site mitigation lands is presented in Section 2.4.2.3 (Screen Extension Mitigation) and in **Table 6.2-1**. The ~~need for and/or selection of one or more~~ extent of habitat improvements necessary at off-site mitigation lands would be dependent upon final impact determination, on-site mitigation, and conditions of project approvals and permits.

Mitigation measures have been recommended in Chapter 4 (Impact Analyses) for potentially significant and significant environmental consequences of the project alternatives. These are compiled in Table S-4~~5~~.

C-085812

Table 6.2-1 - Potential Off-Site Compensation Areas Along the Sacramento River for the Hamilton City Pumping Plant Fish Screen Improvement Project

Site Location and Type					Restoration Potential					Potential Special-Status Species Habitat [a]		
No. [b]	River Mile and Bank	Acreage or Lineal Feet	Conservation Easement	Current Cover Type	Shaded Riverine Aquatic Cover	Riparian Habitat	Elderberry Habitat	Wetland Habitat	Erodible Bank	Bank Swallow	Yellow Billed Cuckoo	Swainson's Hawk
1	242.0 East	9.43 acres	✓	ed	✓						✓	✓
2	242.0 East	0.65 acres	✓	ed	✓						✓	✓
3	241.0 West	100 feet	✓	ed	✓						✓	✓
4	239.8 East	0.51 acres	✓	ed	✓						✓	✓
5	239.8 East	1.69 acres	✓	ed	✓						✓	✓
6	238.1 East	6.17 acres	✓	ed	✓						✓	✓
7	237.9 East	5.6 acres	✓	ed	✓						✓	✓
8	233.9 East	6.51 acres	✓	ed	✓						✓	✓
9	231.2 West	4.53 acres	✓	ed	✓						✓	✓
10	227.5 East	30 to 150 feet	✓	ed	✓						✓	✓
11	226.3 West	0.08 acres	✓	ed	✓						✓	✓
12	226.3 West	36.48 acres	✓	Fallow Row Crops and Riparian Forest	✓	✓	✓	✓			✓	✓

C-085812

C-085813

Table 6.2-1 - Potential Off-Site Compensation Areas Along the Sacramento River for the Hamilton City Pumping Plant Fish Screen Improvement Project (Continued)

Site Location and Type					Restoration Potential					Potential Special-Status Species Habitat [a]		
No. [b]	River Mile and Bank	Acreage or Lineal Feet	Conservation Easement	Current Cover Type	Shaded Riverine Aquatic Cover	Riparian Habitat	Elderberry Habitat	Wetland Habitat	Erodible Bank	Bank Swallow	Yellow Billed Cuckoo	Swainson's Hawk
13	215.3 West	5.5 acres	✓	ed	✓						✓	✓
14	215.3 West	2.33 acres	✓	ed	✓						✓	✓
15	215.0 West	1.57 acres	✓	ed	✓						✓	✓
16	215.0 West	7.24 acres	✓	ed	✓						✓	✓
17	209.5 West	3.4 acres	✓	ed	✓						✓	✓
18	209.0 West	10.0 acres	✓	ed	✓						✓	✓
19	208.6 to 209.3 East	141.8 acres	dc	Riparian Forest and Orchard	✓	✓	✓	✓			✓	✓
20	208.8 to 207.7 East	10.3 acres		Riparian Forest and Walnut Orchard	✓	✓	✓	✓	✓	✓	✓	✓
21	205 West	71.1 acres		Walnut Orchard	✓	✓	✓			✓	✓	✓
22	204.9 West	2.27 acres	✓	ed	✓		✓			✓	✓	✓

C-085813

C-085814

Table 6.2-1 - Potential Off-Site Compensation Areas Along the Sacramento River for the Hamilton City Pumping Plant Fish Screen Improvement Project (Continued)

Site Location and Type					Restoration Potential					Potential Special-Status Species Habitat [a]		
No. [b]	River Mile and Bank	Acreage or Lineal Feet	Conservation Easement	Current Cover Type	Shaded Riverine Aquatic Cover	Riparian Habitat	Elderberry Habitat	Wetland Habitat	Erodible Bank	Bank Swallow	Yellow Billed Cuckoo	Swainson's Hawk
23	202.3 to 205.1 Both	260 acres	dc	Riparian Forest, Wetland Habitat and Extensive Gravel Bar	✓	✓	✓	✓			✓	✓
24	186.5 Both	234.70 acres		Riparian Forest and Walnut Orchard	✓	✓	✓	✓	✓	✓	✓	✓
25	182.5 to 183 West	88 acres		Row Crop. Riparian Forest	✓	✓	✓	✓			✓	✓
26	174 West	192 acres		Riparian Forest and Walnut Orchard	✓	✓	✓	✓	✓	✓	✓	✓
27	168-169 West	42.06 acres		Walnut Orchard	✓	✓	✓		✓		✓	✓
28	205 West	71.7 acres		Walnut Orchard	✓	✓	✓	✓			✓	✓
29	206-208 East	40 acres	✓	Walnut Orchard	✓	✓	✓	✓	✓		✓	✓
30	173 West	2,400 ft.		Riparian Forest	✓	✓	✓		✓	✓	✓	✓

C-085815

Table 6.2-1 - Potential Off-Site Compensation Areas Along the Sacramento River for the Hamilton City Pumping Plant Fish Screen Improvement Project (Continued)

Site Location and Type					Restoration Potential					Potential Special-Status Species Habitat [a]		
No. [b]	River Mile and Bank	Acreage or Lineal Feet	Conservation Easement	Current Cover Type	Shaded Riverine Aquatic Cover	Riparian Habitat	Elderberry Habitat	Wetland Habitat	Erodible Bank	Bank Swallow	Yellow Billed Cuckoo	Swainson's Hawk
31	203 East	3,000 ft.		Riparian Forest	✓	✓	✓		✓	✓	✓	✓
32	209 East	1,500 ft.		Riparian Forest	✓	✓	✓		✓	✓	✓	✓
33	222 East	7,500 ft.		Riparian Forest	✓	✓	✓	✓	✓	✓	✓	✓

[a] Where the presence of special status species is noted, the species could currently occur or could have occurred historically within the bounds of the site or on nearby habitats. It is also important to note that yellow-billed cuckoos, bank swallows, and Swainson's hawks have been reported throughout the Sacramento River corridor. Due to their mobility, they would likely colonize new areas of suitable habitat.

[b] Refers to the site number specified on Figure 2.4-6, ~~the~~ a map of the Sacramento River corridor.

[c] Owned by CDFG.

[d] These properties are narrow strips of land associated with levees and bank protection. Therefore, it is difficult to characterize their habitat type from aerial photographs. These sites are under conservation easements that require the owner to let the site naturally revegetate or be actively restored with native vegetation. These sites could provide SRA Cover or riparian habitat.

C-085815

6.3 Environmental Compliance and Mitigation Monitoring Program

The ECMMP would provide the mechanism for tracking the requirements, implementation schedule, responsibility, and success of mitigation measures adopted for the approved project. Required measures to mitigate or avoid significant effects on the environment would be monitored and reported on through the ECMMP.

Two important criteria for the success of this compliance and monitoring program are:

- the program must ensure that all environmental conditions of project approval are met during the pre-construction, construction, and post-construction/restoration phases of the project; and

- the program would coordinate inspection, monitoring, and reporting activities of the lead and cooperating agencies.

As the CEQA lead agencies, GCID and CDFG would adopt the ECMMP for the project pursuant to CEQA requirements under Public Resources Code Section 21081.6 and CEQ Regulations Sections 1505.2(c) and 1505.3. As the lead Federal agencies for the project, Reclamation and the Corps would specify mitigation measures through their National Environmental Policy Act (NEPA) Record of Decision for the project. While there are some jurisdictional differences between these two sets of requirements, the ECMMP would fulfill both requirements. If any changes to mitigation ~~and enhancement~~ programs are agreed upon by the lead agencies during any project phase, or are required as part of a permit or other project approval, the ECMMP would incorporate and track these changes.

The ECMMP would be broken into three phases: pre-construction, construction, and post-construction. Pre-construction activities would include:

- final siting and scheduling of construction activities;

- final special-status resource inventories;

- development of sub-programs that would include a transportation access management plan, terrestrial habitat (on-site and off-site) mitigation plan (to include mitigation for impacts to riparian, wetland, and SRA Cover habitats), a spill prevention and counter-measure plan, a boater information program, and a worker education program; and

- incorporation of permit, Endangered Species Act, and EIR/EIS approval requirements into bid documents.

During the construction period, ECMMP activities would include:

- monitoring and reporting on construction contractor compliance with project mitigation ~~and enhancement~~ measures;
- implementation of on-site and off-site mitigation requirements; and
- coordination of compliance reporting and related communications between the lead agencies.

Post-construction activities under the ECMMP would include:

- a post-construction environmental compliance summary; and
- on-site and off-site mitigation and restoration ~~and enhancements monitoring~~.

6.3.1 Pre-construction Planning

Environmental protection measures identified during environmental planning and engineering design would be incorporated into construction planning for the project. GCID, Reclamation, and the Corps would work during the pre-construction phase to facilitate understanding of environmental requirements for contractors, workers and field inspectors and to site and schedule construction with regard to special-status resources. To reduce the potential for redundancies in efforts and increase the success of mitigation, the lead agencies propose to designate one representative that would be responsible for coordinating mitigation requirements among the agencies.

Certain preconstruction activities have already been completed (e.g., subsurface archaeological testing and VELB surveys). Other resource surveys would be completed prior to start of construction. These activities include final resource inventories, finalizing proposed schedules and project feature locations; and developing a transportation access management plan, a terrestrial habitat mitigation plan, a spill prevention and counter-measure plan, a boater information program, and a worker education program.

6.3.1.1 Resource Inventories and Final Construction Scheduling and Siting

The lead agencies have completed preliminary resource inventories to allow assessment of potential environmental impacts and identification of mitigation measures. Inventory results for each resource area are discussed in Chapter 3 (Affected Environment) and Chapter 4 (Impact Analyses) of this document. Final environmental inventories would be conducted preceding construction.

Construction activities could impact critical life history stages of special concern species. **Table 6.3-1** depicts considerations for construction scheduling and siting to avoid or minimize impacts to potential habitats for species of special concern.

C-085817

C-085817

Table 6.3-1 - Timing Considerations for Species of Special Concern and Construction Activities

Species	Construction Activities Which Could Affect Species of Concern	Species of Concern Avoidance Periods[a]
Bank Swallow	Gradient Facility Construction/Oxbow Modification	Apr. - Aug.[b]
Osprey	Oxbow Modification, Gradient Facility Construction	mid Mar. - Sept.[b]
Yellow-Billed Cuckoo	Oxbow Modification, Gradient Facility Construction	Jun. – mid Sept.[c]
Swainson's Hawk	Oxbow Modification, Gradient Facility Construction	mid Mar. - Sept.[d]
Spring-run Chinook Salmon	Installation and Removal of Cofferdams	Nov - July[h]
Winter-run Chinook Salmon	Installation and Removal of Cofferdams, Oxbow Modification	mid Jul. - mid May[e]
Steelhead	Installation and Removal of Cofferdams	Jan. - Feb.[f]
Splittail	Installation and Removal of Cofferdams, Oxbow Modification, Gradient Facility Construction	Mar. - May[g]
Green Sturgeon	Installation and Removal of Cofferdams, Oxbow Modification, Gradient Facility Construction	May - Aug.[g]
Valley Elderberry Longhorn Beetle (Elderberry Shrub Transplanting)[i]	Fish Screen Extension, Oxbow Modification, Gradient Facility Construction	Feb. 15 - Nov.

[a] Avoidance periods and zones may be modified pending final site surveys for special concern species.
[b] R. Schlorff, pers. comm., 1997.
[c] J. Gustafson, pers. comm., 1997.
[d] Avoidance Zone = 0.5 mile radius (Estep 1989); R. Schlorff, pers. comm., 1997.
[e] California Department of Fish and Game (1993); D. McKee, pers. comm., 1996.
[f] P. Ward, pers. comm., 1997.
[g] CDFG data on occurrence at HCPP (J. Brown, pers. comm., 1996)
[h] Spring-run chinook salmon fry less than 40 mm may occur at HCPP from Nov - Feb; juvenile spring-run chinook salmon may occur at HCPP from May - Jul (Vogel and Marine 1991; USFWS 1995b).
[i] USFWS (1996b).

Figure 4.5-1 displays known elderberry shrub locations (habitat for VELB), in relation to the project footprint and 50-foot buffer area for elderberry cluster avoidance. Final resource inventories would include identifying any elderberry shrubs that could not be transplanted due to a low probability of the plant surviving, the likelihood of additional impacts to riparian habitat in attempting to transplant an impacted shrub, or excessive difficulty or worker hazard in transplanting the shrub. Plans for elderberry shrub transplanting would comply with USFWS (1996b) guidelines. Initial elderberry transplants would occur from the screen extension area to Wilson Landing, lands owned by CDFG and identified as a suitable transplant site by USFWS and CDFG. Wilson Landing is shown on Figure 2.4-5.

Many potential impacts could be avoided by scheduling construction and siting of project features with special concern resources in mind. The final site survey for species of special concern would identify potential avoidance and buffer zones. Conflicts between construction windows for specific species would be addressed through prioritization of listing status and significance of the impact(s) on that species. If prioritization could not resolve these conflicts, consultation with resource agencies would allow determination of the construction schedule that best meets the needs of each species while achieving project goals.

Table 6.3-2 provides a proposed schedule of site surveys for special-status species in the project vicinity. Nesting and roosting areas would be noted. Reports and maps would be prepared that describe avoidance areas and periods.

Table 6.3-2 - Proposed Schedule of Site Surveys for Species of Special Concern

Species	Survey Dates
Bank Swallow	~~late May - April~~ April - Early August
Osprey	~~late April - March~~ Late March - Early September
Yellow-Billed Cuckoo	~~late May - mid June~~ Mid-June - Early September
Swainson's Hawk	~~late April - March~~ Late March - Early September

6.3.1.2 Development of Sub-Programs

~~Four~~ Five sub-programs to the ECMMP would be developed prior to construction: a transportation access management plan, a terrestrial habitat mitigation plan, a spill prevention and counter-measure plan, a boater information program, and a worker education program. As outlined in Section 4.11, a transportation access management plan would be developed to promote efficient, safe access to construction staging areas. The following would be considered in this plan:

- The ability of access routes to accommodate high levels of construction vehicle and truck traffic. Factors would include road width, surface conditions, vertical clearance, and potentially affected adjacent habitat.
- Securing necessary easements from the landowner, including consideration of improvement and maintenance costs, restoration activities, and damage provisions.
- Ensuring the safety of local residents/workers potentially affected by construction traffic. Notices would be posted and/or sent to such individuals to inform them about the expected changes in traffic levels, and reasonable accommodations to help ensure safety (e.g., temporary fencing and slower construction speed limits would be considered).

Options have been developed to mitigate for terrestrial habitat impacts identified in Chapter 4 (Impact Analyses) and Appendix A (Biological Assessment). Since preparation of the Draft EIR/EIS, ~~A plan would be developed to identify, design, and implement~~ on-site and~~/or~~ off-site mitigation options have been refined and a specific proposal (Parcel No. 037-100-002) has been developed ~~measures necessary~~ to mitigate terrestrial habitat impacts to less-than-significant levels. A proposed plan for Parcel No. 037-100-002 is identified in Section 2.4.2.3 (Screen Extension Mitigation). Extensive coordination activities have been completed with participating resource agencies to identify the basic elements and process for the plan. This includes consideration of measures to address the issues identified through Fish and Wildlife

C-085819

C-085819

Coordination Act (Appendix C) activities with the USFWS. The final plan would include the following components:

- vegetation clearing measures;
- revegetation;
- habitat ~~enhancements~~improvements to compensate for net habitat losses from the project; and
- elderberry transplanting process.

The spill prevention and counter-measure plan would be developed in accordance with local, State and federally-mandated oil and fuel containment measures. The spill prevention plan would be required by California Health and Safety Code Section 25270 if any tank on the construction site exceeds a storage capacity of 20,000 gallons or the storage facility exceeds 100,000 gallons. All precautions would be taken to avoid discharge or accidental spills and Material Safety Data Sheets would be kept on file. The plan would be incorporated into construction contracts for the project. This would include specific measures for containment and clean-up of spills to minimize impacts to Sacramento River water quality and aquatic resources.

Through public comments on the Draft EIR/EIS, a boater information program was recommended to further minimize potential adverse impacts from navigational hazards during construction and operation of the proposed project. Such a program would be developed in consultation with the Department of Boating and Waterways. The lead agencies propose to develop such a program that would include informational brochures for distribution at local, public and private river access points, through local bait and tackle businesses, and through commercial river outfitters in the area. Combined with proposed on-river signs and notices to public service entities (e.g., local law enforcement) during construction, the boater information program would further reduce potential impacts to navigation during construction and operation of the proposed project.

The worker education program would inform construction workers on the purpose and legal basis of protective measures for resources in the project area. Completion of the program would be required for all workers prior to their participation in on-site activities. Avoidance and protective measures for special-status species, species of concern, cultural resources and other important resources would be presented. The definition of "take" under State and Federal regulations for endangered species would be explained. Workers would also be instructed as to what activities would result in take and that unauthorized take (take other than that authorized by the agency having jurisdiction for the species i.e., CDFG, National Marine Fisheries Service (NMFS), or USFWS) is illegal, and that such activities would result in legal action. The Environmental Commitments of the project would be reviewed and explained in terms of construction activities. Each construction worker would be provided a brochure summarizing key environmental issues and would be asked to sign an acknowledgment form that they have been briefed on and understand the procedures to be implemented for protection of significant resources. A record containing the signed brochures will be kept on file at the on-site construction office.

6.3.2 Construction Monitoring

The primary goal of the mitigation and monitoring effort is to minimize impacts to all resources while effectively achieving project objectives. Properly executed construction practices and timely construction progress would mitigate short-term impacts. Long-term objectives include restoration (and compensation to the extent feasible) ~~and enhancement~~ of impacted resources to a condition equal to or better than what existed prior to initiation of project construction. These objectives would be met by instituting practices developed during final design and by utilizing practices described below. Inspection and monitoring during the construction and operational phases would ensure that these objectives are met.

Construction monitoring would include environmental compliance reporting, and coordinating communication efforts between the environmental representative ~~specialists~~, construction inspectors, and lead and permitting agencies. Brief descriptions of each of these activities are presented below.

6.3.2.1 Environmental Compliance Monitoring and Reporting

During the construction phase, an environmental ~~specialist~~ representative of the lead agencies would coordinate, inspect, and monitor all construction and mitigation activities among the agencies (i.e., GCID, Reclamation, and Corps) to ensure compliance with environmental plans, permits and conditions. General goals for the environmental inspection/ monitoring program during the construction period would be to:

- ensure proper implementation of all environmental commitments; and
- provide specialty monitors (e.g., raptor nesting specialist, qualified archaeologist, and fish passage specialist) on an as-needed basis.

The results of the environmental inspection and monitoring program would be documented on a regular basis. Special reports documenting unsatisfactory environmental conditions or non-compliance with environmental commitments would be provided to the lead agencies as these conditions arise.

A coding and filing system of environmental compliance ~~daily~~ records, which would allow for tracking of activities and areas for subsequent review or action, would be maintained by the environmental representative.

C-085821

C-085821

6.3.2.2 Communications

A critical component of a successful ECMMP would be timely, open, and regular communication between all parties. Regular meetings would be held between the environmental ~~monitor~~ representative and the construction supervisors to discuss upcoming environmental implications of construction activities, and to check on the adequacy of progress in resolving outstanding special reports on non-compliance events.

Should a situation arise that could result in an unacceptable environmental impact in which there is a clear conflict with environmental requirements and the time necessary for standard communications, the environmental ~~monitor~~ representative would take immediate action to have the specific tasks discontinued or redirected. Immediate notification would be made sequentially to the on-site construction supervisor and to the appropriate GCID/Reclamation/Corps construction managers. An example of such a situation would be if construction activities required necessary changes in the timing of cofferdam closure during downstream emigration of spring-run chinook salmon fry. Contingencies for such events would be formulated during pre-construction meetings. Communication via cellular phones and radio would facilitate quick response time in such situations.

6.3.3 Post-Construction Planning and Monitoring

Following construction and restoration, mitigation and monitoring activities specified under the ECMMP would continue for pre-determined periods. A post-construction compliance and mitigation evaluation summary would be prepared by the environmental ~~monitor~~ representative. ~~or another appropriate party.~~ Monitoring of restoration efforts would continue as required in the ECMMP for that resource. For example, monitoring could carry on for five years for general riparian restoration. Post-construction monitoring would also include evaluations of mitigation success relative to interim performance criteria and remediation of unsuccessful mitigation efforts.

6.3.3.1 Success and Interim Performance Criteria

Following construction, site-cleanup, and reclamation activities, lead agency representatives would evaluate disturbed areas to ascertain the effectiveness of erosion and sediment control measures and revegetation. Monitoring for native vegetation regrowth is recommended for not less than five years following revegetation.

Monitoring would include quantitative measurements and qualitative descriptions of plant establishment and any potential erosion features. Characteristics such as plant cover, plant density, plant vigor, community diversity, vegetative reproduction, and recruitment of reclaimed and revegetated areas would be established for characteristics of adjacent undisturbed communities. Success criteria would be based on each vegetation community type. For example, total cover in a revegetated riparian woodland would be compared to cover in an adjacent, undisturbed riparian woodland community.

C-085822

C-085822

6.3.3.2 Remediation of Unsuccessful Revegetation

Remedial measures would be taken as soon as practicable for problem areas identified during monitoring. Areas with poor germination and/or growth would be evaluated to determine causes of unsuccessful revegetation. Restoration techniques would be modified as necessary to address any identified problems.

6.4 Fish Protection Evaluation and Monitoring Program (FPEMP)

The project is being designed to minimize fish losses and provide reliability for GCID water diversions at the pumping plant. Numerous alternative screen designs and associated features have been evaluated to identify the preferred project alternative. The proposed fish screen, modifications to the oxbow, internal fish bypass system, and gradient facility include design objectives that would minimize the potential for direct (e.g., impingement and entrainment) and indirect (e.g., predation) mortality of juvenile salmonids and other fish species emigrating past GCID's screened diversion. Additionally, design objectives would minimize disruption of upstream migrating adults.

Throughout the fish screen improvement planning process, it has been recognized that fisheries and engineering evaluations would be required to determine if operating the new facilities meet project goals and if modifications would be needed. The lead and various resource agencies have recommended a Fish Protection Evaluation and Monitoring Program as a means to test the effectiveness and performance of any new facilities. The FPEMP would include baseline data collection (utilizing all past and ongoing studies), short-term, post-construction evaluations, and long-term monitoring of the ability of the project features to meet design criteria and project objectives. Monitoring of construction activities would be addressed separately as part of the ECMMP associated with the EIR/EIS, and would be distinct from the FPEMP.

The objectives of the FPEMP include:

- assure GCID and resource agencies that screen performance requirements are consistent with specified fish protection goals;
- identify potential instrumentation requirements during the screen design phase so that necessary instrumentation can be included as project features in the final screen design;
- develop an appropriate sequencing for data collection and initial evaluation and monitoring elements;
- evaluate the hydraulic and biologic performance of the improved fish screen and completed gradient facilities (Section 2.3, Project Design Considerations);

C-085823

C-085823

- identify corrective measures, as warranted, that would need to be implemented for the screen to consistently meet performance criteria (e.g., baffles or oxbow flow control structure operation specifications);

- identify the range of operations and operational parameters (i.e., degree of operational flexibility) of the fish screen that would best meet project goals and objectives;

- coordinate specific tasks in the FPEMP with the monitoring and mitigation plan (under the ECMMP) to maximize program efficiency, where feasible and appropriate;

- develop a mechanism to address resource agency input to and review of monitoring activities; and

- develop a long-term monitoring program based on the initial findings of the FPEMP that would include early identification of potential contingencies (unanticipated negative changes in river conditions) and a process for addressing and correcting such negative conditions (e.g., unintended migration barriers to fish, hazards to boaters, or oxbow channel flow conditions). The lead agencies would confer to identify the scope and magnitude of such a problem and, dependent upon the issue, take corrective action to minimize potential adverse effects.

In general, the initial findings of the FPEMP would be used to identify and direct implementation of corrective actions necessary to optimize performance of the project. The outline provided below identifies the issues to be addressed by the FPEMP and suggests an approach to evaluate these issues as they relate to key project features. Although the FPEMP would involve numerous analyses, the hydraulic evaluations to be performed for the screen, gradient facility, and lower oxbow are considered to be the highest priority, because design performance criteria for each of these project features were hydraulically defined. The hydraulic evaluation data would be used to determine how to adjust the screen baffles, the oxbow flow control structure and fish bypasses to meet project design criteria under various river flow and HCPP pumping rates. The additional water quality and biological surveys proposed as part of the FPEMP would provide valuable additional information to confirm that meeting design hydraulics would indeed result in an acceptable level of fishery resources protection at the HCPP facility.

A Guidance Manual for implementation of the FPEMP is scheduled to be completed by ~~December 1997~~spring 1998. This Guidance Manual would identify quantitative performance criteria by which key project features (e.g., screen, gradient facility) would be evaluated, as well as a statement of specific objectives for each major component of the FPEMP, data required to address those objectives, the exact technical methodologies to be employed, specific locations and schedules for data collection, range of river flow and HCPP pumping conditions to be evaluated, statistical and other appropriate data analyses required, and decision criteria for remedial actions, if needed.

In developing the Guidance Manual, it is recognized that steelhead and other fish species of concern must be considered in addition to chinook salmon. Furthermore, it would be reasonable

C-085824

C-085824

to intensify data collection efforts during specific periods of the year (e.g., periods of high HCPP pumping rates and migration periods for fish species of particular concern). This would be reflected in the detailed FPEMP schedule included in the Guidance Manual.

6.4.1 Project Performance Required to Achieve Adequate Fish Protection

The improved fish screen at the HCPP has been designed to meet CDFG and NMFS fish screening guidelines under a variety of Sacramento River flow and HCPP pumping conditions, in order to minimize impacts to fishery resources at this facility. The gradient facility has been designed to maintain water depths and current velocities along potential fish migration routes that would not be substantially different from those that exist within natural riffles of the upper Sacramento River, under a variety of flow conditions. In addition, hydraulics elsewhere within the gradient facility were designed to prevent predation rates within the facility from being substantially higher than predation rates within natural riffles of the upper Sacramento River. Finally, the lower oxbow channel would be modified to minimize disruption of immigration and emigration, including measures to minimize losses of emigrating fish to predation. The FPEMP has been developed to evaluate the degree to which these conceptual performance objectives would be met upon completion of the project. The detailed, quantitative performance criteria that would be used to evaluate screen and gradient facility performance and determine the need for remedial actions continue to be refined by the lead and resource agencies associated with the project. As stated above, the agreed-upon performance criteria to be used in the FPEMP would be disclosed in the Guidance Manual.

6.4.2 Data Collection to Facilitate Performance Evaluations of Project Features

Data collection is a key component of the FPEMP. Only by collecting the appropriate data can effective evaluations regarding performance of specific project components and the project as a whole be performed. Because it is of interest to compare hydraulic conditions following implementation of the preferred alternative to hydraulic conditions that currently exist in the project area (i.e., existing conditions), characterization of the existing condition is essential to future project evaluations. Consequently, baseline data collection should be initiated in 1997, and should make effective use of all past and ongoing studies of the HCPP facility. Following adequate characterization of the existing condition, the FPEMP would focus on monitoring hydraulic and other conditions at the screen, gradient facility, and oxbow throughout the first two years following completion of construction. Data collected would be analyzed to determine the degree to which project performance criteria were being met, and to determine whether any corrective actions would be warranted to achieve project performance goals.

Data collection under the FPEMP would occur prior to and following project construction activities.

C-085825

6.4.2.1 Baseline Data Collection

Objective: Collect sufficient pre-construction hydraulic, water quality, and biological data to adequately define the existing conditions so that future changes can be determined.

Hydraulic and Water Quality Data

Hydraulic and water quality data would be collected at the gradient facility site, within the upper oxbow, adjacent to the screen, and within the lower oxbow under a range of river flows and HCPP pumping conditions, beginning in ~~1997~~1998. This information would be used to refine the definition of the existing condition. Parameters of interest include:

- river flow rates;
- river stage at North Island, fish screen, and South Island;
- HCPP pumping rates;
- depth and velocity profiles within the gradient facility area, upper oxbow, at the screen, and lower oxbow;
- sedimentation within the gradient facility area; and
- water quality (e.g., temperature and turbidity).

Biological Data

Biological data of interest include:

- predatory fish distribution and relative abundance at the gradient facility site, upper oxbow, along the screen face, and within the lower oxbow;
- survival rates of young fish passing the screen;
- survival rates of young fish emigrating through the lower oxbow; and
- entrainment of salmonids behind the screen.

6.4.2.2 Post-Construction Data Collection

Data collection efforts undertaken to define the existing condition would be repeated following completion of the project features, with expanded and/or intensified data collection associated with various project features occurring as warranted. Field-collected hydraulic, water quality, and biologic data, as well as hydrodynamic modeling output for the screen, gradient facility, and lower oxbow, would then be evaluated with regard to the performance criteria defined in the Guidance Manual to evaluate the acceptability of project performance.

6.4.3 Performance Evaluation of Key Project Features

The specific periods and duration of monitoring for the various performance criteria defined for different project components would be identified in the Guidance Manual. Monitoring would be performed under a variety of river flow and HCPP pumping rates. The project features to be evaluated, parameters of interest associated with each project feature, and technically appropriate methodologies to be employed are discussed below.

6.4.3.1 Screen Performance Evaluation

Objective: Screen performance would be evaluated to determine whether the screen meets hydraulic performance criteria defined in the Guidance Manual under various river flow and HCPP pumping rates, debris loading/fouling levels, and internal bypass operations (i.e., all bays open, select bays open, or all bays closed). Additional studies would be performed to directly evaluate the relative degree of fish losses that would occur at the screen under different screen hydraulics dictated by different river flows, HCPP pumping rates, debris-accumulation levels, and bypass operation.

Approach and Sweeping Velocities

Approach and sweeping velocities would be measured at each screen panel under a range of river flow and HCPP pumping conditions. For each screen panel, approach and sweeping velocity measurements would be taken at multiple locations vertically and horizontally across the panel, and under various baffle configurations to evaluate the need for adjustment of the baffles under different flow conditions. Measurements would be made with and without the bypass system in operation, and when only one or two bypass bays are open. Debris levels on the front of the screen, as well as biological growth (i.e., algae, periphyton) on the back side of the screen, would be documented each time screen hydraulics were measured.

Channel Velocities

Vertical and/or cross-sectional channel velocities would be measured at pre-determined transects upstream and downstream of the fish screen under a range of river flow and HCPP pumping rates.

Exposure Time

Measurements of sweeping velocities would provide information that can be used to estimate exposure times for fish, concurrent with observations and/or mark and recapture studies.

Fish Losses Due to Impingement, Entrainment, and/or Predation

Estimates of juvenile salmon survival past the screen would be conducted when the bypass system is operational and non-operational, and under a variety of flow conditions. Salmonid survival at the screen would be evaluated using methodologies such as mark-recapture studies and/or through videographic documentation. Additional and specific methodologies to assess entrainment, impingement, and predation at the screen would be identified in the Guidance Manual.

6.4.3.2 Bypass System Performance Evaluation

Objective: Determine bypass bay hydraulic patterns and internal bypass velocities under various flow conditions. Additional bypass system evaluations would be performed in order to assess injury and survival of juvenile migratory fish passing through the bypass system under differing river flow and HCPP pumping rates. Data collected would be used to determine whether survival of fish passing at the screen is higher when the bypass system is operating or not operating. Finally, the hydraulic conditions under which the biological performance (i.e., low physical injury and high survival of bypassed fish) of the bypass system is optimal would be determined.

Hydraulics at the Bypass Bays and Outfall

Velocity profiles would be measured at several locations in front of the bypass bays and adjacent to the bypass outfall. Velocities at the entrances to bypass bays would be used to evaluate the effectiveness of bypass-bay hydraulics at pulling fish into the bypass system. Velocity profiles at the bypass outfall would be taken under a range of lower oxbow flows, and when the bypass system is operational and non-operational. These data would determine the nature of eddies or other hydraulic conditions that could exist at the bypass outfall under various flow conditions that could provide predator holding habitat.

Fish Survival/Relative Proportion of Fish Entering Bypass System

Evaluations conducted to assess bypass performance would be coordinated with those evaluations conducted to assess juvenile salmonid survival past the screen. The relative proportion of juvenile salmonids entering and passing through the bypass system, under a variety of river flow, HCPP pumping rates, and bypass operations (e.g., one, two or all bypass bays open), would be evaluated via videographic documentation and/or mark-recapture studies. Juvenile salmonid survival and transport time within the bypass system would be assessed using methodologies such as mark-recapture studies whereby fish are released directly into the bypass system and recaptured at the bypass outlet.

C-085828

C-085828

Condition of Bypassed Fish

Bypassed fish (distinguished by marks) recaptured near the bypass outfall would be examined for abrasions and other physical signs of injury (e.g., frayed fins, descaling) and stress (e.g., escape response, orientation) in order to evaluate the condition of fish, and thereby their susceptibility to predation and latent mortality, when exiting the bypass system.

Debris Accumulation Within the Bypass System

Periodic examination of bypass entrances and internal pipes for accumulation of sediment and other debris would be conducted. If debris were found to interfere with bypass hydraulics, a program for routine debris removal would be developed.

6.4.3.3 Oxbow Hydraulics Performance Evaluation

Objective: Studies and monitoring would be performed to evaluate the effects of oxbow hydraulics, under a variety of river flow and HCPP pumping rates, on screen performance, fish passage, and predation.

Oxbow Hydraulics

Hydraulic measurements (e.g., depth and velocity profiles) would be made at pre-determined transects throughout the upper and lower oxbow, under a variety of river flow and HCPP pumping rates. Particular attention would be paid to hydraulics at the bypass outfall, the oxbow flow control structure, and the confluence of the lower oxbow with the Sacramento River. Oxbow hydraulic data would be integrated with sedimentation and screen hydraulics data to assess the influence of channel configuration, project features, and sediment accumulation on oxbow and screen hydraulics. Measured oxbow and screen hydraulics would be compared to hydraulic design criteria for these project features to evaluate the effects of oxbow hydraulics on screen performance, fish passage, and predation.

6.4.3.4 Gradient Facility Performance Evaluation

Objective: The gradient facility has been designed to provide desirable hydraulic conditions (e.g., water surface elevations, cross-sectional and longitudinal velocity distributions, depths, and bedload movements) that would minimize impacts to fish migration under a variety of flow conditions. Studies and monitoring would be performed to determine whether the gradient facility is performing as designed under a variety of river flow and HCPP pumping rates.

Gradient Facility Hydraulics

Hydraulic measurements (e.g., water surface elevations, and depth and velocity profiles) would be taken at pre-determined transects upstream, downstream, and within the gradient facility under various flow regimes before and after construction. These values would be compared to those documented for the natural riffle located at River Mile 202.5.

Adult Immigration

Following construction of the gradient facility, fish passage capability would be evaluated under a variety of river flows. Adult fish passage evaluations would be conducted using methodologies such as radio-telemetry studies for sturgeon, and possibly other fish species.

6.4.4 Predation Evaluations

Objective: Evaluate the relative degree of predation on juvenile salmon passing through the oxbow and gradient facility.

Survival of Young Fish Emigrating Through the Oxbow

Evaluations conducted to assess survival of juvenile salmonids emigrating through the upper and lower oxbow would be coordinated with those evaluations conducted to assess juvenile salmonid survival past the screen.

Periodic predatory fish surveys would be conducted to document the seasonal distribution and abundance of predatory fish within the upper and lower oxbow. Predatory fish surveys would focus on evaluating the relative abundance of predators during periods when the potential for predation is greatest (e.g., periods of peak predator abundance and/or peak juvenile emigration periods). Predatory fish surveys would focus additional effort at the screen, bypass outfall, and at the confluence of the lower oxbow with the Sacramento River. Methods for reducing predatory fish abundance would be developed, as warranted.

By integrating the information collected, the relative magnitude of predation occurring at various locations throughout the oxbow (under different flow conditions) would be determined.

Survival of Young Fish Emigrating Through the Gradient Facility

Periodic predatory fish surveys would be conducted to document the seasonal distribution and abundance of predatory fish within the gradient facility. Predatory fish surveys would focus on evaluating the relative abundance of predators during periods when the potential for predation is greatest (e.g., periods of peak predator abundance and/or peak juvenile emigration periods). Density estimates would be compared to predatory fish density estimates for natural riffles in the upper Sacramento River (e.g., riffle at RM 202.5). The tendency for predatory fish to congregate in the resting pools of the gradient facility would be determined. Methods for reducing predatory fish abundance within the gradient facility would be developed, as warranted.

C-085830

C-085830

6.4.5 Sedimentation Evaluations

Objective: Sedimentation has had a major influence on the operation and maintenance of the HCPP facility in the past. Dredging the area in front of the existing screens is currently a recurring maintenance item. FPEMP sedimentation evaluations would be conducted to determine the rates of sedimentation and, therefore, nature of maintenance dredging required following the construction of the project features. Specific project areas of interest for sedimentation evaluations include:

- upper oxbow;
- in front of and behind the fish screen;
- lower oxbow; and
- gradient facility resting pools.

The Guidance Manual would identify a systematic methodology for measuring local sediment build-up in the areas identified above. Sediment accumulation data for the oxbow would be integrated with screen hydraulic data to develop an appropriate sediment removal program that would maintain efficient project performance.

6.4.6 Methods for Data Analyses

Detailed methods for data analyses would be determined after clearly defining and prioritizing the: (1) FPEMP evaluation issues; (2) data requirements; (3) methodologies to be employed for data collection; (4) locations and frequencies of data collection; and (5) specific questions to be answered pertaining to the evaluation issues—all of which remain under development, and would be specified in detail in the Guidance Manual.

6.4.7 Development of a Corrective-Action Program (Including an Implementation Schedule)

The Guidance Manual also would provide the framework for a corrective-action program, including a tentative schedule for effectively achieving system performance consistent with design criteria. Specific corrective actions to be implemented would be developed, as required, following identification of project features that fail to meet design criteria under defined river flow and HCPP pumping rates.

C-085831

C-085831

Chapter 7
List of Preparers

C-085832

C-085832

7.0 LIST OF PREPARERS

Table 7-1 identifies the names and qualifications of the persons who are primarily responsible for preparing this Environmental Impact Report/Environmental Impact Statement, including those persons who provided substantive supporting information or analyses.

Table 7-1 - List of Preparers

Lead Agency Representatives			
Chris Beale Julie Brown Nick Villa		California Department of Fish and Game	
Sandra Dunn Ben Pennock		Glenn-Colusa Irrigation District	
Matt Davis Bob Junell		U.S. Army Corps of Engineers	
Lauren Carly Kurt Flynn		U.S. Bureau of Reclamation	
Name	**Education**	**Expertise**	**Participation**
Surface Water Resources, Inc.			
Paul Bratovich	M.S. 1985 Fishery Resources B.S. 1977 Fisheries	Fisheries biology, endangered species flow-habitat relationships, habitat restoration	Principal-In-Charge; Aquatic Setting (support); Aquatic Impacts (lead)
Rick Lind	M.A. 1984 Geography (Water Resources) B.A. 1979 Geography (Natural Resources)	CEQA/NEPA compliance, water resources planning, water and energy resources project permitting, environmental program management	EIR/EIS Project Manager; Project Description and Development of Alternatives (lead); Hydrology and Water Resources Setting (support); and Mitigation and Monitoring Compliance (lead)
Walter Bourez	M.S. 1995 Civil Engineering B.S. 1988 Civil Engineering Professional Engineer, California	Hydrologic modeling	Hydrology and Water Resources Setting (support); Hydrology and Water Resources Impacts (support); Hydrology and Water Resources Technical Report, Appendix B (lead)
Carol Brown		Administrative support, document management	Literature Cited; Individuals and Organizations Receiving the ~~Draft~~ EIR/EIS; document editing and formatting

C—085833

C-085833

Table 7.1-1 - List of Preparers (Continued)			
Name	**Education**	**Expertise**	**Participation**
Surface Water Resources, Inc. (Continued)			
Michael Bryan	Ph.D. 1993 Toxicology & Fisheries Biology M.S. 1989 Fisheries Biology B.S. 1986 Fisheries Biology & Biology	Aquatic toxicology, fisheries biology, ecological risk assessment, water quality, experimental design and statistical analyses	Aquatic Resources Setting and Impacts (support)
Meredith Clement	B.S. 1996 Environmental Policy, Analysis & Planning	CEQA/NEPA compliance, urban planning	Alternatives (support); Public and Agency Consultation and Coordination (support); List of Preparers
Ines Ferreira	Ph.D. (in progress) Civil & Environmental Engineering M.S. 1993 Civil & Environmental Engineering	Hydrologic modeling, fluid dynamics, nutrient transport	Hydrology and Water Resources Setting and Impacts (support)
Amy Harris	M.S. (in progress) Biological Conservation B.S. 1993 Biological Sciences	Fisheries biology	Alternatives (support); Aquatic Resources Setting and Impacts (support); Terrestrial Resources Setting and Impacts (support); Public and Agency Consultation (support)
Steve James	M.S. 1996 Biology/Botany B.A. 1984 Aquatic Biology B.A. 1979 Environmental Studies	Conservation biology, California and Federal Endangered Species Act compliance, habitat restoration	Aquatic Resources Setting and Impacts (support); Terrestrial Resources Setting and Impacts (lead); Biological Assessment (lead)
George "Buzz" Link	B.S. 1975 Civil Engineering Professional Engineer, California	Hydraulic engineering, hydrologic modeling	Hydrology and Water Resources Impacts (support)
Michelle Lynch	M.S. 1996 Civil Engineering B.S. 1993 Civil Engineering Engineer in Training, California	Hydrology, water quality, hydrologic modeling	Hydrology and Water Resources Setting (lead) and Impacts (lead); Hydrology and Water Resources Technical Report, Appendix B (support)

C-085834

C-085834

Table 7.1-1 - List of Preparers (Continued)			
Name	**Education**	**Expertise**	**Participation**
Surface Water Resources, Inc. (Continued)			
Jeff Strawn	B.S. 1989 Marketing	Technical illustration, cartography, graphics, Geographic Information System (GIS) analyses, spreadsheet management	Cartography/map creation for EIR/EIS
Beak Consultants, Inc.			
Matthew Franck	B.A. 1989 Environmental Policy, Analysis and Planning	Urban Planning	Land Use Setting and Impacts (lead); Noise Setting and Impacts (lead); Transportation and Traffic Safety Setting and Impacts (lead)
Sandra Taylor	M.S. 1993 Zoology and Physiology B.A. 1989 Biology	Wildlife and fisheries biology	Terrestrial Resources Mitigation and Monitoring (support)
C&C Resources			
Catherine LeBlanc	M.S. 1990 Animal Behavior B.S. 1984 Biological Sciences	Biological sciences and environmental permitting	Soils and Geology Setting and Impacts (lead); Visual Resources Setting and Impacts (lead); Recreation and Navigation Setting and Impacts (lead); Air Quality Setting and Impacts (lead)
Jensen & Associates			
Peter M. Jensen	Ph.D. 1972 Anthropology M.A. 1969 Anthropology B.A. 1968 Anthropology	Archaeological, historical, and cultural resource management studies and Native American consultation	Cultural Resources Setting and Impacts (lead)
Jones & Stokes Associates, Inc.			
Bill Mitchell	B.S. 1980 Biology M.S. 1988 Natural Resources and Fisheries	Fisheries biology	Aquatic Setting (support); Aquatic Impacts (support)

C-085835

C-085835

Chapter 8
Literature Cited

C-085836

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8.0 LITERATURE CITED

(American Association of State Highway and Transportation Officials 1970) American Association of State Highway and Transportation Officials. Guide on Evaluation and Attenuation of Traffic Noise. 1970.

(Arnold et al. 1994) Arnold, R.A, J.A. Halstead, D. Kavenaugh, and K.H. Osborne. Valley elderberry longhorn beetle. In: *Life on the Edge*. Biosystems Books. Santa Cruz, CA. 1994.

(Ayres 1991) Ayres Associates. Riverbed Gradient Restoration - Sacramento River Mile 206 - California, 30% of Design (BOD) Report. December 1991.

(Ayres 1995) Ayres Associates. Riverbed Gradient Restoration Structures for the Sacramento River at the Glenn-Colusa Irrigation District (GCID) Intake, California. Supplemental Hydraulic Report. Fort Collins, Colorado. July 1995.

(Ayres 1996a) Ayres Associates. Gradient Maintenance Facility Preliminary Design, Cost Comparison, and Habitat Impacts. Prepared in cooperation with Jones & Stokes Associates, Inc. for the U.S. Army Corps of Engineers, Sacramento District. August 1996.

(Ayres 1996b) Ayres Associates. Gradient Restoration Facility - Glenn-Colusa Irrigation District, Preferred Location. Memorandum to U.S. Army Corps of Engineers. May 10, 1996.

(Ayres 1996c) Ayres Associates. Evaluation of Geomorphic and Hydraulic Conditions on Natural Riffles at RM 202.5 and 205.6. December 4, 1996.

(Ayres 1996d) Ayres Associates. Draft Technical Memorandum. Riverbed Gradient Facility for the Sacramento River at the Glenn-Colusa Irrigation District (GCID) Intake, California. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento, California. December 1996.

(Ayres 1997a) Ayres Associates. Memorandum. Construction Issues for Gradient Facility at GCID. January 23, 1997.

(Ayres 1997b) Ayres Associates. AutoCad Data supplied to SWRI. January 1997.

(Ayres 1997c) Ayres Associates. Memorandum - Approximate Conceptual Rock Dike Locations at the GCID Project Site. May 16, 1997.

(Ayres 1997d) Ayres Associates. Memorandum from Scott Hogan to Peter Valentine (Corps) and RMA - 2V Model Construction Runs. May 15, 1997.

(*Ayres 1997e*). Ayres Associates. Draft Gradient Facility Letter Report. Riverbed Gradient Facility for the Sacramento River at the Glenn-Colusa Irrigation District Intake, California. Prepared for the U. S. Army Corps of Engineers. October 1997

(*Barbour and Davis 1969*) Barbour R.W. and W.H. Davis. *Bats of America.* The University of Kentucky Press. Lexington, KY. 1969.

(*Barton et al. 1986*) Barton, Bruce A., C.B. Schreck, L.A. Sigismondi. Multiple Acute Disturbances Evoke Cumulative Physiological Stress Responses in Juvenile Chinook Salmon. American Fisheries Society 115:245-251. 1986.

(*Beak 1992*) Beak Consultants Inc. (Beak) Submittal of Preliminary Maps and Field Survey Results for the Glenn-Colusa Irrigation District Gradient Restoration Facility Biological Data Reports. Submitted to the U.S. Army Corps of Engineers, Environmental Resources Branch, Sacramento, CA. 1992.

(*Beak 1993*) Beak Consultants Inc. Biological Data Report for the Listed Species Potentially Affected by the Sacramento River Gradient Restoration Project - Glenn County, California. Unpublished Report prepared for the U.S. Army Corps of Engineers. 1993.

(*Bell 1986*) Bell, M.C. Fisheries Handbook of Engineering Requirements and Biological Criteria. Fish Passage Development and Education Program. U.S. Army Corps of Engineers, North Pacific Division, Portland, Oregon. 1986.

(*Bell and Bell 1994*) Bell, L. H. and D. H. Bell. Industrial noise control: fundamentals and applications. 2nd ed., rev. and expanded. New York: M. Dekker. 1994.

(*Boggs 1987*) Boggs, S., Jr. Principals of Sedimentology and Stratigraphy. Merrill Publishing Company. 1987.

(*Bovee 1978*) Bovee, K.D. Probability-of-use criteria for the family Salmonidae. U.S. Fish and Wildlife Service, Instream Flow Information paper No. 4, Fort Collins, Colorado. 1978.

(*Bryant 1983*) Bryant, M. D. The role and management of woody debris in west coast salmonid nursery streams. North American Journal of Fisheries Management. 3:322-330. 1983.

(*Buechner 1992*) Buechner, M. Preliminary Population Viability Analysis for Bank Swallows (*Riparia riparia*) of the Sacramento River, California. Prepared for the California Department of Fish and Game, Wildlife Management Division, *in* Nongame Bird and Mammal Section Report 92-01. 1992.

(*Burt and Grossenheider 1980*) Burt, W.H. and R.P. Grossenheider. *A Field Guide to Mammals.* Houghton Mifflin Company, Boston. 1980.

(*CARB 1991*) California Air Resources Board. Fact Sheet 39 (revised 11/91).

(*CARB 1993*) California Air Resources Board. Air Quality Data Summary. 1993.

(CARB 1994) California Air Resources Board. Air Quality Data Summary. 1994.

(CARB 1995) California Air Resources Board. Air Quality Data Summary. 1995.

(CARB and CDFA 1995) California Air Resources Board and California Department of Food and Agriculture. Progress Report on the Phase Down of Rice Straw Burning in the Sacramento Valley Air Basin 1992-1994. 1995.

(Carly 1997) Carly, L. Memorandum to Technical Advisory Group and EIR/EIS Work Group. January 29, 1997.

(CBOC 1993) California Burrowing Owl Consortium. Burrowing Owl Survey Protocol and Mitigation Guidelines. 1993.

(CDBW, no date) California Department of Boating and Waterways (CDBW). Sacramento River: Boating Trail Guide - from Bridge to Colusa. Sacramento, CA. No date.

(CDC 1996) California Department of Conservation, Farmland Mapping and Monitoring Program. Important Farmland Maps (1994) for Glenn and Colusa counties. Unpublished data. 1996.

(CDFG 1987a) California Department of Fish and Game. California Native Plant Status Report, *Limnanthes floccosa* ssp. *californica.* California Department of Fish and Game, Sacramento, CA. 1987.

(CDFG 1987b) California Department of Fish and Game. Factors affecting striped bass abundance in the Sacramento-San Joaquin River System, Exhibit 25. State Water Resources Control Board 1987 Water Quality/Water Rights Proceeding on the San Francisco Bay/Sacramento-San Joaquin Delta. 1987.

(CDFG 1987c) California Department of Fish and Game. Requirements of American Shad in the Sacramento-San Joaquin River system, Exhibit 23. State Water Resources Control Board 1987 Water Quality/Water Rights Proceeding on the San Francisco Bay/Sacramento-San Joaquin Delta. 1987.

(CDFG 1991) CDFG. California Endangered Species Act consultation for the construction of the Sacramento River bank protection project (CESA No. 9002). 1991.

(CDFG 1993a) California Department of Fish and Game. Draft Fish Screening Criteria. February 1993.

(CDFG 1993b) California Department of Fish and Game. Plan of Action for the Upper Sacramento River.

(CDFG 1996) California Department of Fish and Game. RAREFIND. California Natural Diversity Data Base. March 15, 1996.

C-085839

C-085839

(CDMG 1966) California Division of Mines and Geology. Geology of Northern California. Bulletin 190. 1966.

(CDMG 1982) California Division of Mines and Geology. Guidelines for Geologic/Seismic Considerations in Environmental Impact Reports. 1982.

(CDMG 1992) California Division of Mines and Geology. Fault-Rupture Hazard Zones in California. Special Publication No. 42. 1992.

(CH2M Hill 1989) CH2M Hill. Final Feasibility Report. GCID/CDFG Fish Protection and Gradient Restoration Facilities. 1989.

(CH2M Hill 1990) CH2M Hill. Revised Draft GCID Long-Range Water Supply Plan Reconnaissance Report. Prepared for Glenn-Colusa Irrigation District. April 1990.

(CH2M Hill 1996) CH2M Hill. Technical Memorandum. Potential Pumping Restrictions at GCID for Alternative D Without GRF/GMF. September 19, 1996.

(Chapman et al. 1982) Chapman, J.A. and G.A. Feldhamer, editors. *Wild Mammals of North America.* The Johns Hopkins University Press. Baltimore, MD. 1982.

(City of Sacramento 1995) City of Sacramento. Sacramento River Watershed Sanitary Survey. City of Sacramento Department of Utilities and City of West Sacramento Department of Public Works. Prepared by Archibald & Walberg Consultants, Marvin Jung & Associates, McGuire Environmental Consultants, Montgomery Watson. December 1995.

(Clark 1970) Clark, William B. Gold Districts of California. California Division of Mines, Bulletin 193. San Francisco, California. 1970.

(Colusa County 1989) Colusa County. Colusa County General Plan. Prepared by Sedway Cooke Associates. 1989.

(Corps 1988) U.S. Army Corps of Engineers. Department of the Army Permit. 1988.

(Corps 1991) U.S. Army Corps of Engineers. Environmental Impact Report, Sacramento Flood Control Project Systems Evaluation Phases II-V. 52 p. and appendices. 1991.

(Corps 1992) U.S. Army Corps of Engineers. Department of the Army Permit. Permit Number 199500587 provided to the Glenn-Colusa Irrigation District for dredging of the west channel of the Sacramento River (RM 205 to 206). 1992.

(Corps 1996) U.S. Army Corps of Engineers. Department of the Army Permit. Permit Number 199500587 provided to the Glenn-Colusa Irrigation District for dredging of the west channel of the Sacramento River (RM 205 to 206). April 10, 1996.

(Cramer and Associates 1990) Cramer, S.P., and Associates. Survival of Juvenile Chinook at the Glenn-Colusa Irrigation District's Intake. Progress Report, April-July 1990.

C-085840

C-085840

(Cramer and Associates 1992) Cramer, S.P., and Associates. Juvenile Chinook Passage Investigations at Glenn-Colusa Irrigation District Diversion. Annual Report 1991. February 1992. Corvallis, Oregon.

(Cramer and Associates 1993) Cramer, S.P., and Associates. Juvenile Chinook and Sacramento Squawfish Monitoring at the Glenn-Colusa Irrigation District Diversion. 1992 Annual Report Submitted to Glenn-Colusa Irrigation District. 1993.

(CVRWQCB 1994) California Regional Water Quality Control Board, Central Valley Region. The Water Quality Control Plan. The Sacramento River Basin and The San Joaquin Basin. Third edition. 1994.

(De Haven 1989) De Haven, R.W. Distribution, extent, uniqueness, and replaceability of shaded riverine aquatic cover of selected reaches of the Sacramento River system, Sacramento Valley, California. U.S. Fish and Wildlife Service, Unpublished Manuscript. 1989.

(Dolloff 1986) Dolloff, C. A. Effects of stream cleaning on juvenile coho salmon and Dolly Varden in southeast Alaska. Transactions of the American Fisheries Society. 115:743-745. 1986.

(DWR 1975) Department of Water Resources (DWR). Irrigation Efficiency, Sacramento Valley Westside. Department of Water Resources Memorandum Report. 1975.

(DWR 1984) Department of Water Resources. Middle Sacramento River Spawning Gravel Study Atlas. River Atlas Appendix. Department of Water Resources. 1984.

(DWR 1988) Department of Water Resources. Hydrologic Data 1985, Volume II: Northeastern California. Department of Water Resources Bulletin 130-85, Sacramento, CA. 1988.

(DWR 1991) Department of Water Resources. Updates to River Atlas Appendix for DWR (1984). AutoCad digitized data from Corps 1991 aerial photography. Unpublished, Northern District. 1991.

(DWR 1993) Department of Water Resources. Upper Sacramento River Habitat Modeling Progress Report. TIR ND-93-01. 1993.

(DWR 1994) California Department of Water Resources. BA: Effects of the Central Valley Project and State Water Project on Delta Smelt and Sacramento Splittail. Prepared for the U.S. Fish and Wildlife Service by the California Department of Water Resources and the U.S. Bureau of Reclamation. August 1994.

(DWR 1994a) Department of Water Resources. California Water Plan Update. Department of Water Resources Bulletin 160-93. October 1994.

(DWR 1994b) Department of Water Resources. Ground Water Levels in the Sacramento Valley Ground Water Basin, Colusa County. January 1994.

C-085841

C-085841

(DWR 1994c) Department of Water Resources. Ground Water Levels in the Sacramento Valley Ground Water Basin, Glenn County. January 1994.

(DWR 1996a) Department of Water Resources. GCID Sacramento River Diversion Data. Unpublished. Obtained from Division of Planning. 1996.

(DWR 1996b) Department of Water Resources. Groundwater Quality Data. September 1996.

(DWR 1996c) Department of Water Resources. SB 1086 Riparian Habitat Committee Draft Report, Sacramento River Riparian Conservation Area Inner River Zone. May 22, 1996.

(ECOS 1991) ECOS. Final Environmental Assessment of Streambed Gradient Restoration Structures in the Sacramento River at River Mile 206. Prepared for the U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA. 1991.

(Elrlich et al. 1988) Ehrlich, P.R., D.S. Dobkin, and D. Wheye. *The Birder's Handbook: A Field Guide to the Natural History of North American Birds.* Simon and Schuster. New York. 1988.

(EPA 1971) U.S. Environmental Protection Agency. "Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances." NTID300.1. 1971.

(EPA 1993) U.S. Environmental Protection Agency. San Francisco Estuary Project Technical Reports. 1993.

(EPA 1995) U.S. Environmental Protection Agency. Draft Anadromous Fish Restoration Plan (and working papers). Prepared for the Secretary of the Interior. December 6, 1995.

(Estep 1989) Estep, J.A. Biology, Movements, and Habitat Relationships of the Swainson's Hawk in the Central Valley of California, 1986-1987. California Department of Fish and Game, Nongame Bird and Mammal Section, Sacramento, California, 1989.

(Eubank 1948) Eubank, Elizabeth. Glenn County Directory 1947-48. Sacramento Lithograph Company. Sacramento. 1948.

(Faber 1988) Faber, P.M. and R.F. Holland. *Common Riparian Plants of California.* Pickleweed Press, Mill Valley, CA. 1988.

(Faler 1988) Faler, M.P., L. M. Millar, and K. I. Welke. Effects of variation in flow on distributions of northern squawfish in the Columbia River below McNary Dam. N. Amer. J. Fish. Mgmt. 8:30-35. 1988.

(Fry 1979) Fry, D.H., Jr. Anadromous fishes of California. California Department of Fish and Game, Sacramento, CA. 1979.

C-085842

C-085842

(Ganssle 1966) Ganssle, D. Fishes and Decapods of San Pablo and Suisun Bay. Pages 64-94 *in* D. W. Kelley, editor, Ecological studies of the Sacramento-San Joaquin Estuary. Part 1. California Department of Fish and Game Bulletin 133. 1966.

(Garcia 1989) Garcia, A. The Impacts of Squawfish Predation on Juvenile Chinook Salmon at Red Bluff Diversion Dam and other locations in the Sacramento River. U.S. Fish and Wildlife Service, Report No. AFF/FAO-89-05. 1989.

(Garrett et al. 1994) Garrett, R. P. Springer, D. Yparraguire, A Dahl. Aleutian Canada geese. In: *Life on the Edge*. Biosystems Books. Santa Cruz, CA. 1994.

(Garrison and Mc Kernan 1994) Garrison, B. A. and R. Mc Kernan. Bank Swallow. In: *Life on the Edge*. Biosystems Books. Santa Cruz, CA. 1994.

(GCID 1978) Glenn-Colusa Irrigation District (GCID). Agreement for the Transportation of Water (Sacramento and Colusa National Wildlife Refuges) Contract 14-16-001-78021. January 18, 1978.

(GCID 1979) Glenn-Colusa Irrigation District. Agreement for the Transportation of Water (Delevan National Wildlife Refuge) Contract 14-16-001-79115. October 5, 1979.

(GCID 1995a) Glenn-Colusa Irrigation District. Report On Water Measurement Program For 1994. Glenn-Colusa Irrigation District, Willows, CA. 1995.

(GCID 1995b) Glenn-Colusa Irrigation District. Water Transfer Policy. February 16, 1995.

(GCID 1996a) Glenn-Colusa Irrigation District. Report on Water Measurement Program for 1995. Glenn-Colusa Irrigation District. May 1996.

(GCID 1996b) Glenn-Colusa Irrigation District. Glenn-Colusa Irrigation District Water Conservation Policy. Adopted April 18, 1996.

(GCID 1996c) Glenn-Colusa Irrigation District. Letter from O.L. "Van" Tenney to Rick Lind dated June 18, 1996.

(GCID 1997) Glenn-Colusa Irrigation District. 1996 Hydraulic Monitoring Report. CH2M Hill. April 1997.

(Gertsch et al. 1994) Gertsch, M., D. Van Der Water, B. Walton. American Peregrine Falcon. In: *Life on the Edge*. Biosystems Books. Santa Cruz, CA. 1994.

(Glenn County 1993a) Glenn County. General Plan Environmental Impact Report. 1993.

(Glenn County 1993b) Glenn County. Glenn County General Plan, Environmental Setting Technical Paper. Prepared by Quad Consultants. 1993.

(Glenn County Public Works Department 1990) Glenn County Public Works Department. Existing Daily Traffic (ADT) Volumes. June 12, 1990.

C-085843

C-085843

(Gorder and Lee 1995) Gorder, N. K. N., and J. M. Lee. Information on Rice Pesticides Submitted to the California Regional Water Quality Control Board, Central Valley Region. California Environmental Protection Agency, Department of Pesticide Regulation, Environmental Monitoring and Pest Management Branch, Environmental Hazards Assessment Program, Sacramento CA. December 28, 1995.

(Gudde 1975) Gudde, Erwin G. California Gold Camps. University of California Press. Berkeley. 1975.

(Hall 1979) Hall, F.A., Jr. An Evaluation of Downstream Migrant Chinook Salmon, Oncorhynchus tshawytscha, Losses at Hallwood Cordua Fish Screen. California Department of Fish and Game, Anadromous Fisheries Branch. Administrative Office Report 79-5. 17 p. 1979.

(Hallock et al. 1976) Hallock, R.J., R.F. Elwell, and D.H. Fry. Migrations of Adult King Salmon (Oncorhynchus tshawytscha), in the San Joaquin Delta, As demonstrated By The Use Of Sonic Tabs. California Department of Fish and Game. Fisheries Bulletin 151. 1976.

(Hanson et al. 1993) Hanson, B., S. R. Grattan, and A. Fulton. Agricultural Salinity and Drainage. University of California Irrigation Program, University of California, Davis. 1993.

(Harvey 1991) Harvey, B. C. 1991. Interactions among stream fishes: predator-induced habitat shifts and larval survival. Oecologia, 87:29-36. 1991.

(Harwood and Helley 1987) Harwood, D.S. and E.J. Helley. Late Cenozoic Tectonism of the Sacramento Valley, California. U.S. Geologic Survey Professional Paper 1359. 1987.

(Hastings et al. 1996) Hastings, M.C., A.N. Popper, J.J. Finneran and P.J. Lanford. Effects of Low-Frequency Underwater Sound on Hair Cells of the Inner Ear and Lateral Line of the Teleost Fish *Astronotus ocellatus*. Journal of the Acoustical Society of America. March 1996.

(HDR 1994) HDR Engineering, Inc. Fish Screen Modification Feasibility Report. March 1994.

(Helley and Harwood 1985) Helley, E.J. and D.S. Harwood. Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierra Foothills, California. U.S. Geologic Survey Map MF-1790. 1985.

(Hickman 1993) Hickman, J.C., ed. 1993. *Higher Plants of California.* University of California Press. Berkeley. 1993.

(Holland 1986) Holland, R.F. Preliminary Descriptions of the Terrestrial Communities of California. California Department of Fish and Game, Non-Heritage Game Program. October 1986.

(Hoover, Rensch & Rensch 1970) Hoover, Rensch & Rensch. Historic Spots in California. 3rd ed. Stanford University Press, Stanford. 1970.

(Humphrey and Garrison 1986) Humphrey, J.M. and B.A. Garrison The status of bank swallow populations on the Sacramento River, 1986. California Department of Fish and Game, Wildlife Management Division. Sacramento, CA. 1986.

(Jennings 1994) Jennings, C.W. Fault Activity Map of California and Adjacent Areas with Locations of Recent Volcanic Eruptions. Department of Conservation, Division of Mines & Geology. Sacramento, CA. Geologic Data Map No. 6. 1994.

(Joint Fisheries Agreement 1989) Joint Fisheries Agreement. Joint Statement of Agreement between the Fish and Wildlife Service, National Marine Fisheries Service, and the California Department of Fish and Game Regarding Protection of Fish at the Glenn-Colusa Irrigation District Facilities. November 1989.

(Joint Stipulation of Parties 1992) Joint Stipulation of Parties. United States of America v. Glenn-Colusa Irrigation District (USA). Civil No. S-91-1074 DFL-JFM. 1992.

(Joint Stipulation of Parties 1993) Joint Stipulation of Parties. United States of America v. Glenn-Colusa Irrigation District (USA). Civil No. S-91-1074 DFL-JFM. 1993.

(JSA 1987) Jones and Stokes (JSA). Survey of habitat and populations of the valley elderberry longhorn beetle along the Sacramento River. Sacramento, CA. 1987.

(JSA 1996a) Jones and Stokes Associates (JSA). Initial Study of Streambed Protection at River Park and Lower American River. Prepared for Corps of Engineers and California Reclamation Board. July 1996.

(JSA 1996b) Jones and Stokes Associates. VELB Field Survey Results for the Sacramento River at the Glenn-Colusa Irrigation District intake. Letter to the U.S. Army Corps of Engineers. October 31, 1996.

(JSA 1997a) Jones and Stokes Associates. Preconstruction Field Surveys for Yellow-Billed cuckoo, Nesting Swainson's Hawk, and Bank Swallows - Riverbed Gradient Facility for the Sacramento River at the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant, California. Memorandum from Steven Avery (JSA) to Peter Valentine (Corps). September 29, 1997.

(JSA 1997b) Jones and Stokes Associates. Cost Estimates for Mitigation Planting and Wetland Creation for Gradient Facility along the Sacramento River. Draft memorandum. October 27, 1997.

(JSA 1997c) Jones and Stokes Associates. Revised Mitigation Calculations. Memorandum from Jones and Stokes to the U. S. Army Corps of Engineers. November 3, 1997.

C-085845

C-085845

(Klaseen and Ellison 1974) Klaseen, T.A. and D.K. Ellison. Soil Survey of the Butte County Area, California. United States Department of Agriculture, Soil Conservation Service. U.S. Government Printing Office, Washington D.C. 1974.

(Knudsen et al. 1994) Knudsen, F.R., P.S. Enger and O. Sand. Avoidance Responses to Low-Frequency Sound in Downstream Migrating Atlantic Salmon Smolt, *Salmo salar*. 1994.

(Kondolf 1993) Kondolf, M.G. Glenn-Colusa fish screen improvements geomorphological investigations, Task B5. May 22, 1993.

(LaForge and Hawkins 1986) LaForge, R.C. and F.F. Hawkins. Seismotectonic Study of Northernmost California for Shasta, Keswick, Spring Creek Debris, Trinity, Lewiston, and Whiskeytown Dams. U.S. Bureau of Reclamation, Engineering and Research Center, Division of Geology, Geologic Services Branch, Seismotectonics Section, Seismotectonic Report 86-1. 1986.

(Lonzarich and Quinn 1995) Lonzarich, D. G. and T. P. Quinn. Experimental evidence for the effect of depth and structure on the distribution, growth, and survival of stream fishes. Canadian Journal of Zoology. 73:2223-2230. 1995.

(Maule et al. 1988) Maule, Alec G., C.B. Schreck, C.S. Bradford, B.A. Barton. Physiological Effects of Chinook Salmon past Dams on the Columbia River. American Fisheries Society 117:245-261. 1988.

(McGinnis 1984) McGinnis, Samuel M. Freshwater Fisheries of California. University of California Press, Berkeley, CA. 1984.

(McGowan 1961) McGowan, Joseph A. History of the Sacramento Valley, Volume 1. Lewis Historical Publishing Company, New York. 1961.

(McKernan and Whitfield 1994) McKernan, R. and M. Whitfield. Willow flycatcher. *In* C. Thelander, Ed., *Life on the Edge*. Biosystems Books, Santa Cruz, CA. 1994.

(Meehan 1991) Meehan, W. R. Summer habitat use by young salmonids and their responses to cover and predation in a small southeast Alaska stream. Transactions of the American Fisheries Society. 120: 474-485. 1991.

(Mesa 1994) Mesa, M. G. Effects of Multiple Acute Stressors on the Predator Avoidance Ability and Physiology of Juvenile Chinook Salmon. Transactions of the American Fisheries Society 123:786-793. 1994.

(Miller and Lea 1972) Miller, D.J. and R.N. Lea. Guide to the Coastal Marine Fishes of California. California Department of Fish and Game, Fish Bulletin 157. 1972.

(Mount 1994) Mount, Jeffrey F. Rivers of California: Form and Function. Department of Geology. University of California, Davis. 1994.

(Moyle 1976) Moyle, P.B. *Inland Fishes of California.* University of California Press. Berkeley, CA. 1976.

(Moyle et al. 1989) Moyle, P.B., J.E. Williams, and E.D. Wikramanayake. Fish Species of Special Concern of California. Final report submitted to the California Department of Fish and Game, Inland Fisheries Division, Contract No. 7337. 1989.

(Moyle et al. 1992) Moyle, P.B., B. Herbold, D.E. Stevens, and L.W. Miller. Life history and status of delta smelt in the Sacramento-San Joaquin estuary, California. Transactions of American Fisheries Society 121:67-77. 1992.

(Moyle et al. 1995) Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. Fish species of concern in California, second edition. Report Prepared for the California Department of Fish and Game, Rancho Cordova, CA. 1995.

(Munz 1968) Munz, Philip A. *A California Flora.* University of California Press. Berkeley and Los Angeles. 1968.

(Murray et al. 1994) Murray, Burns and Kienlen - Consulting Engineers. Colusa Drain Mutual Water Company. October 1994.

(Mussetter 1997) Harvey M. Geomorphic Analyses for GCID Reach, RM 201-210 Sacramento River (SOW 3/24/97). Prepared for Mussetter Engineering, Inc. ~~April 14,~~ June 1997.

(Nehlsen et al. 1991) Nehlsen, W., J.E. Williams, and J.A. Lichatowich. Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho and Washington. Fisheries 16(2):4-21. 1991.

(NMFS 1993) National Marine Fisheries Service (NMFS). 1993. Biological Opinion for Winter-Run Chinook Salmon. February 12, 1993.

(NMFS 1997) Fish Screen Criteria for Anadromous Salmonids. National Marine Fisheries Service, Southwest Region. January 1997.

(Norris and Mohl 1983) Norris, K.S. and B. Mohl. Can Odontocetes Debilitate Prey With Sound? The American Naturalist. July 1983.

(NSVAB 1994) Northern Sacramento Valley Air Basin. Attainment Plan. 1994.

(Painter et al. 1980) Painter, R.E., L.H. Wixom, and M. Meinz. Management plan for American shad in central California. Final Report, Job No. 5 California Department of Fish and Game, Anadromous Fish Conservation Act, Project AFS-17. 1980.

(Parks and Recreation 1990) California Department of Parks and Recreation. California Historical Landmarks. California Department of Parks and Recreation, Sacramento. 1990.

C-085847

C-085847

(Parks and Recreation 1992) California Department of Parks and Recreation. California Points of Historical Interest. California Department of Parks and Recreation, Sacramento. 1992.

(Peak & Associates 1995) Peak & Associates. Cultural Resources Assessment of the Proposed Glenn-Colusa Irrigation District Screening Alternatives, Glenn, Butte and Tehama Counties, California. Report on file Northwest California Information Center, CSU Sonoma. 1995.

(Peterson 1990) Peterson, R.T. *A Field Guide to Western Birds.* Houghton Mifflin Co. Boston. 1990.

(Pickard et al. 1982) Pickard, A., A. Grover, and F. Hall, Jr. An Evaluation of Predator Composition at Three Locations on the Sacramento River. Interagency Ecology Study Program for the Sacramento-San Joaquin Estuary Technical Report No. 2, September 1982.

(Public Meeting Summary 1996) Summary of September 23, 1996 Public Meeting.

(Quanterra 1996) Quanterra Environmental Services. Report on analytical results for soil samples associated with Corps River Stabilization project. 1996.

(Ragir 1972) Ragir, Sonia. The Early Horizon in Central California Prehistory. Contributions of the University of California Archeological Research Facility, No. 15. Berkeley, California. 1972.

(Raleigh et al. 1986) Raleigh, R.F., W.J. Miller, and P.C. Nelson. Habitat Suitability Index Models and Instream Flow Suitability Curves: Chinook Salmon. U.S. Fish and Wildlife Service, Biological Report 82(10.122). 1986.

(RCE 1993) CH2M Hill and Resource Consultants & Engineers, Inc. (RCE). Sheet pile driveability tests and well logging report; Sacramento River fisheries enhancement structure (riverbed gradient restoration facility), Sacramento River mile 206, California. 1983.

(RCE 1994a) Resource Consultants & Engineers, Inc. Draft: Riverbed Gradient Restoration Structures for the Sacramento River at the Glenn-Colusa Irrigation District Intake, California, 2-Dimensional Modeling of a Natural Riffle and Gradient Restoration Facility. Resource Consultants & Engineers. February 1994.

(RCE 1994b) Resource Consultants & Engineers, Inc. Construction Sequence/Scenario for a Gradient Restoration Facility at the Glenn-Colusa Irrigation District Intake, California. 1994.

(Reclamation 1964) Reclamation and GCID. 1964. Contract between the U. S. and Glenn-Colusa Irrigation District, diverter of water from Sacramento River sources providing for project water service and agreement on diversion of water. April 6, 1964.

C—085848

C-085848

(Reclamation 1989) USDI Bureau of Reclamation. Report on Refuge Water Supply Investigations. Central Valley Hydrologic Basin, California. March 1989.

(Reclamation 1991) USDI Bureau of Reclamation (Reclamation). Planning Report/Final Environmental Statement, Shasta Outflow Temperature Control, Shasta County, California. 1991.

(Reclamation 1992) USDI Bureau of Reclamation (Reclamation). BA for U.S. Bureau of Reclamation. 1992 Central valley Project Operations. Mid-Pacific Region. Sacramento, CA. 1992.

(Reclamation 1995a) USDI Bureau of Reclamation. Refuge Water Supply Conveyance Alternatives Refinement Memorandum. May 1995.

(Reclamation 1995b) USDI Bureau of Reclamation. Technical memoranda presented to the Technical Advisory Group, May 17, 1996.

(Reclamation 1996a) USDI Bureau of Reclamation. DRAFT: Sedimentation Study - Phase II for the Gradient Restoration Facility and Gradient Modification Facility, Glenn-Colusa Irrigation District, California. September 1996.

(Reclamation 1996b) USDI Bureau of Reclamation. Meeting Notes. Glenn-Colusa Irrigation District Fish Screen Modifications/Replacement. October 18, 1996.

(Reclamation 1996c) USDI Bureau of Reclamation. Memorandum received October 30, 1996 discussing results of Quanterra environmental analysis of soil samples from the proposed gradient facility site. 1996.

(Reclamation 1996d) USDI Bureau of Reclamation. Glenn-Colusa Irrigation District Fish Screen Modifications/Replacement Conceptual Design Study. Bureau of Reclamation Technical Service Center, Denver, Colorado. August 1996.

(Reclamation 1996e) USDI Bureau of Reclamation. GCID Alternative D Model Study Progress Report. No date. Bureau of Reclamation Technical Service Center, Denver, Colorado.

(Reclamation 1996f) USDI Bureau of Reclamation: Letter from Arthur Glickman to Technical Advisory Group dated July 25, 1996.

(Reclamation 1996g) USDI Bureau of Reclamation. Technical memoranda to Mr. Rick Wantuck of NMFS and presented to the Technical Advisory Group, December 16, 1996.

(Reclamation 1996h) USDI Bureau of Reclamation. NEPA Handbook. 1996.

(Reclamation 1996i) USDI Bureau of Reclamation. Modeling Assumptions for the Base Scenario of the CVPIA Dedicated Yield Study. March 7, 1996.

C–085849

C-085849

(Reclamation 1997a) USDI Bureau of Reclamation. GCID HCPP Fish Screen Improvement Project Concept Design Study. Executive Summary. Bureau of Reclamation Technical Service Center. April 1997.

(Reclamation 1997b) USDI Bureau of Reclamation. GCID Model Study Progress Report Screen Model and Fish Bypass Model. May 9, 1997.

(Reclamation 1997c) USDI Bureau of Reclamation. Sedimentation Study - Phase II for the Gradient Restoration Facility and Gradient Maintenance Facility Glenn-Colusa Irrigation District California. April 1997.

(Reclamation 1997d) USDI Bureau of Reclamation. Fish Screen Structure Extension. Fish Screen Structure Improvement Project Glenn-Colusa Irrigation District. Central Valley Project Improvement Act, California. Technical Specifications. October 21, 1997.

(Reclamation 1997e) USDI Bureau of Reclamation. Central Valley Project Improvement Act Drat Programmatic Environmental Impact Statement. September 1997.

(Resources Agency 1989) The Resources Agency, State of California. Upper Sacramento River Fisheries and Riparian Habitat Management Plan. January 1989.

(Richardson and Harrison 1990) Richardson, T.H. and P. Harrison. An Analysis of Fish and Wildlife Impacts of Shasta Dam Water Temperature Control Alternatives. Prepared for the Bureau of Reclamation, Sacramento, CA. December 1990.

(Robert 1977) Roberts, W.G., J.G. Howe, and J. Major. A survey of riparian forest flora and fauna in California. *In* A. Sands, (ed.), Riparian Forests in California: their ecology and conservation. Institute of Ecology Publication No. 15. University of California, Davis. 1977.

(Rogers 1891) Rogers, Justus H. Colusa County. Its History Traced From a State of Nature Through the Early Period of Settlement and Development to the Present Day. Justus H. Rogers, Orland. 1891.

(Scardaci et al. 1995) Scardaci, S. C., A. U. Eke, J. E. Hill, J. D. Rhoades, and M. C. Shannon. Salinity Studies on Rice. Abstracts from Rice Field Day 1995. University of California Cooperative Extension. 1995.

(Schaffter et al. 1983) Schaffter, R.G., P.A. Jones and J.G. Karlton. Sacramento River and Tributaries Bank Protection and Environmental Investigation - Evaluation of Impacts on Fisheries. Final Report. California Department of Fish and Game. Sacramento, California. 1983.

(Schlosser 1987) Schlosser, I. J. The role of predation in size and age-related habitat use by stream fishes. Ecology, 68:651-659. 1987.

(Settlement Contract 1964) Contract Between the United States Department of Interior Bureau of Reclamation and Glenn-Colusa Irrigation District. April 6, 1964.

(Shirvell 1990) Shirvell, C. S. Role of instream rootwads as juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss)* cover habitat under varying streamflows. Canadian Journal of Fisheries and Aquatic Sciences. 47:852-861. 1990.

(Shively et al. 1996) Shively, R. S., T. P. Poe, M. B. Sheer, R. Peters. Criteria for reducing predation by northern squawfish near juvenile salmonid bypass outfalls at Columbia River dams. Regulated Rivers 12(4-5):493-500. 1996.

(Skinner and Pavlik 1994) Skinner, M.W. and B.M. Pavlik, eds. *Inventory of Rare and Endangered Plants of California.* California Native Plant Society. Sacramento, CA. 1994.

(SLC 1993) California State Lands Commission. 1993.

(Smith 1977) Smith, F. A short review of the status of riparian forests. *In* A. Sands, (ed.), Riparian Forests in California: their ecology and conservation. Institute of Ecology Publication No. 15. University of California, Davis. 1977.

(Snider and Gerstung 1986) Snider, W.M., and E. Gerstung. Instream Flow Requirements of the Fish and Wildlife Resources of the Lower American River, Sacramento County, California. California Department of Fish and Game, Stream Evaluation Report No. 86-1. 1986.

(Spyres 1992) Spyres, M. Salinity Levels Affecting Rice in the Colusa. Submitted at a University of California, Davis Cooperative Extension Seminar on Salinity and Rice. 1992.

(Stebbins 1985) Stebbins, R.C. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Company. Boston. 1985.

(Stevens et al. 1990) Stevens, D.E., L.W. Miller, and B.C. Bolster. Report to the fish and Game Commission: A Status Review of Delta Smelt (*Hypomesus transpacificus*) in California. Department of Fish and Game. Candidate Species Status Report 90-2. 1990.

(TAG Meeting April 16, 1997) Draft Meeting Notes from Technical Advisory Group Meeting. April 16, 1997.

(Tehama County 1983) Tehama County. Tehama County General Plan. 1983.

(Tsai 1973) Tsai, C. Water quality and fish life below sewage outfalls. Trans. Amer. Fish Soc. 102:281-292. 1973.

(Udvardy 1977) Udvardy, M.D.F. *The Audubon society Field Guide to North American Birds - Western Region.* Alfred A. Knopf. New York. 1977.

(USDI 1992) United States Department of Interior. National Register of Historic Places. *Federal Register.* Washington D.C. 1992.

(USFWS 1992) U.S. Fish and Wildlife Service. Shaded Riverine Aquatic Cover of the Sacramento River System: Classification as Resource Category 1 Under the FWS Mitigation Policy. Memorandum and substantiating report from Acting Assistant Regional Director - Fish and Wildlife Enhancement, Region 1, Portland, Oregon. October 1992.

(USFWS 1993) U.S. Fish and Wildlife Service. Survival and Conditions of Juvenile Salmonids Passing Through the Downstream Migrant Fish Protection Facilities at Red Bluff Diversion Dam on the Sacramento River, Spring 1993. Report No. AFF1-FRO-93-10. November 1993.

(USFWS 1995a) U.S. Fish and Wildlife Service. Draft USBR-GCID Fish Screen Improvement Project Planning Aid Memorandum - Revised Habitat Evaluation Procedure Analysis Memorandum. U.S. Fish and Wildlife Service, Ecological Services. November 3, 1995.

(USFWS 1995b) U.S. Fish and Wildlife Service. Anadromous Fish Restoration Plan and Working Papers. 1995.

(USFWS 1995c) U.S. Fish and Wildlife Service. Working Paper: Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California. Volume 2. Prepared for the U.S. Fish and Wildlife Service under the direction of the Anadromous Fish Restoration Program Core Group. Stockton, California. May 9, 1995.

(USFWS 1996a) U.S. Fish and Wildlife Service. Determination of Threatened Status for the California Red-Legged Frog. 61 CFR 25813. May 23, 1996.

(USFWS 1996b) U.S. Fish and Wildlife Service. Mitigation Guidelines for the Valley Elderberry Longhorn Beetle. September 19, 1996.

(USFWS 1997a) U.S. Fish and Wildlife Service. Draft Habitat Evaluation Procedures Analysis, Appendix to Revised Administrative Draft Fish and Wildlife Coordination Act Report, Glenn-Colusa Irrigation District Fish Screen Improvement Project, Hamilton City Pumping Plant, Glenn, County, California. September 1997.

(Vogel and Marine 1991) Vogel, D.A., and K.R. Marine. Guide to Upper Sacramento River Chinook Salmon Life History. Prepared for the U.S. Bureau of Reclamation, Central Valley Project. 1991.

(Vogel and Marine 1995a) Vogel, D. A. and K. R. Marine. 1994 Biological Evaluation of the New Fish Screens at the Glenn-Colusa Irrigation District's Sacramento River Pump Station. Unpublished Report. Glenn-Colusa Irrigation District. February 1995.

C—085852

C-085852

(Vogel and Marine 1995b) Vogel, D. A. and K. R. Marine. 1995 Predation Evaluations Near the GCID Sacramento River Pump Station. Technical Memorandum Dated December 1, 1995 from Natural Resource Scientists to Glenn-Colusa Irrigation District.

(Vogel et al. 1988) Vogel, D. A., K. R. Marine, and J.G. Smith. Fish Passage Action Program for Red Bluff Diversion Dam, Final Report on Fishery Investigations, U.S. Fish and Wildlife Service Report No. FR1/FAO-88-19. 1988.

(Vondracek and Moyle 1983) Vondracek, B. and P.B. Moyle. Squawfish Predation at Red Bluff Diversion Dam. Contract Report for the California Department of Water Resources. December 20, 1983.

(Ward 1989) Ward, P.D. A Review and Evaluation of the Losses of Migrant Juvenile Chinook Salmon at the Glenn-Colusa Irrigation District. California Department of Fish and Game, Glenn-Colusa Fish Screen. Unpublished Office Report (with appendices). 1989.

(Ward 1990) Ward, P.D. Letter dated November 30, 1990 to Mr. Robert Clark, Glenn-Colusa Irrigation District from Mr. Patrick O'Brien, Fisheries Management Supervisor, California Department of Fish and Game, regarding the Department of Fish and Game's comments on the progress report Survival of juvenile chinook at the Glenn-Colusa Irrigation District's Intake. 1990.

(WET 1991) Water Engineering and Technology, Inc. Riverbed Gradient Restoration Sacramento River Mile 206 California, 30% Basis of Design (BOD) Report. Prepared for the U.S. Army Corps of Engineers, BOD Report 14. December 1991.

(Widell 1997) Office of Historic Preservation. Letter from Cherilyn Widell to Roger Patterson, Bureau of Reclamation. May 13, 1997.

(Wilson 1978) Wilson, Norman L., and Arlean H. Towne. Nisenan, IN, Handbook of North American Indians, Volume 8: California, Robert F. Heizer, Editor, pp. 387-397. Smithsonian Institution, Washington, D.C. 1978.

PERSONAL COMMUNICATIONS

(B. Jones, pers. comm., 1996) Jones, B. Butte County Public Works Department. Personal telephone communication. June 17, 1996.

(B. Pennock, pers. comm., 1993) Pennock. B. Glenn-Colusa Irrigation District. Telephone conversation. 1993

(B. Pennock, pers. comm., 1996) Pennock, B. Glenn-Colusa Irrigation District. Personal telephone communication. June 17, 1996 and June 28, 1996.

(B. Pennock, pers. comm., 1997) Pennock, B. Glenn-Colusa Irrigation District. Personal conversation 1997.

(B. Snider, pers. comm., 1996) Snider, B. California Department of Fish and Game. Personal communication. 1996.

(B. Wallace, pers. comm., 1996) Wallace, B. President, Colusa Mutual Drain Company. Personal communication August 22, 1996.

(C. Hanson, pers. comm., 1996) Hanson, C. Hanson Environmental, Inc. Personal communication. 1996.

(C. Hanson, pers. comm., 1997) Hanson, C. Hanson Environmental, Inc. Personal communication. 1997.

(C. Leighton, pers. comm., 1996) Leighton, C. Glenn County Planning Department. Personal telephone conversation. June 18, 1996.

(Cramer & Associates, pers. comm., 1996) Cramer, S. Cramer and Associates. Personal telephone communication. July 17, 1996.

(D. Hilts, pers. comm., 1996) Hilts, D. Personal communication. June 11, 1996.

(D. Kohlhorst pers. comm., 1997) Kohlhorst, D. California Department of Fish and Game, Bay-Delta and Special Water Projects Division. Personal telephone communication. March, 4 1997.

(D. Mitchum, pers. comm., 1996) Mitchum, D. Personal communication. November 12, 1996.

(D. Vogel, pers. comm., 1997). Vogel, D. NRS. Personal communication. 1997.

(G. Stern, pers. comm., 1997) Stern, G. National Marine Fisheries Service. Personal communication. 1997.

(G. Wylie, pers. comm., 1997) Wylie, G. U.S. Geologic Survey, Biological Resources Division. Personal communication. February 3, 1997.

(I. Plescov, pers. comm., 1992) Plescov, I. California Department of Boating and Waterways. Telephone conversation 1992.

(J. Brown, pers. comm., 1996) Brown, J. California Department of Fish and Game, Inland Fisheries Division. Personal communication. September 12, 1996.

(J. Brown, pers. comm., 1997) Brown, J. California Department of Fish and Game, Inland Fisheries Division. Personal communication. March 27, 1997.

(J. Gustafson, pers. comm., 1996) Gustafson, J. California Department of Fish and Game. Personal telephone conversation. October 31, 1996.

(J. Reed, pers. comm., 1996) Reed, J. Tehama County Planning Department. Personal telephone conversation. June 18, 1996.

(J. Renning, pers. comm., 1996) Renning, J. Personal communication. June 11, 1996.

(K. Tokunaga, pers. comm.) Tokunaga, K. Glenn County Air Pollution Control District. Telephone conversations. 1993, 1994, 1996.

(L. Hrynchuk, pers. comm., 1997) Hrynchuk, L. California Air Resources Board. Technical Services. Telephone conversation. August 1997.

(L. Painter, pers. comm., 1996) Painter, L. Butte County Planning Department. Personal telephone conversation. June 18, 1996.

(M. Lee, pers. comm., 1996) Lee, M. Personal communication. August 21, 1996.

(M. Stanbery, pers. comm., 1996) Stanbery, M. Glenn County Sheriff's Office. Telephone conversation. 1996.

(P. Bratovich, pers. comm., 1997) Bratovich, P. Surface Water Resources, Inc. Personal communication. 1997.

(P. Foley, pers. comm., 1996) Foley, P. U.C. Davis. Telephone conversation. November 13, 1996.

(P. Huckabay, pers. comm., 1996) Huckabay, P., DWR, Northern District. Personal communication. 1996.

(P. Ward pers. comm., 1993) Ward, P. California Department of Fish and Game, Biologist, Personal communication. 1993.

(P. Ward, pers. comm., 1996) Ward, P. California Department of Fish and Game, Inland Fisheries Division. Personal telephone communication. July 9, 1996.

(P. Ward, pers. comm., 1997) Ward, P. California Department of Fish and Game, Inland Fisheries Division. Personal telephone communication. 1997.

(R. Jurek, pers. comm., 1996) Jurek, R. California Department of Fish and Game. Telephone communication. October 30, 1996.

(R. McGaugh, pers. comm., 1993) McGaugh, R. California Department of Parks and Recreation. Telephone conversations. 1993.

(R. Schlorff, pers. comm., 1997) Shlorff, R. California Department of Fish and Game. Personal telephone conversation. January 14, 1997.

(R. Wallace, pers. comm., 1993) Wallace, R. Glenn County Sheriff's Department. Telephone conversations. 1993.

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(S. Cramer, pers. comm., 1996) Cramer, S. Personal communication. 1996.

(S. James, pers. comm, 1997) James, S. 1997. Surface Water Resources, Inc. Field Account. April 18,1997.

(S. Laymon pers. comm., 1996) Laymon, S. Kern River Research Center. Personal telephone conversation. January 1996.

(T. Jackson, pers. comm., 1996) Jackson, T. California Department of Fish and Game. Personal telephone communication. July 17, 1996.

(W. Carson, pers. comm., 1996) Carson, W. USDI Bureau of Reclamation. Telephone conversation. 1996.

(W. Mitchell, pers. comm., 1996) Mitchell, W. Jones & Stokes Associates, Inc. Telephone conversation. 1996.

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CHAPTER 9
LIST OF EIR/EIS RECIPIENTS

C-085857

C-085857

9.0 INDIVIDUALS AND ORGANIZATIONS RECEIVING THE ~~DRAFT~~ EIR/EIS

9.1 Distribution of the Draft EIR/EIS

The following is a list of agencies (in addition to the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) lead agencies) and other interested parties that receiveding a copy of the Draft EIR/EIS.

Individuals

Thomas E. and Karen M. Alexander
Harold and Louis Berge
Marjorie G. Brock
Jai and Satya Vati Chand
Walter Cook
Cordell and Lola Cose
Stanford M. Davis
Brad Eidman
Harold and Janice Flood
Donald Hunter
Leonard and Diane Knecht
Robert McLane
Paul E. and Patricia Ragan
Eugene Spatfa
Dallas and Lois Stolenberg

Business Organizations

Ayres Associates
Barnard Coust
Deseret Farms (Wilson Ranch)
Farm Development Corporation
Gro-Marine, Inc.
Medley Realty
Montgomery Watson
Tehama Land Development Company
Tehama Local Development Company
Tetra Tech
The Ferguson Group
The Gualco Company
Will & Carlson

Local Government

City of Arbuckle
City of Chico
City of Colusa
City of Corning
City of Orland
City of Red Bluff
City of Sacramento
City of Tehama
City of Williams
City of Willows
Colusa City Council
County of Butte Planning Department
County of Colusa Planning Department
County of Glenn Planning Department
County of Sacramento Water Resources Division
County of Tehama Planning Department
Glenn County Air Pollution Control District
Glenn County Board of Supervisors
Hamilton City
Monterey County Water Resources Agency

Congressional and Legislative Representatives

Honorable Barbara Boxer
Honorable Vic Fazio
Honorable Dianne Feinstein
Honorable K. Maurice Johannessen
Honorable George Miller
Honorable Bernie Richter
Honorable Tom Woods

State Government

California Air Resources Board
California Department of Boating and Waterways
California Department of Conservation
California Department of Food and Agriculture
California Department of Parks and Recreation
California Department of Transportation
California Department of Water Resources
California Environmental Protection Agency
California Regional Water Quality Control Board - Central Valley Region
California Resources Agency
California Water Commission
Native American Heritage Commission
Office of Historic Preservation
State Lands Commission
State Reclamation Board

Federal Government

Advisory Council on Historic Preservation
National Marine Fisheries Service
National Park Service
U.S. Coast Guard
U.S. Environmental Protection Agency (Washington DC and San Francisco)
U.S. Fish and Wildlife Service
USDI Bureau of Indian Affairs
USDI Bureau of Land Management
Sacramento National Wildlife Refuge Complex

Special Interest Groups

Butte Environmental Council
California Farm Water Coalition
California Rice Industry Association
California Sports Fishing Protection Alliance
California Waterfowl Association
California/Nevada American Fisheries Society
Colusa County Farm Bureau
East Sand Slough Ski Team

Special Interest Groups (Continued)

Environmental Defense Fund
Family Water Alliance
Farmers Rice Cooperative
Friends of the River
Glenn County Farm Bureau
Golden Gate Fishermen's Association
Natural Heritage Institute
Natural Resources Defense Council
Nature Conservancy
NOR-CAL Fishing Guides
Pacific Coast Federation of Fisherman Association
~~Sacramento National Wildlife Refuge Complex~~
Sacramento River Council
Sacramento River Preservation Trust
Sacramento Valley Landowners Association
Sacramento/San Joaquin Estuary FRO
Salmon Unlimited
Sierra Club
Tehama Coop Extension
Tehama County Farm Bureau
Tehama Fly Fishers Preservation Trust
Tehama Sportsman Club
United Anglers of California
Western States Water Council

Libraries

Antioch Public Library
Bayliss Branch Library
Bureau of Reclamation Library
Butte County Library
California State Library
California State Resources Agency Library
Colusa County Library
Elk Creek Branch Library
Hamilton City Library
Natural Resources Library, U.S. Department of Interior
Shasta County Library
Solano County Library
Stockton-San Joaquin County Library
Stockton-San Joaquin Law Library

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Libraries (Continued)

Sutter County Free Library
Tehama County Library
Willows Public Library
Yolo County Library

Schools/Universities

California State University, Chico, Special Collections Department, Meriam Library
California State University, Sacramento, Program Director, Water Programs
Humboldt State University, Fisheries Department
Northeast Information Center, Department of Anthropology, California State University, Chico
Northwest Information Center, Department of Anthropology, California State University, Sonoma
Northwestern University Institute for Policy Research
University of California-Berkeley, Water Resources Center Archives
University of California Cooperative Extension Farm Advisor
University of California, Davis , Shields Library
University of the Pacific Library

Media

Appeal Democrat
Chico Enterprise-Record
Colusa Sun Herald
Corning Observer
Orland Press Register
Red Bluff Daily News
Sacramento Valley Mirror
The Sacramento Bee
Valley Post
Willows Journal

~~Local~~ Levee and Water Districts

Colusa Basin Drainage District
Colusa Drain Mutual Water Company
El Camino Irrigation District
Imperial Irrigation District
Maxwell Irrigation District
Oakdale Irrigation District
Orland Unit Water Users Association
Princeton-Codora-Glenn Irrigation District
Provident Irrigation District
Sacramento River West Side Levee District
Tehama-Colusa Canal Authority
Westlands Water District

Reclamation Districts

Reclamation District #2047

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9.2 Distribution of the Final EIR/EIS

The following is a list of agencies (in addition to the CEQA and NEPA lead agencies) and other interested parties receiving a copy of the Final EIR/EIS.

Individuals

Thomas E. and Karen M. Alexander
Harold and Louis Berge
Marjorie G. Brock
Jai and Satya Vati Chand
Cordell and Lola Cose
Stanford M. Davis
Harold and Janice Flood
Carl Funke
Donald Hunter
Leonard and Diane Knecht
Paul E. and Patricia Ragan
Leroy Schaad
Eugene Spatfa
Dallas and Lois Stolenberg

Business Organizations

Deseret Farms (Wilson Ranch)

Local Government

County of Butte Planning Department
County of Colusa Planning Department
County of Glenn Planning Department
County of Tehama Planning Department
Glenn County Air Pollution Control District
Glenn County Board of Supervisors
Hamilton City

Congressional and Legislative Representatives

Honorable Barbara Boxer
Honorable Vic Fazio
Honorable Dianne Feinstein
Honorable K. Maurice Johannessen
Honorable George Miller
Honorable Bernie Richter
Honorable Tom Woods

State Government

California Department of Boating and Waterways
California Department of Water Resources
California Regional Water Quality Control Board - Central Valley Region
California Resources Agency
State Lands Commission
State Reclamation Board

Federal Government

National Marine Fisheries Service
National Park Service
U.S. Environmental Protection Agency (Washington DC and San Francisco)
U.S. Fish and Wildlife Service
Sacramento National Wildlife Refuge Complex

Special Interest Groups

Friends of the River
Sacramento River Preservation Trust

Libraries

Butte County Library
Colusa County Library
Hamilton City Library
Natural Resources Library, U.S. Department of Interior
Tehama County Library
Willows Public Library

Schools/Universities

California State University, Chico, Special Collections Department, Meriam Library

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Local Levee Districts and Water Districts

Colusa Basin Drainage District
Colusa Drain Mutual Water Company
Maxwell Irrigation District
Orland Unit Water Users Association
Princeton-Codora-Glenn Irrigation District
Provident Irrigation District
Sacramento River West Side Levee District
Tehama-Colusa Canal Authority

Reclamation Districts

Reclamation District #2047

CHAPTER 10
COMMENTS/RESPONSES
ON DRAFT EIR/EIS

Table 10-1
Index to Written and Oral Comments on the Draft EIR/EIS*

Individuals (I)		
Jai Chand	October 31, 1997	I1
Leroy Schaad	November 4, 1997 (oral) November 7, 1997	I2
Carl Funke	November 7, 1997	I3
Business Organizations (B)		
Deseret Farms	November 24, 1997	B1
Local Government (L)		
Glenn County Board of Supervisors	November 4, 1997	L1
State Government (S)		
The Reclamation Board	October 14, 1997	S1
The Reclamation Board	October 21, 1997	S2
Department of Water Resources	November 10, 1997	S3
State Lands Commission	November 19, 1997	S4
Federal Government (F)		
National Park Service	October 22, 1997	F1
U.S. Fish and Wildlife Service	November 21, 1997	F2
U.S. Environmental Protection Agency	November 24, 1997	F3
Special Interest Groups (G)		
California Sportfishing Protection Alliance	November 10, 1997	G1
Sacramento River Preservation Trust	November 24, 1997	G2
Friends of the River	November 24, 1997	G3
Local Levee Districts and Water Districts (D)		
Colusa Basin Drainage District	November 14, 1997	D1
Reclamation Districts (R)		
Reclamation District No. 2047	November 12, 1997	R1

*Unless otherwise noted, comments listed are written comments.

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10.0 COMMENTS/RESPONSES TO COMMENTS ON DRAFT EIR/EIS

This chapter presents written and oral comments submitted on the Draft EIR/EIS. The lead agencies' responses to comments are also presented.

Table 10-1 provides an index to the comments received on the Draft EIR/EIS. The comments are organized by the same categories used to list those that received copies of the Draft EIR/EIS (Chapter 9, Individuals and Organizations Receiving the EIR/EIS). The lead agencies' responses to comments are presented side-by-side with the comments to facilitate review of both the responses and the comments.

The remaining pages of this chapter present new information not presented in the Draft EIR/EIS. However, the text on the following pages is not underlined to aid the reader in reviewing the information.

Table 10-1
Index to Written and Oral Comments on the Draft EIR/EIS*

Individuals (I)		
Jai Chand	October 31, 1997	I1
Leroy Schaad	November 4, 1997 (oral) November 7, 1997	I2
Carl Funke	November 7, 1997	I3
Business Organizations (B)		
Deseret Farms	November 24, 1997	B1
Local Government (L)		
Glenn County Board of Supervisors	November 4, 1997	L1
State Government (S)		
The Reclamation Board	October 14, 1997	S1
The Reclamation Board	October 21, 1997	S2
Department of Water Resources	November 10, 1997	S3
State Lands Commission	November 19, 1997	S4
Federal Government (F)		
National Park Service	October 22, 1997	F1
U.S. Fish and Wildlife Service	November 21, 1997	F2
U.S. Environmental Protection Agency	November 24, 1997	F3
Special Interest Groups (G)		
California Sportfishing Protection Alliance	November 10, 1997	G1
Sacramento River Preservation Trust	November 24, 1997	G2
Friends of the River	November 24, 1997	G3
Local Levee Districts and Water Districts (D)		
Colusa Basin Drainage District	November 14, 1997	D1
Reclamation Districts (R)		
Reclamation District No. 2047	November 12, 1997	R1

*Unless otherwise noted, comments listed are written comments.

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P.O. Box 31
Gridley, CA 95948

I1

October 31, 1997

U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 955814

Ref: Colusa Glenn Canal District - Sacramento River

Dear Sir:

A My Property that is sitting next to the said pumping plant in Hamilton City has had erosion since the district dredged up the old river channel next to my place and filled it with rocks and gravel. This shows on their map. They were in a bind at that time and their interfering the flow of the river started the erosion on my place. All of their filling up of the river with gravel and rocks is filling the main stream of the Sacramento River and I am getting more erosion on the east side of my ranch.

B In 1970 my neighbors on the east side of the river, New Hall Land Co., did the same thing to me as the district plans on doing with damming up the main stream above me on both sides to raise the water level in the river to feed the intake channel. That is going to force the water against me where I have an erosion and loss of 85-90 acres to New Hall Land Company's actions. Now this time around the water will shoot right to the east side corner and wash against the gravel bar bringing that gravel bar more closer to my walnut orchard and it will really play havoc to my place. I have already lost enough land due to my neighbors thoughtless actions, I don't want to lose any more of my orchard due to the district's actions.

C Nobody is allowed to interfere with the river's flow. The canal district does some ritual every year at my place when I am not around, early in the morning or later in the evening. For five years now the district goes in my place without my permission and surveys my place for their new canal site. The district marks my place in a few places along Montgomery Avenue and each time I am not to disturb their markers. The district employees tell me each time that they have a very good site to put the canal through my place because my place where they are to set their pumps has a lake type water on the mouth of their new canal and there is a rifle down stream in the river that ensures good water for all of the time for their canal.

These employees also tell me that the district has hired real expensive lawyers to put me out of my place. They tell me that they won't see me around any more. I understand that the GCCD district is a great and powerful because it is a semi government agency. I would like to know that a poor farmer like me can farm his walnuts that he planted in 1976 and 1982 and brought them into production with my family's help. I want this orchard that has just started to produce and paying its way now after 21-22 years that we have worked so hard to bring into production. It looks to me that it might not be with me anymore if whatever the district is going to do will be successful in doing.

Thank you for your consideration.

Sincerely,

Jai Chand
10-3-97

Jai Chand

D P.S. Considering the district is successful in the designs they will be digging their feeder channel and killing the small fish forever. The more the district raises the main stream by damming the more sand and gravel they will get in their feeder channel. They don't have a solution for this. If the solutions is not right it give more problems. They won't be without problems after all of their expenses.

Mr. Jai Chand - I1

A The lead agencies are aware of the ongoing erosion processes in the lower oxbow adjacent to Mr. Chand's property. The erosion is a natural result of flows through the oxbow during flood conditions as discussed in Section 3.1.4.6 (River Channel Stability) and shown in Figure 3.1-10.

B The lead agencies acknowledge Mr. Chand's concerns regarding the expansion of the existing gravel bar. The gradient facility effects on river flows would be greatest at low flows and negligible at high flows. Therefore, because changes in river channel location and erosion processes are greatest at high flows, the course and direction of flows of the river would not be substantially changed by the gradient facility. With the proposed lower oxbow improvements, less erosion potential would exist adjacent to Mr. Chand's property. With existing riprap along the main river channel adjoining Mr. Chand's property (Figure 3.1-9), there would be reduced possibility of future river erosion of Mr. Chand's property.

C Mr. Chand's complaints regarding GCID activities on and concerning his property (i.e., surveying and marking, etc.) are noted. However, responses to such comments are not within the scope of this document.

D The proposed project would substantially increase protection for fish due to a number of considerations, including reduced approach velocities at the screen, increased fish screen bypass flows, and reduced predation as described in Section 4.2.4.4 (Screen Extension with Gradient Facility and Internal Fish Bypass to Oxbow Impacts). The gradient facility is expected to result in slight increases (one to two percent) in sedimentation of the upper oxbow as described under *Sedimentation* in Section 4.1.4 (Impacts). The lead agencies acknowledge that the project would not solve all fish protection problems, but believe that the preferred project would substantially improve conditions for both fish protection and water supply diversions as described in Sections 5.2 (Environmentally Superior Alternative) and 5.3 (Agency Preferred Alternative).

I2 (Oral)

--oOo--

LEROY E. SCHAAD
P.O. Box 1209
Williams, California 95987
(916) 473-5510

THE REPORTER: State your name, please.

MR. SCHAAD: Leroy Schaad.

A I'm a farmer here in -- rice farmer here in the Williams area. And we are down here at the end of the Glenn-Colusa south end of the system. And the flow of this water is very important to us down here as it is everywhere. And so we have consistently -- the people in this area have been keeping track of this fish-screen operation and keeping that new -- the delivery of the oxbow channel open so we -- which the gradient has to be restored so that we have it like it's planned here and the fish screen extended and -- and also the bypass be improved and the outlet back into the river improved like they're planning here according to all the plans here.

B And I appreciate the way this thing is being financed, and I think that the members of the district have been very responsive to the -- giving the share that they should toward promoting this project and paying for it. And it should get us into the new millennium just like we are supposed to be with the real updated system that is absolutely necessary for any farmer to have water at the

Mr. Leroy Schaad - I2 (Oral)

A Your and other farmers' interests in the fish screen improvement project, and your statements regarding the importance of the project to water delivery in the Williams area, are noted.

B The lead agencies acknowledge your support for the proposed cost-sharing of the project, and your identification of the value of the fish screen improvements over the project life.

reasonable rate and maximum efficiency for price and production both.

Thank you.

--oOo--

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I2 (Written)

Thank you for participating in today's public hearing/open house. This comment form is provided for your use in submitting written comments on the Draft EIR/EIS and Corps of Engineers Regulatory Program for the project. Please write your comments below and deposit this form in the comment box at the Court Reporter Station—or fold, seal, and mail this self-addressed form so that it is **postmarked no later than November 24, 1997.**

We appreciate your input!

A

I'M VERY MUCH IN FAVOR OF THE EIR/EIS DRAFT FOR FISH SCREEN IMPROVEMENT PROJECT, HAVING ATTENDED THE PUBLIC HEARING NOV 4th IN WILLIAMS. EVERY PHASE OF PROJECT WILL BENEFIT THE LANDOWNERS OF THE DISTRICT AT AN AFFORDABLE COST.

RECEIVED
NOV 07 1997
By______

I would ☑ would not☐ be interested in future public notices on the fish screen project.

Name	LEROY E SCHAAD		
Title	LANDOWNER IN GLENN-COLUSA IRRIGATION DISTRICT		
Organization			
Address	P.O. BOX 1209 WILLIAMS CA. 95987		
Phone	916-473-5510	Fax	

I2

C-085875

Mr. Leroy Schaad - I2 (Written)

A The lead agencies acknowledge Mr. Schaad's support for accepting the EIR/EIS.

PUBLIC HEARING/INFORMATION OPEN HOUSE

RECEIVED NOV 07 1997

13

GLENN-COLUSA IRRIGATION DISTRICT • CALIFORNIA DEPARTMENT OF FISH AND GAME • U.S. ARMY CORPS OF ENGINEERS • U.S. BUREAU OF RECLAMATION

In cooperation with
U.S. FISH AND WILDLIFE SERVICE and NATIONAL MARINE FISHERIES SERVICE

HAMILTON CITY PUMPING PLANT FISH SCREEN IMPROVEMENT PROJECT
DRAFT ENVIRONMENTAL IMPACT REPORT/ENVIRONMENTAL IMPACT STATEMENT
CORPS OF ENGINEERS REGULATORY PROGRAM

COMMENT FORM

Thank you for participating in today's public hearing/open house. This comment form is provided for your use in submitting written comments on the Draft EIR/EIS and Corps of Engineers Regulatory Program for the project. Please write your comments below and deposit this form in the comment box at the Court Reporter Station—or fold, seal, and mail this self-addressed form so that it is ***postmarked no later than November 24, 1997.***

We appreciate your input!

A As a Farmer in the Glenn-Colusa Irr. Dist. I see the completion of this project as proposed essential to the economic well being of the region. Because of current flow restrictions, we have seen our water costs nearly double and severe water use restrictions. These water restrictions have resulted in decreased water quality in areas of the district and in areas of individual fields. This has reduced our income both as a direct cost and also indirectly by reducing yields.

The flat plate screen design is proven to be effective. It is simple in design and maintenance. The Army Corps gradient facility in the river will improve bypass flows past the screen thereby improving fish passage, and stabilize the river in the area, helping to insure that this facility will last a long time.

Let's get this project built and protect one of our nations most valuable natural resources, irrigated farmland!

I would ☒ would not☐ be interested in future public notices on the fish screen project.

Name	Carl Funke		
Title	Farmer		
Organization			
Address	7542 County Rd 44		
	Willows CA 95988		
Phone	916-934-2593	Fax	

I3

C—085877

Mr. Carl Funke - I3

A Mr. Funke's position that the completion of the proposed project is essential to the economic well being of the region is noted by the lead agencies. Mr. Funke's other comments encouraging the building of the project and the protection of irrigated farmland are also noted.

Deseret Farms of California
Wilson Ranch

6169 Wilson Landing Road
Chico, CA 95973-8902
(916) 343-5365
Fax: 891-8037

B

November 24, 1997

Fish Screen Improvement Project
Draft EIR/EIS/Permit Comments
Attn: Rick Lind
455 Capital Mall, Suite 600
Sacramento, CA 95814

Ref: Hamilton City GCID Improvement Project

A

During the past year we have met with GCID and other Government Agencies. We have shared concerns about upstream issues that could potentially impact the construction and subsequent function of GCID's proposed Fish Improvement Project. The bank protection of our property, "Snaden Island," needs to be resolved before this project proceeds.

- Our primary concern is that approximately 50 million dollars will be spent on a project that could be lost if upstream bank protection is not repaired and maintained. Some of the early work completed by Ayres Associates addressed this issue.

  There are presently two breaches along Snaden Island. Under the right conditions, additional flooding, a new Sacramento River channel could be formed long the east side of Snaden Island. If this were to happen, the new channel could potentially re-enter the river below GCID's inlet, seriously impacting the the 50 million-dollar investment.

B

- An additional concern we have is the effect the gradient restoration might have on upstream erosion along our property. Will the increased elevation of the river at low flow, caused by the gradient restoration, enhance erosion beyond what is experienced now?

C

It is important that these issues be addressed. We would appreciate the opportunity of meeting with you or others to discuss this matter. In our view, it is not prudent to continue a project of this magnitude until pertinent issues are resolved.

Sincerely,

Robert L. Hatch
Manager

Deseret Farms - B1

A Your concern for the protection of Deseret Farms property and the fish screen project is noted. Butte County is the entity responsible for maintaining the revetment at RM 208, which was constructed under the Chico Landing to Red Bluff Bank Protection Project. The lead agencies have reviewed the breaches along Snaden Island and have assessed the potential for river bypass of the fish screen location (Section 4.1.4, Impacts). The lead agencies have concluded that continued maintenance of the revetment at RM 208, combined with erosion resistant materials and other revetment in the area (Figure 4.1-2), would prevent sudden river channel movement. If channel movement occurs, it would likely be gradual and allow sufficient time for the agencies to take preventative measures.

B Effects on water surface elevation caused by the gradient facility would be dependent upon river flow. At river flows between 7,000 cfs and 20,000 cfs, water surface elevations would increase up to approximately two feet between the gradient facility and RM 207. At flows of 40,000 cfs and above, the effects on water surface elevation become negligible. Approximately 85 percent of the average monthly river flows are up to 20,000 cfs (Table 3.1-5). Increases in water surface elevations from the proposed gradient facility would primarily occur within this range. Therefore, no substantial increases in bank erosion would be expected with these water elevation changes.

C The lead agencies expect to have further discussions with Deseret Farms regarding their concerns.

L1

Glenn County Board Of Supervisors

Glenn County Board of Equalization
Air Pollution Control District

Courthouse, 526 West Sycamore Street
Post Office Box 391
Willows, CA 95988-0391
Telephone (916) 934-6400 · Fax (916) 934-6419

CHARLES HARRIS, SR., District 1
GARY FREEMAN, District 2
DICK MUDD, District 3
DENNY BUNGARZ, District 4
KEITH HANSEN, District 5
VINCE MINTO, County Clerk - Recorder

November 4, 1997

Fish Screen Improvement Project
Draft EIR/EIS Comments
455 Capitol Mall, Suite 600
Sacramento CA 95814

RE: Draft Environmental Impact Report/Environmental Impact Statement on the Hamilton City Pumping Plant Fish Screen Improvement Project, Northern Sacramento Valley, California

A

Thank you for the opportunity to comment on the EIR/EIS on the proposed Hamilton City Pumping Plant Fish Screen Improvement Project. The Glenn County Board of Supervisors believes that the EIR is very complete and that the project will provide a benefit to the environment and to Glenn County.

It is very important to the economy of Glenn County that the Glenn-Colusa Irrigation District be able to obtain the full amount of water that is needed for the District.

B

We have examined the alternatives discussed in the EIR/EIS and we believe that the preferred alternative identified in the EIR would be the most suitable solution to the problems faced by the Glenn-Colusa Irrigation District.

Thank you for your consideration of these comments.

Yours truly,

GLENN COUNTY BOARD OF SUPERVISORS

Keith Hansen

KEITH HANSEN, CHAIRMAN

cc: Glenn-Colusa Irrigation District

Glenn County Board of Supervisors - L1

A The lead agencies note the Glenn County Board of Supervisors' position on the completeness of the EIR/EIS. The lead agencies also note that the Glenn County Board of Supervisors believes the project "will provide a benefit to the environment and to Glenn County."

B In selecting the final project design, the lead agencies will consider the Board of Supervisors' position that the preferred alternative, as identified in the Draft EIR/EIS, is the "most suitable solution to the problems faced by the Glenn-Colusa Irrigation District."

S1

THE RECLAMATION BOARD
1416 Ninth Street, Room 1601
Sacramento, CA 95814-5509
(916) 653-5434 FAX: (916) 653-5805
Permits: (916) 653-5726 FAX: (916) 653-5805

October 14, 1997

Mr. Rick Lind
Mr. Paul Bratovich
Surface Water Resources, Inc.
455 Capitol Mall, Suite 600
Sacramento, California 95814

Re: Hamilton City Pumping Plant Fish Screen Improvement Project, Preliminary Draft EIR/EIS.

Dear Mr. Lind and Mr. Bratovich:

A The subject proposed project is located on the Sacramento River and adjacent to Oxbow between River Miles 205 and 206 at the Glenn County and Tehama County boundary. The project is located within a designated floodway over which The Reclamation Board has jurisdiction. Section 8710 of the California Water Code requires that a Reclamation Board permit be obtained prior to start of any work within floodways or levees regulated by the Board.

B Section 8 of The Reclamation Board's regulations (copy attached) requires that applications for permits submitted to the Board must include a completed environmental
C questionnaire that accompanies the application and a copy of any environmental documents prepared for the project. For any foreseeable significant environmental impacts, mitigation for environmental impacts should be proposed. Applications are reviewed for compliance with the California Environmental Quality Act.

D Our initial review of the project did not raise any major concerns for issues under the jurisdiction of the Board. However, the project should not result in adverse hydraulic impacts to the Sacramento River, such as channel or bank erosion, sedimentation, or increase in water surface for the designated floodway design discharge of 180,000 cfs.

The Reclamation Board - S1

A The lead agencies acknowledge that the project is located within a designated floodway over which The Reclamation Board has jurisdiction. Any permits required by the California Water Code would be obtained prior to the start of any work within the floodways or levees regulated by the Board.

B The lead agencies would complete and submit the required permit applications and environmental questionnaire as requested by the Board. A copy of any environmental documents prepared for the project would also be provided to the Board.

C The lead agencies have proposed mitigation measures in the EIR/EIS for foreseeable significant and potentially significant environmental impacts. Mitigation measures for such impacts are presented in Chapter 4 (Impact Analyses) and summarized in Table S-4 of the Summary of the EIR/EIS.

D The project would not result in adverse hydraulic impacts to the Sacramento River. Floodway capacity would not be adversely affected during construction because no in-river activities would occur in the peak runoff months as described in Section 4.1.4.3 (Screen Extension with Gradient Facility Impacts). Changes in floodway discharge also would not be affected during operation. The increase in upstream river stage as a result of channel improvements (including gradient restoration) would have no measurable effects at flow levels of 180,000 cfs.

Mr. Rick Lind and Mr. Paul Bratovich
October 14, 1997
Page Two

For further information, please contact me at (916) 653-5434 or Ricardo Pineda, Chief Engineer for The Reclamation Board, at (916) 653-0402.

Sincerely,

Peter D. Rabbon
General Manager

cc: Navigation and Flood Control Unit
CESPK-CO-O
Sacramento District
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

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C-085886

S2

THE RECLAMATION BOARD
1416 Ninth Street, Room 1601
Sacramento, CA 95814-5509
(916) 653-5434 FAX: (916) 653-5805
Permits: (916) 653-5726 FAX: (916) 653-5805

October 21, 1997

Fish Screen Improvement Project
Draft EIR/EIS Comments
455 Capitol Mall, Suite 600
Sacramento, California 95814

Re: Proposed Comments on the Draft Environmental Report/Environmental Impact Statement for the Hamilton City Pumping Plant Fish Screen Improvement Project

GENERAL:

A The project proposed the construction of riprapped banks and levee slopes and artificial gradient structures in the Sacramento River Designated Floodway. The draft EIS/EIR does not disclose any adverse impact to flood management. However, the placing of a gradient structure in the river will act as a low dam and tend to cause sediment to accumulate upstream. This may destabilize the river and possibly encourage meandering upstream of the gradient facility, as the river may seek the path of least resistance.

B C Construction in the river should be limited to time periods from April 15 to October 30 each year. Material should not be stockpiled in the designated floodway during flood season, which is November to April 15.

SPECIFIC:

D **S-18** *"The potential for the river to meander or flood would not be substantially affected by the presence of any project features including the gradient facility."*

Response: The large amount of riprap on the banks and the levee slopes will prevent meandering. Preventing meandering and keeping the river in place appears to be the purpose of the riprap, and the document should state this.

E **Table 1.7-1**, CEQA Responsible Agencies; (State) The Reclamation Board. *"Encroachment Permit (Cal. Water Code Section 8590) if project has the possibility of impacting a Federal Flood Control Project Levee."*

A The EIR/EIS identifies and discusses potential adverse effects to the floodway capacity during construction under the "Issues Identified and Considered in EIR/EIS Process" section of the Summary, under "Hydrology and Water Resources" in Tables S-3 and 2.6-2 under the impact topic "Flooding Potential During Construction", and under Section 4.1.4.3 (Screen Extension with Gradient Facility Impacts). Potential adverse effects from the gradient facility on floodway capacity, upstream sedimentation, and upstream river meandering have been extensively studied and documented. A summary of these studies is presented in the EIR/EIS under the subsection River Channel Stability in Section 4.1.4 (Impacts). These studies indicate:

- negligible effects on floodway capacity with less than a 0.5-foot increase in water surface elevation at river flows of 100,000 cfs at approximately RM 207.5. Effects on river water elevation continue to diminish upstream;

- deposition of approximately two feet of sediment upstream of the gradient facility in the mainstem river as far as RM 207 (Reclamation 1997c); and

- the gradient facility would have no effect on upstream channel meandering, relative to the no-project alternative, because the gradient facility is hydraulically active only at low flows and the Sacramento River alignment upstream of the HCPP is controlled by the upstream revetment at RM 208, left bank, and the erosion-resistant River Bank Formation on the right bank. See also the response to Comment S2 D.

E

Add: "Encroachment Permit will be necessary for all work within the Sacramento River Designated Floodway." (California Code of Regulations, Title 23, Waters, Division 1. The Reclamation Board, Article 5 - Designated Floodways.)

Page 1-37, Encroachment Permit

Add: "The Reclamation Board will require an Encroachment Permit for all work within the Sacramento River Designated Floodway."

If you have any questions, please call Annalena Bronson at 654-4532.

Sincerely,

Peter D. Rabbon
General Manager

cc: William J. Bennett, Chief
Division of Planning and Local Assistance
1020 Ninth Street
Sacramento, California 95814

Annalena Bronson
Division of Integrated Flood Management
1416 Ninth Street, Room 1641
Sacramento, California 95814

C-085889

B The proposed project schedule considers a number of issues including river runoff and fish protection. The lead agencies would coordinate with cooperating and responsible agencies and the final schedule would reflect the conditions at that time. The EIR/EIS indicates that main river channel construction activities would occur between April 30 and November 15 (Figure 2.4-14), which is within two weeks of the recommended schedule.

C Material could be stockpiled on Montgomery Island and Wilson Landing, but would be sited in a manner to minimize the potential to reduce floodway capacity.

D The comment that the gradient facility is designed to stabilize the river channel is correct. The lead agencies' reference to river meandering concerns areas upstream and downstream of the project site. The text has been revised to clarify that the gradient facility would not substantially affect river meandering upstream or downstream of the project area, but would stabilize both the gradient and channel location in the immediate vicinity of the HCPP.

E Table 1.7-7 and Section 1.7.6.2 have been revised to reflect The Reclamation Board's suggestions.

STATE OF CALIFORNIA—THE RESOURCES AGENCY PETE WILSON, Governor

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

NOV 10 1997

Fish Screen Improvement Project
Draft EIR/EIS Comments
455 Capitol Mall, Suite 600
Sacramento, California 95814

The Department of Water Resources has the following comments on the Draft Environmental Impact Report/Environmental Impact Statement for the Hamilton City Pumping Plant Fish Screen Improvement Project.

A

1. Although outside the scope of the project purpose, the improvements associated with the preferred alternative would clearly increase the potential for use of the Hamilton City Pumping Plant as a possible point of diversion for a proposed CALFED westside reservoir. The document should state this increased potential as a possible future benefit of the project.

B

2. The gradient facility would be designed to create hydraulic conditions that would not hinder upstream fish passage. The document should describe what physical measurements or biological monitoring will take place to insure that the completed structure is not an impediment to fish passage, especially for sturgeon.

C

3. Included on page S-18 is the statement "The potential for the river to meander . . . would not be substantially affected by the presence of any project features including the gradient facility." This statement is incorrect. The stated purpose of the gradient facility is to stabilize the river channel. The effect of the gradient facility, and associated bank revetment, is to directly reduce the potential for river meandering.

D

4. On several occasions the document indicates a potential impact that would likely result from a particular alternative or action but does not indicate whether it would be a mitigated or unmitigated impact. For example, on page S-18, it states that a potentially significant impact of the no-project alternative would be the loss of Shaded Riverine Aquatic Cover. The narrative implies that this alternative would result in an unmitigated impact to SRA compared to other alternatives. We recommend that the reader be informed as to whether the impact being discussed cannot or would not be mitigated in a particular instance.

Department of Water Resources - S3

A The lead agencies acknowledge DWR's position that improvements associated with the preferred alternative would increase the potential for use of the Hamilton City Pumping Plant (HCPP) as a possible diversion point for a proposed CALFED westside reservoir or other diversion projects. Such use and potential operation for this purpose is not within the scope of this EIR/EIS and would be a separate action subject to separate environmental review and decision-making. The potential use of HCPP for CALFED and other possible water management programs is addressed in Section 4.16.3.11, Sacramento Valley Water Management Programs.

B Biological monitoring to ensure that hydraulic conditions would not hinder upstream fish passage, including sturgeon, would be conducted as described in Section 6.4 (Fish Protection Evaluation and Monitoring Plan). The specifics of the plan are being developed by the lead agencies in conjunction with the National Marine Fisheries Service, U.S. Fish and Wildlife Service, and others. The final plan would not be completed until after the Final EIR/EIS is certified and the design of the gradient facility is finalized after completion of the physical model studies.

C See response to Comment S2 D.

D To the extent that impacts from actions of the no-project alternative would be similar to the project alternatives, mitigation measures have been identified and discussed in the EIR/EIS. In some instances, mitigation is not identified for some of the significant or potentially significant impacts of the no-project alternative because it would be subject to separate environmental review if none of the action alternatives are implemented (see discussion under Section 2.4.1.3 (No-Project Mitigation) and under Section 4.0 (Impact Analyses). Mitigation is identified for the project alternatives as described in the Summary (Table S-4), Section 5.1 (Comparison of Impacts Among Alternatives), and

Section 6.2 (Mitigation Measures Recommended for Project Features). Text has been added under "Impact Conclusions" in the Summary to make it clearer for the reader.

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If you have any questions, you may contact William J. Bennett, DWR's Chief of the Division of Planning and Local Assistance, at (916) 327-1646.

Sincerely,

for Robert G. Potter
Chief Deputy Director

cc: Glenn-Colusa Irrigation District
Post Office Box 150
Willows, California 95988

The Reclamation Board
1416 Ninth Street
Sacramento, California 95814

Northern District
Department of Water Resources
2440 Main Street
Red Bluff, California 96080

Department of Fish and Game
1416 Ninth Street
Sacramento, California 95814

Mr. Kirk Rodgers
U.S. Bureau of Reclamation
2800 Cottage Way
Sacramento, California 95825

C-085895

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S4

STATE OF CALIFORNIA | PETE WILSON, *Governor*

CALIFORNIA STATE LANDS COMMISSION
100 Howe Avenue, Suite 100 South
Sacramento, CA 95825-8202

ROBERT C. HIGHT, *Executive Officer*
(916) 574-1800 FAX (916) 574-1810
California Relay Service From TDD Phone **1-800-735-2922**
from Voice Phone **1-800-735-2929**

Contact Phone: (916) 574-1890
Contact FAX: (916) 574-1885

November 19, 1997

File Ref. SCH 93062042

Ms. Maureen Gorsen
General Counsel
The Resources Agency
1020 Ninth St Third Floor
Sacramento CA 95814
Attention: Nadell Gayou

Mr. Rick Lind
Fish Screen Improvement Project
Draft EIR/EIS/Permit Comments
455 Capitol Mall Suite 600
Sacramento CA 95814

Dear Ms. Gorsen and Mr. Lind:

Subject: Hamilton City Pumping Plant Fish Screen Improvement Project Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) and Corps of Engineers Regulatory Program, SCH 93062042

Staff of the California State Lands Commission (SLC) has reviewed the above project. Based on this review, we offer the following comments.

Jurisdiction:

The proposed project analyzed in the document is comprised of a number of separate but related sub-components, distinguished in part by function and location, by agency responsibility, and by funding source. The various project subcomponents and alternatives under review are depicted in Figure S-2 and may be summarized into two major groups: those relating to the pumping plant itself, including fish screens and bypass/oxbow improvements; and those relating to a riverbed gradient control structure.

A As noted in the draft EIR/EIS, Table 1.7-7, the SLC has authority over projects affecting in-river structures, and thus the SLC is a Responsible Agency for this project. Both the east and west channels of the Sacramento River in the location of the proposed project are state-owned sovereign lands under the jurisdiction of the SLC. However, we will not require application for a lease for those portions of the project which are considered part of the pumping plant intake

California State Lands Commission - S4

A The lead agencies would seek the necessary permits from The Reclamation Board and the U.S. Army Corps of Engineers for portions of the project which are considered part of the pumping plant intake structure.

Ms. Maureen Gorsen
Mr. Rick Lind
November 19, 1997
Page Two

A structure, including the fish screens and various other improvements to the west or "oxbow" channel, providing a permit is issued by either the Department of Water Resources, The Reclamation Board, or the U. S. Army Corps of Engineers, pursuant to Public Resources Code 6327.

The remaining element of the proposed project, the Gradient Facility, is comprised of a number of structural alterations to the bed and banks of the current mainstem of the Sacramento River (east channel), which will attempt to control the riverbed slope. The Gradient Facility part of the project will be designed and constructed by the U. S. Army Corps of Engineers, authorized as part of the Sacramento River Flood Control Project.

B Normally, for those portions of the Sacramento River Flood Control Project constructed on sovereign lands, the State Reclamation Board, as non-federal sponsor, obtains a lease from the SLC as part of its responsibility to provide all lands, easements, and rights-of-way for flood control projects. For example, for the Sacramento River Bank Protection Project ("Sac Bank"), The Reclamation Board and the SLC have a long-standing master lease agreement, PRC 7302.9, for past and future bank protection on the Sacramento River and tributaries. Due to the unusual nature of the proposed Gradient Facility, it appears that the Glenn Colusa Irrigation District will be the non-federal sponsor, and thus will need to apply to the SLC for a separate lease for those parts of the Gradient Facility which extend over sovereign lands.

We note that the Gradient Facility has not yet been designed in detail (page 2-45, top), and that it is not scheduled for construction until 1999. We therefore suggest that the Glenn-Colusa Irrigation District, as local sponsor, contact us for authorization at a later date, when the design and engineering of the project components are more settled.

Environmental Impacts

C With regard to the Gradient Facility, we are primarily concerned with navigation, safety, and recreational boating impacts discussed, in section 4.4. We concur that Department of Boating and Waterways advice should be sought and propose that their suggestions be made part of the written record of project conditions. Also, in addition to the mitigation measures presented in the text, we recommend that a program of boater education be instituted, targeting local boaters, e.g., by information signs and brochures at the nearest boat launches, marine and tackle shops. We also recommend that any signs, buoys, or other safety and navigation measures be regularly monitored and maintained for the entire life of the project.

D The document indicates that for smaller boats, the riverbed structure may pose some problems, but no greater than a "natural riffle" would. However, the natural riffles in this portion of the Sacramento River can adjust in bed form and depth, which is why the Gradient Facility is needed in the first place. By contrast, an engineered structure might function like bedrock and be immovable. We recommend that the program which is ultimately design provide a contingency

B GCID anticipates that it would be the non-federal sponsor for the gradient facility portion of the project. GCID would coordinate with the State Lands Commission and apply for any necessary leases for those portions of the project which extend over sovereign lands.

C Mitigation measures, such as posting of warning signs, are proposed for Impact 4.4-3 (potential hazards to boaters and interference with shore recreation activities during construction). In addition to posting and maintenance of warning signs, consultation with the California Department of Boating and Waterways would continue through the operations phase of the project and include development of a boater information program.

D The EIR/EIS section on performance evaluation (Section 6.4, Fish Protection Evaluation and Monitoring Plan) includes identification of potential contingencies such as unintended negative impacts on the river. Specifically, the lead agencies would confer to identify the scope and magnitude of such a problem and, dependent upon the issue, take corrective action to minimize potential adverse effects to boaters. Detailed design studies and physical model testing would be utilized to minimize the potential for such unintended impacts, but the lead agencies acknowledge the possibility, albeit unlikely, of such a situation. The gradient facility performance evaluation portion of the project's monitoring program would provide the forum to address problems in early years of operation. GCID would continue to have maintenance responsibilities for the remainder of the project life.

E As described in Section 4.4 (Recreation and Navigation), the width and depth of the gradient facility is expected to be sufficient for the passage of most 21-foot water craft at normal water levels. Navigation of large vessels through the project area is not expected to be hindered during construction activities (construction activities would not take place during the flood season therefore, no construction equipment would be present) or flood events during operation (project features would be submerged during such events). Barges and other water-based construction equipment would be removed during construction in the case of a flood event.

Ms. Maureen Gorsen
Mr. Rick Lind
November 19, 1997
Page Three

D plan for project modification if it has unintended negative impacts on the river, e.g. the river gradient below the structure becomes too steep and the structure begins to act like a waterfall. The Gradient Facility Performance Evaluation, referenced on page 6-22, in particular should address this issue. Lastly, the environmental analysis should address whether water-based

E construction or flood-fight vessels, e.g. large rock or crane barges, could navigate if necessary through this area during construction and operation of this project.

Thank you for the opportunity to comment. If you have any questions concerning our comments, please contact Diana Jacobs at (916) 574-1877.

Sincerely,

Mary Griggs

MARY GRIGGS
Environmental Services
Division of Environmental
Planning and Management

cc: Ms. Lauren Carly
U.S. Bureau of Reclamation
PO Box 988
Willows, CA 95988

Mr. Matt Davis
U.S. Army Corps of Engineers
1325 J Street
Sacramento CA 95814

Ms. Sandra Dunn
Glenn-Colusa Irrigation District
De Cuir & Somach
400 Capitol Mall Suite 1900
Sacramento CA 95814

Mr. Nick Villa
California Department of Fish and Game
1701 Nimbus Road Suite A
Rancho Cordova CA 95670

OPR

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C-085902

C-085902

On October 22, 1997, Mr. Matt Wagers of the National Park Service called Mr. Rick Lind and left the following message on voice mail:

> Rick, this is Matt Wagers from the National Park Service in San Francisco. I'm calling to let you know that the National Park Service has no comment on the fish screen improvement project up in Hamilton City. If you need to contact me, my number is (415) 427-1442. Thanks.

National Park Service - F1

Comment noted.

F2

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
3310 El Camino Avenue, Suite 130
Sacramento, California 95821-6340

IN REPLY REFER TO:

November 21, 1997

Mr. Rick Lind
Surface Water Resources Inc.
455 Capitol Mall, Suite 600
Sacramento, California 95814

Subject: Draft Environmental Impact Report/Environmental Impact Statement for the Hamilton City Pumping Plant Fish Screen Improvement Project

Dear Mr. Lind:

The following comments are based on the U. S. Fish and Wildlife Service's (Service) review of the draft Environmental Impact Report/Environmental Impact Statement (DEIR/EIS) for the Glenn-Colusa Irrigation District's (GCID) Hamilton City Pumping Plant fish screen improvement project.

GENERAL COMMENTS

A The Service is supportive of the project's purpose of fish protection. The proposed fish screen project is intended to eliminate the adverse effects to fisheries resources associated with the largest inadequately screened water diversion on the Sacramento River. The gradient facility, as an integral project component, creates the majority of adverse environmental impacts from the proposed project. Unavoidable adverse effects to terrestrial and aquatic resources, especially Shaded Riverine Aquatic Cover, riparian forest, and wetland habitats, need to be mitigated to the fullest extent possible to realize the proposed project's maximum benefit to fish and wildlife resources.

B In our review of the September 1994 administrative draft EIR/EIS for the proposed action, the Service had commented on the need for a mitigation plan to address terrestrial and aquatic habitat impacts. The response to our comment was "*specific mitigation plans will be developed and included as part of the revised DEIR/EIS when further design revision is completed and a specific proposed action identified.*" The preferred alternative was identified in December 1996. This September 1997 DEIR/EIS does not contain a mitigation plan. A mitigation plan needs to be developed in coordination with the resource trust agencies and included in the final EIR/EIS.

C Discussion of the internal fish bypass system with the return to river outfall needs to be more neutral in comparison to the open channel bypass. Closed bypass systems are widely used and perform adequately at other large fish screen facilities in the Pacific Northwest and locally, such as at Red Bluff Diversion Dam, approximately 40 miles upstream of the Hamilton City Pumping Plant.

U.S. Fish and Wildlife Service - F2

A Through planning meetings with the lead and cooperating agencies, including the USFWS, feasible mitigation measures for impacts to Shaded Riverine Aquatic (SRA) Cover, riparian forest and other riparian habitats (including the valley elderberry longhorn beetle [VELB]), and wetland habitat were identified, evaluated, and incorporated into the project design. Specifically, the lead agency representatives worked with USFWS representatives as part of a Habitat Evaluation Procedures team to quantify habitat impacts and compensation amounts. Impacts to these habitats have been avoided to the greatest extent possible while still achieving the goals of the project. This includes revegetation of revetted banks within the affected project site, as well as improvement of shoreline and adjacent riparian habitat at the proposed off-site mitigation location.

B The September 1994 administrative draft EIR/EIS did not result in a public document. Comments from that document were, however, considered by the lead and cooperating agencies in preparing the current document. The 1997 public Draft EIR/EIS followed the lead agencies' collaborative work with USFWS, NMFS, and other agencies on the November 1996 administrative draft, March 1997 agency approval draft, and June 1997 pre-public draft. Mitigation planning has paralleled the USFWS development of the Coordination Act Report (Appendix C) and evaluation of mitigation options.

SPECIFIC COMMENTS

D

Page S-1 and Chapter 1, page 1-1. Purpose of the Project. The second purpose of the project, "*to maximize GCID's capability to divert the full quantity of water it is entitled to divert to meet its water supply delivery obligations*" differs markedly in scope from the purpose statement in the approval draft EIR/EIS (July 31, 1997). The GCID's current water right entitlement is 825,000 acre-feet. The full quantity of water GCID is entitled to needs to be defined. The GCID's Water Transfer Policy claims water rights of more than a million acre-feet of water. Neither the DEIR/EIS or the associated Fish and Wildlife Coordination Act report analyzed the effects of increased water diversions at levels above historic conditions. This revised project purpose also implies that reductions on alternative water sources currently used by GCID to meet water delivery obligations are not likely to be reduced.

E

Page 1-27, Table 1.7-3. With the consolidation of the Service's California State Office and the Sacramento Fish and Wildlife Office, the appropriate title for Joel Medlin is now Deputy Field Supervisor.

F

Page 1-33, Fish and Wildlife Coordination Act. The Fish and Wildlife Coordination Act (FWCA) provides for the equal consideration of fish and wildlife resources on federally funded or permitted water resource development projects. Impacts to federally listed species are not assessed under the FWCA but under separate procedures of the Endangered Species Act of 1973, as amended.

G

Page 2-14, Table 2.4-4. One of the purposes of the Habitat Evaluation Procedures (HEP) conducted for this project was to provide acreage estimates needed to compensate habitat losses, These estimated acreages could then be used to approximate the environmental mitigation costs resulting from land acquisition, habitat creation and/or enhancement, and monitoring actions for a cost comparison between the alternatives. Environmental mitigation costs specific to each alternative should be developed.

H

Page 3-55, Delta Smelt. The local project area may be upstream of the range of the Delta smelt, but the proposed project will potentially increase the quantity and the use period that water is diverted at the Hamilton City Pumping Plant. This change in quantity and timing of water diversions may affect flows in the Sacramento and San Joaquin Delta. These effects should be assessed in relation to Delta smelt.

I

Page 4-29, Table 4.1-11. Predicted reductions in GCID water demand on alternative water supplies may have additional benefits to fish and wildlife resources. Reduced GCID water demand on Stony Creek should provide additional water to improve instream flows and broaden the options for fisheries and riparian habitat enhancement on Stony Creek. Reduced GCID demands on Tehama-Colusa Canal deliveries has planning implications for the development of the long-term solution to resolve fish passage and water delivery constraints at Red Bluff Diversion Dam.

J

Page 4-37. Potential for Gradient Facility to Effect Upstream and Downstream River Meandering. The addition of the rock dikes on the left bank of the Sacramento River upstream of the gradient facility to limit bank erosion substantiates the Service's concern that river dynamics may not be well enough understood to predict the long-term effects from the gradient facility on river morphology. Additional bank protection or in-river work may be needed in the future to maintain the function of the gradient facility.

As part of the lead agencies' discussions with the USFWS regarding mitigation, options have been identified that could mitigate for project effects. Specific plan elements have been identified in Chapter 2 (Project Description and Development of Alternatives) and Chapter 6 (Environmental Commitments and Mitigation and Monitoring) based on the lead agencies' proposed mitigation. As described in the text, the lead agencies would continue to work with the USFWS and other agencies to plan details and implementation of the selected mitigation.

C The lead agencies agree that closed bypass systems have been successful and widely used at other large fish screens. The potential for disorientation and cumulative stress of juvenile fish transported through any closed bypass system has been cited in the literature, as is indicated in Impact 4.2-30 of the EIR/EIS. Concerns specific to the Hamilton City Pumping Plant are disclosed in the EIR/EIS. The potential for increased predation from the return to river bypass would be due to the combined effect of an increased transport time, potential hydraulic effects in the pipelines, and the bypass outfall location near a large pool which could provide predator holding opportunities. The discussion of this impact was intended to be as neutral as possible, while still disclosing the potential impact of predation on juvenile fish.

D Entitlements are defined by water rights law. The authorizing actions for this project are limited to fish screen improvements and do not include modifying GCID water supplies. No change to entitlements would result from the proposed action. Projected changes to alternative water sources are addressed in Section 1.4 (Project Objectives), Table 2.6-2 (Issues Carried Forward for Further Analysis), Section 2.2.1 (Regional Study Area), Section 2.4 (Alternatives), Section 4.1 (Hydrology and Water Resources), and Section 5.1 (Comparison of Impacts Among Alternatives).

As stated in Section 2.4, "HCPP operations would not be expected to change substantially from historical (i.e., pre-1992) conditions, but would increase over current conditions." Therefore, water diversions with the proposed action would not increase above historic conditions, and such potential effects do not need to be analyzed. The projected changes to GCID water sources used to meet water delivery obligations are described in Section 4.1 (Hydrology and Water Resources), and in Section 5.1 (Comparison of Impacts Among Alternatives). Specifically, Table 5.1-1 shows anticipated reductions in recaptured irrigation runoff, Tehama-Colusa Canal deliveries, and groundwater. Details on the projections are presented in Appendix B (Hydrology and Water Resources Technical Report).

E Table 1.7-3 has been revised.

K Page 4-64, Operation, Impact 4.2-13; Page 4-85, Operation, Impact 4.2-24; and Page 4-97, Operation, Impact 4.2-34. Increased proportion of flows diverted through the oxbow channel considered a beneficial impact to fisheries. Increasing the number of juvenile fish potentially exposed to the fish screen should not be considered a beneficial impact. Operation of a positive barrier fish screen that reduces entrainment and impingement of juvenile fish, for which the screen is designed, is a beneficial impact. The increased diversion of fish and flows through the oxbow channel and the screen would be a negative impact to fish species or life stages (eggs and larvae) subject to entrainment and impingement. The screen design criterion does not provide adequate protection when compared to the no-project alternative.

L Page 4-81, Impact 4.2-22. Project impacts to non-vegetated erodible shoreline were dismissed as less than significant, "... *because this type of shoreline does not provide unique habitat.*" Non-vegetated erodible shoreline does provide unique habitat, especially for species such as the State-listed bank swallow. Non-vegetated erodible shoreline also plays a critical role in the riverine ecosystem process by allowing a river to meander, creating a diversity of habitats in various successional stages. The determination of impact significance to non-vegetated erodible shoreline may be better assessed in the context of project impacts compared to the extent of non-vegetated erodible shoreline existing in the upper Sacramento River.

M Page 4-92, Operation, Impact 4.2-29. It should be stated that the bypass flow split of 25% internal bypass system compared to 75% oxbow channel applies at river flows of 7,000 cfs and pumping rates of 3,000 cfs. At higher river flows and/or reduced pumping rates, the percent of flows (and presumably the number of fish) in the internal bypass system decreases.

N Page 6-4, Environmental Commitments, fifth bullet and Page 6-9, Environmental Compliance and Mitigation Monitoring Program, third bullet. On- and off-site environmental commitments should not be limited to terrestrial habitats, but should also include aquatic habitat enhancement to compensate project impacts, especially losses to Shaded Riverine Aquatic Cover.

O Page 6-11, Table 6.3-1, Timing Considerations for species of special concern and construction activities. The transplant window for elderberry shrubs (November through the first two weeks of February) needs to be identified and included in the construction scheduling considerations.

P Appendix B, Hydrology and Water Resources Technical Report, B.2.3.1 Hydrology and Demands, CVP Demands. Central Project Water demands for the Sacramento, Delevan, and Colusa National Wildlife Refuges under the 2020 hydrologic conditions should not be reduced from the 1995 "existing conditions" level. The Central Valley Project Improvement Act requires the Secretary of the Interior to provide Level 4 (105,000 acre-feet per year) water supplies to the Sacramento, Delevan, and Colusa National Wildlife Refuges. The 2020 water demand for refuges should be 105,000 acre-feet per year.

Q Appendix B, Hydrology and Water Resources Technical Report, B.4.2. Disaggregation. Provide further explanation of the monthly to weekly conversion process.

The Service appreciates the opportunity to participate in this multi-agency planning effort to provide long-term fish protection at the Hamilton City Pumping Plant. We look forward to the continued coordination with the involved agencies to implement and evaluate an acceptable solution.

F Section 1.7.6 has been revised.

G Additional cost information on the proposed and optional mitigation programs has been included in Chapter 2 (Project Description and Development of Alternatives) of the Final EIR/EIS.

H Delta smelt were considered but concluded not to be affected by the project. Delta smelt do not occur in the project area. The project would not be expected to substantially change Sacramento River flows below Knight's Landing and therefore would not substantially change flows in the Delta or affect delta smelt. Diversions would be anticipated to increase at Hamilton City Pumping Plant, and decrease at locations such as the Tehama-Colusa Canal (see response to Comment F2D above). Although increased reliance on groundwater under the no-project alternative could potentially shift the timing of flows entering the Delta, predicting the change in timing under either the no-project or project alternatives would be speculative. Flows below Knight's Landing on the Sacramento River would be substantially similar with or without the project.

I The hydrologic modeling results for this project indicate that there would be no substantial changes in Stony Creek flows under the preferred alternative, as indicated in Table 4.1-10 of the EIR/EIS. Decreases in diversions at Tehama-Colusa Canal would occur under the preferred alternative, as noted in the comment. Table 4.1-10 also describes the anticipated decrease in diversions at Tehama-Colusa Canal. Sections 4.16.3.8 (Stony Creek Management Plan) and 4.16.3.11 (Sacramento Valley Water Management Programs) discuss these and related water management opportunities.

J See response to Comment G2B. The design purpose of the rock dikes would be to help minimize the potential for river meander around the gradient facility. No additional bank protection or in-river work, beyond maintenance of existing and proposed facilities, would be expected with the proposed project.

K The beneficial impact conclusion for Impact 4.2-24 and Impact 4.2-34 was based upon the net effect of several factors. Increasing the number of fish exposed to the fish screen was not considered to be a beneficial impact. Rather, changes in local flow characteristics and channel morphology and screen performance (e.g., improved approach and sweeping velocities and bypass performance) under this alternative was concluded to provide sufficient benefit to outweigh the negative effects of exposing more fish to the screen.

If you have any questions regarding these comments, please contact Steve Hirtzel of my staff at (916) 979-2733.

Sincerely,

for Wayne S. White
Field Supervisor

cc: USBR, Sacramento, California
USBR, Willows, California (Attn: Lauren Carly)
USBR, Shasta Lake, California (Attn: Kurt Flynn)
USACOE, Sacramento, California (Attn: Mike Nolan/Matt Davis/Bob Junell)
CDFG, Sacramento, California
CDFG, Rancho Cordova, California (Attn: Nick Villa)
NMFS, Santa Rosa, California (Attn: Gary Stern)
DWR, Sacramento, California
GCID, Willows, California (Attn: Van Tenney)
Decuir and Somach, Sacramento, California (Attn: Sandy Dunn)

Hence, the net loss of juvenile fish due to impingement and entrainment would be expected to be reduced, which would be a beneficial impact relative to the existing condition and no--project alternatives.

The no-project alternative includes hydraulic improvements in the oxbow and reduced approach velocities at the existing screen as described in Section 2.4.1 (No-Project Alternative). As a result, no-project would be substantially similar to project conditions considering only this factor (impingement and entrainment). Therefore, the net result of the project relative to the no-project condition for this impact alone was determined to be "no difference," as shown in Table 5.1-2 of the EIR/EIS.

L The EIR/EIS description for Impact 4.2-22 has been revised.

M The comment regarding flow split has been incorporated into the EIR/EIS. The flow split between the internal fish bypass system and the lower oxbow of 25% and 75%, respectively, was based on information provided by the physical model developed by Reclamation, as cited in the EIR/EIS. Recent design changes for the oxbow flow control structure and internal bypass entrance bays provide for greater flexibility for managing flow split in that part of the system. Final design would address, to the greatest extent feasible, the reduction of hot spots at the bypass entrances. Higher flows/pumping rates would not necessarily reduce hot spots. The discussion under Impact 4.2-29 of the EIR/EIS explains that the bypass system would be expected to result in decreased juvenile fish losses.

N Bullet 5 in Section 6.1 (Environmental Commitments) has been revised.

O The information on transplant windows for elderberry shrubs has been added.

P The assumptions used for 2020 hydrologic conditions, including demands for wildlife refuges, are from the CVPIA Programmatic EIS Future No Action runs as discussed with Reclamation in August 1996. The lead agencies acknowledge that the CVPIA Level 4 water supplies to the refuges would be 105,000 acre-feet.

Q Section B.4.2 has been revised to further explain the monthly to weekly conversion process.

F3

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

November 24, 1997

Rick Lind
Fish Screen Improvement Project
Draft EIR/EIS Comments
455 Capitol Mall, Suite 600
Sacramento, CA. 95814

Dear Mr. Lind:

The Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement (DEIS) for the project entitled **Glenn-Colusa Irrigation District, Hamilton City Pumping Plant Fish Screen Improvement Project, Glenn County, California.** Our review is pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508), and Section 309 of the Clean Air Act.

Glenn-Colusa Irrigation District's (GCID) water diversions from the Sacramento River at its Hamilton City Pumping Plant have been identified as a significant impediment to the downstream migration of juvenile salmon. To minimize future losses of fish, and as a component of the US Department of Interior's program to restore fisheries under the Central Valley Project Improvement Act, a fish screen improvement project is proposed. The preferred alternative was unanimously selected by involved State and Federal agencies.

The purposes of the project are to minimize losses of all fish in the vicinity of the pumping plant diversion, including the endangered winter-run chinook salmon, and to maximize GCID's capability to divert the full quantity of water it is entitled to divert to meet its water supply delivery obligations. The pumping plant diversion point is located on an oxbow adjacent to the Sacramento River near the intersection of Butte, Tehama, and Glenn Counties. Three project alternatives and a no-project/no-action alternative are analyzed for an assumed 50-year project life. The preferred alternative is a fish screen extension with an instream Sacramento River gradient facility and an internal fish bypass with the return to the oxbow. The other project alternatives include variations in the extension of the fish screen, gradient facility, and internal fish bypass. The no-project alternative includes increased restrictions on Hamilton City Pumping Plant operations and actions by GCID to replace reduced water supplies from the pump station (e.g., additional groundwater wells, transfers, use of other diversion points). Additional features included in all alternatives are a replacement oxbow flow control structure and bridge to Montgomery Island, and bank and channel modifications (riprap, fill) in the oxbow and on the mainstem of the river to improve and stabilize channel alignment and hydraulics.

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A EPA strongly supports the State and Federal Agencies' commitment to monitoring and adaptive management as provided for in the Environmental Compliance and Mitigation Monitoring and Fish Protection Evaluation and Monitoring Programs. These commitments will ensure implementation of successful mitigation, validation monitoring, and the execution of appropriate corrective actions. Flexibility and adaptive management is especially critical given the complex and intrinsically changing nature of

B the meandering river system. To help maximize flexibility while remaining focused on project objectives, we recommend the FEIS include a table which prioritizes action items, thus providing guidance on what must be done in what order if adequate resources are not received.

C We also wish to acknowledge the eight+ years of intensive study, hydrological modeling, and collaborative effort which has taken place to meet both the fish protection and water supply reliability objectives. We believe this research could also benefit management at other diversion points which may be significant impediments to fisheries recovery. Because of the clear beneficial effects to endangered fisheries, the long-term intensive collaborative effort and research, and connection to the CVPIA Anadromous Fish Restoration Plan, we have classified this DEIS as Lack of Objections-Adequate, LO-1 (see attached "Summary of the EPA Rating System"). We appreciate the opportunity to review this DEIS. Please send one copy of the Final EIS to this office at the same time it is officially filed with our Washington, D.C. office. If you have questions or wish to discuss our comments, please call Ms. Laura Fujii, of my staff, at (415) 744-1579.

Sincerely,

David J. Farrel, Chief
Federal Activities Office
Cross Media Division

Filename: glennfis.dei
MI002044

cc: Lauren Carly, BOR, Willows
Matt Davis, COE, Sacramento
Nick Villa, CDFG, Rancho Cordova
Sandra Dunn, GCID, Sacramento
USFWS, Sacramento
NMFS, Santa Rosa
CRWQCB, Central Valley Region

U.S. Environmental Protection Agency - F3

A The lead agencies acknowledge the U.S. EPA's support for the State and Federal lead agencies' commitment to monitoring and adaptive management as provided for in the Environmental Compliance and Mitigation Monitoring and Fish Protection Evaluation and Monitoring programs.

B The lead agencies acknowledge U.S. EPA's concerns regarding availability of resources and recommendation regarding prioritizing actions. Implementation of the proposed project includes construction of several project components. All of the identified components would be considered necessary, and would be constructed over approximately three years as shown in Chapter 2. The lead agencies anticipate sufficient resources to complete all project components. In the event of insufficient resources, the agencies would collectively determine how to address the issue and proceed in a prudent manner.

C The lead agencies also acknowledge the U.S. EPA's support for the intensive study, hydrological modeling and collaborative effort which has taken place on this project and which could benefit management considerations at other diversion points.

SUMMARY OF RATING DEFINITIONS AND FOLLOW-UP ACTION

Environmental Impact of the Action

LO-Lack of Objections

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC-Environmental Concerns

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

EO-Environmental Objections

The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU-Environmentally Unsatisfactory

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of environmental quality, public health or welfare. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommend for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1-Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2-Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3-Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From: EPA Manual 1640, "Policy and Procedures for the Review of Federal Actions Impacting the Environment."

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CALIFORNIA SPORTFISHING PROTECTION ALLIANCE
P.O. BOX 357
QUINCY, CALIFORNIA 95971

Colonel Dorothy F. Klasse
District Engineer
Sacramento District
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814-2922

November 10, 1997

Re: Public Notice No. 199700567; Glenn Colusa Irrigation District, Appliant; Draft Environmental Impact report/Environmental Impact Statement; Hamilton City Pumping Plant Fish Screen Improvement Project, Northern Sacramento Valley, California; Sacramento River; Comments by California Sportfishing Protection Alliance regarding COE Public Notice 199700567 and Draft EIR/EIS

Dear Colonel Klasse:

We have reviewed Public Notice 199700567 regarding Glenn Colusa Irrigation District's (GCID) application for a Department of the Army permit under the authority of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act to modify GCID's Hamilton City Pumping Plant facilities in the Sacramento River. We reference said COE notice of October 3, 1997.

We have also reviewed the Draft EI/EIS for the Hamilton City Pumping Plant Fish Screen Improvement Project, Northern Sacramento Valley, California; Sacramento River. We reference said EIR/EIS [State Clearing House No. 93062042].

A We are writing directly to the COE because of the following information. The California Sportfishing Protection Alliance (CSPA) filed a complaint with the State Water Resources Control Board (SWRCB) against GCID about ten years ago requesting the SWRCB to order GCID to modify the existing fish screen because of adverse impacts to the people's chinook salmon and steelhead trout resources. The SWRCB referred the complaint and that fish screen matter to the COE.

B We are concerned about the length of time it has taken the COE, other state and federal agencies, and GCID, to
C finally recommend to modify the pumping facilities. Disclose and include an estimate as to the number of chinook salmon and steelhead entrained and harmed at the pumping facility in the draft EIR/EIS for the past ten years. The Draft EIR/EIS has five alternatives. The alternatives are: (1) No-Project Alternative; (2) Screen Extension Alternative; (3) Screen

C-085919

California Sportfishing Protection Alliance - G1

A Comment noted.

B The lead agencies acknowledge the Alliance's concerns regarding the time required to develop a proposed project. However, the history and number of previous fish screen failures, combined with legal challenges and regulatory changes that have occurred over this period, dictated the need for in-depth studies, numerical analyses, and physical models to develop a viable solution to the fish screen problem. In addition, GCID has taken interim measures (e.g., the interim flat-plate fish screen installed in 1993) to help reduce effects on fishery resources until a long-term solution could be implemented. A review of the lead agencies' diligence in pursuing a solution is summarized in Section 1.5.2 (History of Fish Screens), Section 1.6 (Authorizing Actions and Roles of Agencies), and Section 2.1 (Development of Alternatives).

Extension with Gradient Facility; (4) Screen Extension with Gradient Facility and Internal Fish Bypass (Return to Oxbow); and (5) Screen Extension with Gradient Facility and Internal Fish Bypass (Return to River). The highest rated alternative is the Screen Extension with Gradient Facility and Internal Fish Bypass (Return to Oxbow). The lowest rated alternative is the No Project Alternative.

The alternative selection decision will be made collectively by the COE, U.S. National Marine Fisheries Service, U.S. Fish and Wildlife Service, Department of Fish and Game, U.S. Bureau of Reclamation, including GCID.

D We are opposed to the "No Project Alternative". The "No Project Alternative is likely to jeopardize the continue existence of winter-run chinook salmon. See 16 USC Section 1536(a) [ESA].

The fish screen to be selected and constructed should be the alternative that will be the most effective in preventing entrainment, harm, and losses to winter-run chinook salmon, and other races of chinook salmon, steelhead trout, and other fish species.

E Fish screens are not 100% effective. Consequently, there must be a long term monitoring program to determine the number and species of fish entrained, harmed, and lost at the pumping facility. GCID should be required to fund the cost of the annual monitoring program and plan. The final EIR/EIR should include the recommended monitoring program and plan. This would be reasonable since the taxpayers will be footing a large part of the construction cost of the proposed project. And the taxpayers were not at the table when the cost of the fish screen was negotiated between GCID and the state and federal agencies.

F Fish screens are not 100% effective. GCID should also be required to compensate the people for all losses to fish species entrained, harmed, and lost at the new fish screen facility. Compensation should be in the form of a trust fund for the purpose of anadromous fishery restoration and protection projects.

All potential direct, indirect, and cumulative impacts to the human environment resulting from the construction of the new fish screen should be disclose, evaluated, and fully mitigated in the draft EIS/EIS.

That concludes the comments of the CSPA. Please forward a copy of the final EIR/EIS to me. Thank you.

California Sportfishing Alliance - G1 (Continued)

C As part of the Stipulated Agreement between National Marine Fisheries Service, Glenn-Colusa Irrigation District, and California Department of Fish and Game, fisheries studies were performed at the project site to assess the extent of entrainment at the pumping facility. These and other fisheries studies used in the development of the proposed project are addressed in the EIR/EIS (e.g., Section 3.2, Aquatic Resources). Screw trap results from behind the interim flat-plate screen show an absence of chinook salmon and steelhead entrainment .

D Prior to certifying the EIR/EIS and rendering a decision on the project, the lead agencies will consider the Alliance's opposition to the no-project alternative. The lead agencies consider its preferred alternative as described in Section 5.3 (Agency Preferred Alternative) as meeting the Alliance's interest in selecting the alternative most effective in preventing entrainment, harm, and losses to winter-run chinook salmon and other fish species.

E The lead agencies have proposed a comprehensive monitoring program as described in Section 6.4 (Fish Protection Evaluation and Monitoring Program). This monitoring program is being developed by the lead agencies in cooperation with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service. Final monitoring plans would be developed upon final project design and implemented with the start of project operation. One of the primary objectives of the program would be to fine-tune operations of the fish screen baffles, internal fish bypass bays in the screen, and the oxbow flow control structure to maximize fish protection under variable river flows and HCPP operations.

F See responses to Comment G1 C. Design and operation of the project will reduce the impacts to fishery resources to less than significant levels. Funding responsibility for the monitoring program is not within the scope of the EIR/EIS, but cost-sharing would be consistent with the State and Federal lead agency decisions on the project. The project is considered an anadromous fishery restoration and protection project as defined through CVPIA (Section 1.5.2, History of Fish Screen), SB 1086 (Section 3.1.2.5, SB 1086 Upper Sacramento River Fisheries and Riparian Habitat Plan), and the Joint Stipulation of Parties among NMFS, CDFG, and GCID (Section 1.3, Need for Project).

Respectfully Submitted

Bob Baiocchi

Robert J. Baiocchi, Consultant
For: California Sportfishing Protection Alliance
P.O. Box 357
Quincy, CA 95971
Bus Tel: 530-836-1115 or 530-283-3767; Fax: 530-283-5017
e-mail - cspa@psln.com (Note new area code)

Service List

Rick Lind
Fish Screen Improvement Project
Draft EIR/EIS Comments
455 Capitol Mall, Suite 600
Sacramento, CA 95814

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Jim Crenshaw, President
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California Department of Fish and Game
1701 Nimbus Road
Rancho Cordova, CA 95670

Jerry Johns, Asst. Chief
Division of Water Rights
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000

Interested Parties (numerous by e-mail)

sacramento river preservation trust

G2

November 24, 1997

Hamilton City Pumping Plant (HCPP)
Fish Screen Improvement Project
Draft EIR/EIS/Permit Comments
Attn: Rick Lind, Surface Water Resources, Inc.
455 Capitol Mall, Suite 600
Sacramento, CA 95814

Dear Mr. Lind,

The Sacramento River Preservation Trust (Trust) has done an initial review of the Draft Environmental Impact Report/Environmental Impact Statement (DEIR/EIS) for the HCPP Fish Screen Improvement Project and is hereby submitting the following comments:

A

1) The Trust has serious concerns about the gradient facility that is being proposed as part of the Preferred Alternative. This concern is historical on our part and has not been adequately addressed in the DEIR/EIS.

On page S-8, in referring to "natural flood events and other hydraulic forces of the meander process," it is stated that "history demonstrates that these dynamic processes can totally disable fish screen systems at the HCPP." The document then states that "A key project objective is to design a fish screen improvement project that minimizes the potential risk of screen failure due to local changes in river gradient."

On page S-14, the discussion concerning the gradient facility continues with the statement that the facility would be designed "with the characteristics of a natural riffle," with the rationale being that "if fish species and recreational boaters can accommodate natural riffle hydraulic conditions within the Sacramento River, then those hydraulic conditions would provide an acceptable basis for the design of the gradient facility."

So far, so good. However, the discussion on page S-14 ends with the revelation that "The lead agencies are currently in the **design phase** of the project. **Detailed plans** have **not** been developed on the approach and methods for construction of the gradient facility." (Emphases ours)

Clearly, the key requirement of the DEIR/EIS to provide sufficient project information so that an informed decision can be made **has not been met** relative to the issue of the gradient facility. The potential impacts of this component of the HCPP project are **significant** and cannot be put off to

Earth Share OF CALIFORNIA

P.O. Box 5366, Chico, CA 95927
(916) 345-1865

Recycled Paper

Sacramento River Preservation Trust - G2

A Your concern regarding the proposed gradient facility is noted. Significant and potentially significant environmental impacts of the gradient facility are fully addressed in the EIR/EIS (Table 2.6-2, Issues Carried Forward for Further Analysis), Section 4.1 (Hydrology and Water Resources), and Table 5.1-1 (Comparison of No-Project and Project Alternatives Relative to Existing Conditions). The reference to detailed plans "...on the approach and methods for construction of the gradient facility."...does not apply to the design viability, function, or impacts of the gradient facility; rather, as also stated on page S-14 of the Draft EIR/EIS, the detailed plans refer to the construction method. The lead agencies consider the information on the proposed and alternative construction methods in the EIR/EIS as adequate for addressing the potential scope and significance of impacts that would result from construction of the gradient facility. If there are changes in the project that would have potentially significant impacts that were not addressed in the EIR/EIS, then the lead agencies would prepare and issue a supplement or an addendum to the document.

The Issues To Be Resolved that are addressed in the Summary are specific to final design considerations. Substantial new information is not anticipated regarding the potential environmental effects of the project. These issues are sufficiently addressed in the EIR/EIS to make an informed decision regarding the potential consequences of the proposed action. The potential impacts of dredging, rock dikes, optional construction methods, dredge spoil handling, and possible mitigation actions are

A

another day. Without further analysis, the Trust believes the DEIR/EIS is therefore incomplete and out of compliance with the law. (It would appear that the DEIR/EIS is in agreement with our conclusion. Please see page S-23 **ISSUES TO BE RESOLVED • Gradient facility construction method and schedule**, and page S-24 • **The need for periodic dredging of the Sacramento River to maintain effective operation of the gradient facility • The final design and siting of the rock dikes that would help maintain alignment of the river in the vicinity of the gradient facility • Mitigation program for terrestrial habitat and SRA Cover impacts**.)

B

2) Related to the above is the issue of river channel stability. The DEIR/EIS covers this issue on pages 3-29 through 3-35 and appears to rely a great deal on the work of Harvey Mussetter. The Trust is hereby requesting a copy of Mr. Mussetter's 1997 work (*Geomorphic Analyses for GCID Reach, RM 201-210, Sacramento River*). In addition, we would point out that, in referring to the severe flood damage that occurred at RM 208 during January, 1997, the reference to Figure 1.1-2 (see page 1-3) is valuable in that it shows more of the potential of this reach of the river than Mr. Mussetter appears to believe is possible. Simply put, Figure 1.1-2 shows the interrelationship of Snaden Slough to the meander loop that now forms the oxbow adjacent to the HCPP. The enclosed map showing historical river channel movement for the reach from RM 202-209 should also be of benefit in this discussion, as it clearly shows just how dynamic this reach of river truly is.

A consequence of the above is the Trust's belief that the scope of the DEIR/EIS is **insufficient** relative to the discussion of channel stability/meander. What this translates to in the real world is the potential for a **significant** increase in the amount of rock revetment/rip-rap and related channelizing activity that may be required in order to maintain the integrity of the proposed project. This potential is of great concern to the Trust and must be addressed in greater detail than that shown in the DEIR/EIS.

C

3) On page 2-62, in the section entitled "**PROJECT DESCRIPTION AND DEVELOPMENT OF ALTERNATIVES**," Table 2.5-1 has a discussion on "Screen Locations-Alternative Sites for Screens." In particular, it refers to an additional fish screen at RM 201 and the reasons for its elimination as a potential alternative. In a 1993 report by Dr. Kondolf entitled "Glenn-Colusa Fish Screen Improvements Draft Geomorphological Investigations, Task B5.5," it is stated on page 2 that "Another site for Alternative F (requiring more pumping to reach the canal) is downstream near RM 200.5 within a straight, historically stable reach with an extensive outcrop of resistant cemented gravels, where an intake **would be stable and have the**

analyzed throughout Chapter 4 (Impact Analyses) and Chapter 5 (Comparison of Alternatives).

B A copy of the Mussetter (1997) report prepared by M. Harvey was transmitted in January 1998. The flood of January 1997 and its effect on the river from RM 202 through 209 are fully addressed in the Mussetter (1997) report.

The lead agencies are aware of the meander history of this stretch of river (Figure 3.1-9, Erodibility of Geologic Units in Project Area; Figure 3.1-10, Historic Sacramento River Alignment). Analyses described in the EIR/EIS address the dynamics of the meander potential of the river in this area. The issue of river meander and gradient and discussions of analyses performed are presented in Section 1.4 (Project Objectives), Section 1.5.2 (History of Fish Screens), Section 2.1 (Development of Alternatives), Section 2.3.2 (Project Design Considerations: River and Oxbow Hydraulics), Section 2.4.3 (Screen Extension with Gradient Facility Alternative), Section 3.1.4.6 (River Channel Stability), Section 4.1.4 (Hydrology and Water Resources Impacts), and Section 5.1.1 (Comparison of Alternatives; Hydrology and Water Resources). These and other sections fully explore potential channel stability/meander over the 50-year life of the project using the best available information and analysis methods.

The project design includes revetment necessary to help stabilize the river channel/gradient in the vicinity of the fish screen. No additional bank protection is anticipated beyond that identified in the EIR/EIS. Future bank protection would require additional environmental review under NEPA and CEQA.

C Additional information regarding the elimination of this alternative was provided to the Sacramento River Preservation Trust in January 1998. Table 2.5-1 has been revised to more fully explain the basis for elimination of this alternative.

D CALFED's evaluation of possible new reservoirs is beyond the scope of this fish screen project. In addition to the Sites Reservoir, CALFED is evaluating a large number of alternatives that would serve purposes beyond the purposes of this fish screen project and that would be the subject of separate NEPA/CEQA review. The CALFED Chico Landing Intertie alternative would not qualify as a feasible alternative to the fish screen project because it does not meet the fish screen project purposes, need, and objectives. Timing (several years before construction), C **benefit of a relatively straight flow pattern in the channel."** (Emphasis added)

Early on, the Trust recommended that the general site location referred to by Dr. Kondolf should be investigated for the reasons stated. Please provide any and all materials that were used to justify the elimination of this alternative.

D 4) As part of the CALFED process, a number of new facilities are being discussed. It is the Trust's understanding that the possibility of a Sites Reservoir outside Maxwell has generated an engineering concept called the Chico Landing Intertie. This intertie would be a very large pumping facility located on the Sacramento River in the vicinity of the Monroeville Bend (at approximately RM 189). It is the Trust's position that this facility may qualify as an alternative to the proposed project and should be included in the analysis referenced in #3 above.

E 5) On pages S-32 and S-33, Table S-4, mitigation measures for Recreation and Navigation are recommended, yet the gradient facility has yet to be designed and it appears the California Department of Boating and Waterways has yet to be consulted. Is this a case of the cart before the horse?

F Under Terrestrial Biology, mitigation measures that reference a **10-foot** buffer zone for riparian habitat and a **50-yard** buffer zone for active nests of the yellow-billed cuckoo leave a lot to be desired. In addition, construction avoidance within active Swainson's Hawk nesting sites "to the extent feasible" and similar avoidance for nesting habitat for bank swallows "where feasible" can hardly be called mitigation. The recommended action of taking measures "to prevent bank swallows from nesting within 0.25 miles of construction sites between April and August" takes the cake and should be eliminated entirely as a proposed mitigation measure.

G 6) The Trust looks forward to reviewing the recommended Environmental Compliance and Mitigation Monitoring Program (ECMMP) and the Fish Protection Evaluation and Monitoring Program (FPEMP) that will be included as part of the Final EIR/EIS. It is our understanding, as stated on page S-9, that final cost estimates will be presented at the same time (implying, of course, that such estimates are not currently available).

Though details like those referenced in #5 above are of concern to the Trust, our primary interest is in seeing that adequate funding is in place by **all** parties so that the monitoring requirements of the ECMMP and FPEMP are met in an adequate and timely fashion. Please provide the appropriate assurances that this, in fact, will be the case.

institutional (cost allocation, ownership, and regulatory), operational (integration with GCID system and operational flexibility, reliability and capacity), cost (new facilities to intertie with GCID), and other considerations do not support this CALFED alternative as a fish screen project alternative. See also the response to Comment S3 A.

E The Department of Boating and Waterways has been consulted regarding the project and the proposed mitigation measures. Coordination with the Department will continue through the final design, construction, and operation phases of the project.

F Proposed construction work and development of construction access corridors would occur within and adjacent to riparian habitats. In those instances where specific resources of special concern would not be affected, a 10-foot buffer is adequate to account for operation of heavy equipment. A wider avoidance area would be provided for specific resources as described in the EIR/EIS. For the purposes of this project, the lead and cooperating agencies agreed that all riparian impacts, whether permanent or temporary, would be considered permanent due to the length of time required to reestablish reasonably mature riparian growth. Therefore, areas within the 10-foot buffer zone would also be mitigated as if they were permanently damaged.

Surveys conducted in early summer 1997 indicated no yellow-billed cuckoos were present within the project site. The 50-yard buffer zone was recommended (as referenced in the EIR/EIS) by Steve Laymon of the Kern River Research Center.

Mitigation measures for potential impacts to Swainson's hawks were developed using information from CDFG. Bank swallow mitigation was prepared following discussions with Ron Schlorff of CDFG. These mitigation measures are discussed in Section 4.5 of the EIR/EIS.

G The scope of the ECMMP and FPEMP are described in Chapter 6 (Environmental Commitments and Mitigation and Monitoring). The details of these plans would be finalized following agency decisions on the project and permit conditions. See also responses to Comments S4 D, F3 B and G1 E.

Updated cost estimates are in Chapter 2 of the Final EIR/EIS. The lead agencies are obligated to ensure that sufficient funding is allocated for mitigation implementation and monitoring during and following construction.

H 7) Though the Trust is both aware of and has participated in a number of informational meetings over the years concerning the HCPP project, the November 4 meetings were not advertised as public hearings on the DEIR/EIS. The Trust believes this was a mistake and is hereby requesting a public meeting(s) before any and all lead agencies prior to the adoption of the **Final** EIR/EIS. (The identification of **four** lead agencies, in fact, leaves us somewhat confused as to exactly how this process is to proceed to a final decision. Clarification on this issue is hereby requested as well.)

I 8) Last but not least, based on the length of time it has taken to generate the DEIR/EIS for this project, the Trust believes a more significant review period is called for and is therefore requesting an additional 30-day extension to allow comments to be submitted by any and all interested parties. The issue here is not construction deadlines, but the right of the public to insure that their money is being spent wisely and well.

We appreciate being given the opportunity to submit comments on the HCPP project and look forward to your timely response to our concerns.

Sincerely,

John Merz
Chair, Board of Directors

cc: Trust Board of Directors
Interested parties

H The November 4, 1997 meetings, hosted by the lead agencies, were noticed as "public hearings" in 10 publications including: Appeal Democrat (Marysville), Chico Enterprise-Record, Oroville Mercury Register, Red Bluff Daily News, Redding Record Searchlight, Sacramento Valley Mirror, Tri County News, Colusa County Sun Herald, Orland Press Register and Willows Journal. In addition to these notices, the Notice of Availability, which included the date, time and location of the public meetings, was mailed to over 600 people. Finally, the Draft EIR/EIS cover page also identified the date, time, and location of the November 4 meetings.

The above activities exceed NEPA and CEQA noticing requirements and therefore, no additional public hearings are planned for the project at this time. GCID will certify the EIR/EIS at a future Board of Directors meeting. That meeting will be open to the public.

Following the lead agencies' notices of availability on this Final EIR/EIS, each agency will prepare and issue its individual decisions on the adequacy of the EIR/EIS, including whether to approve the project as proposed and under what conditions the project would be allowed to proceed to construction in accordance with CEQA and NEPA requirements. For those lead agencies with permitting responsibilities (e.g., U.S. Army Corps of Engineers), permits would then be issued that could specify additional terms and conditions on the project. Following project approvals, construction of project facilities would be initiated as soon as possible.

Preparation of the EIR/EIS has been a joint process of the lead agencies in cooperation with the USFWS, NMFS, and other agencies (Cover Page and Section 1.7, Public and Agency Consultation and Coordination). Based on public and agency comments on the Draft EIR/EIS, the lead agencies have jointly prepared this Final EIR/EIS, including the identification of mitigation measures and anticipated decision conditions. As a result, the lead agencies have collectively identified and plan to incorporate, as appropriate, anticipated decision requirements into each decision document on the project. Each agency would issue its decision document on the project.

I One of the purposes of the project is to minimize losses of all fish in the vicinity of the pumping plant diversion, including endangered winter-run chinook salmon. Project planning and design studies have been underway for more than a decade. Within the past year, a preferred design has been selected for the proposed project as discussed in the EIR/EIS. Lead agency decisions whether to approve the project and under what conditions are scheduled to be made in early 1998. If approved, the project would be implemented as soon as possible.

Extension of the public comment period by 30 days would not allow the lead agencies to make their decisions and, if appropriate, then initiate and complete key construction activities in time to meet critical construction windows for special-status fish species, thereby causing delays in project implementation. As noted in the lead agencies' December 17, 1997 letter regarding this request, without a demonstrated need for extending the comment deadline, the lead agencies do not believe that an extension to the comment period is warranted, and therefore the lead agencies did not approve the request for an extension.

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G3

FRIENDS OF THE RIVER

November 24, 1997

Fish Screen Improvement Project
Draft EIR/EIS/Permit Comments
Attn: Rick Lind
455 Capitol Mall, Suite 600
Sacramento, CA 95814

Dear Mr. Lind:

The following are comments submitted by Friends of the River in response to the draft EIR/EIS for the Hamilton City Pumping Plan Fish Screen Improvement Project.

A

I. FRIENDS OF THE RIVER REQUESTS AN EXTENSION OF TIME TO SUBMIT DETAILED COMMENTS.

Friends of the River is listed in the Chapter 9 of the EIR/EIS as a special interest group receiving EIR/EIS (pg. 9-2). In fact, Friends of the River did not receive the document until we became aware of its availability on November 7 and requested a copy which was then hand delivered to us during the week of November 10. The failure to provide a copy of the EIR/EIS in a timely manner effectively restricted our comment period to 14 days. Given the length and complexity of the document, this short period is not sufficient for Friends of the River to submit complete and comprehensive comments. We therefore request a 30 day extension of time to submit comments.

B

II. THE INTENT AND PURPOSE OF THE PROJECT ARE MISLEADING.

Friends of the River finds the EIR/EIS to be misleading in terms of its intent and purpose. The proposed action is presented as a "fish screen improvement project" when, in fact, it is a water diversion enhancement project. The impacts of this project are not so much associated with the construction and operation of a fish screen facility, as with the diversion of water from the Sacramento River by the Glenn Colusa Irrigation District (GCID). The EIR/EIS goes so far as to attribute potentially negative impacts on water quality and juvenile salmon to the "no project" alternative -- even though these impacts are associated with GCID's diversion, not with the operation of the fish screen.

C

III. THE IMPACTS OF THE GRADIENT FACILITY ON ENDANGERED FISH ARE NOT ADEQUATELY ADDRESSED.

The EIR/EIS understates the potential impacts of the gradient facility and its accompanying 8,000 feet of rock rip-rap bank protection on endangered (F,S) winter run chinook salmon, threatened (F) winter run steelhead, and candidate endangered (S) spring run chinook salmon. Adults and juveniles of all three stocks will be forced to migrate past the gradient facility and the rip-rap. USFWS studies prove that rip-rap provides poor habitat for these species, particular juveniles. Rip-rap does provide excellent habitat for species which predate on juvenile salmon and steelhead. The impact of the gradient facility and its needed bank protection on threatened, endangered, or sensitive (TES) fish species should be considered a significant and unavoidable impact. This impact is not adequately addressed or mitigated.

128 J Street (second floor), Sacramento, CA 95814-2207

916/442-3155 • FAX: 442-3396 • Email: info@friendsoftheriver.org • http://www.friendsoftheriver.org

Friends of the River - G3

A On September 30, 1997, a copy of the Draft EIR/EIS was sent via United Parcel Service, three-day guaranteed delivery, to the Davis, California office of Friends of the River. A second courtesy copy was provided to the Friends of the River's Sacramento office on November 12, 1997, the same date the request was received. As a result, Friends of the River had more than 45 days to review the document.

One of the purposes of the project is to minimize losses of all fish in the vicinity of the pumping plant diversion, including endangered winter-run chinook salmon. Project planning and design studies have been underway for more than a decade. Within the past year, a preferred design has been selected for the proposed project as discussed in the EIR/EIS. Lead agency decisions whether to approve the project and under what conditions are scheduled to be made in early 1998. If approved, the project would be implemented as soon as possible.

Extension of the public comment period by 30 days would not allow the lead agencies to make their decisions and, if appropriate, initiate and complete key construction activities in time to meet critical construction windows for special-status fish species, thereby causing delays in project implementation. As noted in the lead agencies' December 17, 1997 letter regarding this request, without a demonstrated need for extending the comment deadline, the lead agencies do not believe that an extension to the comment period is warranted, and therefore the lead agencies did not approve the request for extension.

B The lead agencies, in cooperation with the NMFS and USFWS, have identified two primary purposes of the project. The first is to minimize losses of all fish in the vicinity of the pumping plant diversion, including

B (Continued)

endangered winter-run chinook salmon. The second is to maximize GCID's capability to divert the full quantity of water it is entitled to divert to meet its water supply delivery obligations.

As stated in Section 2.4 (Alternatives), the proposed fish screen improvements would enable GCID to meet instantaneous (peak) demands within the existing capacity of the HCPP. Reclamation PROSIM analyses used for this study forecast some changes in deliveries to GCID and other water users as analyzed under the future (2020) condition in this EIR/EIS. HCPP operations would not be expected to change substantially from historical (i.e., pre-1992) conditions, but would increase over current conditions. Total GCID water supply deliveries would not change significantly (Appendix B, Hydrology and Water Resources Technical Report). GCID would reduce its reliance on interim water supplies (e.g., Tehama-Colusa Canal deliveries and groundwater pumping) used to make up for recent years of HCPP restrictions.

The EIR/EIS identifies and addresses impacts associated with increased diversions from the HCPP (over existing conditions) along with the corresponding reductions in diversions from other GCID sources including the Tehama-Colusa Canal, groundwater and irrigation runoff recapture (e.g., Table 4.1-5 and the Hydrology and Water Resources section of Table 5.1-1). Section 2.4.1 (No-Project Alternative) of the EIR/EIS states that if the lead and participating agencies do not implement a long-term solution for the HCPP diversion, as authorized to do so, then the no-project alternative would occur, starting in 1998 (Table 2.4-1 and Figure 2.4-1). GCID's operations would change at HCPP and throughout its water delivery system. To augment fish protection at the existing facility, it is assumed that permit requirements for the no-project alternative would require compliance with existing California Department of Fish and Game (1993) and National Marine Fisheries Service (NMFS) screen criteria to the extent possible year-round (Figure 1.5-2 and Figure 2.4-2). It would be expected that approach velocity criteria (i.e., 0.33 feet per second) could likely be achieved, but that other criteria such as sweeping velocities (i.e., greater than 2.0 feet per second), internal bypass system velocities, and screen exposure times (i.e., less than 2.5 minutes) would not likely be achieved.

Negative impacts would result from the no-project alternative to water quality within the GCID service area and to fisheries within the Sacramento River. Water quality both in the service area and at the point of outflow from the district would be negatively impacted by increased recapture and reuse, thereby increasing salinity. Fisheries would be negatively impacted by increased diversions for GCID at the Red Bluff Diversion Dam (into the

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C-085938

D

IV. THE DIRECT IMPACTS OF THE GRADIENT FACILITY ARE NOT FULLY CONSIDERED.

Although the EIR/EIS speculates that the proposed gradient facility will not necessarily increase upstream and downstream river meandering (pg. 4-37), the document fails to consider the likely direct impact of the facility in terms of increasing the need for bank protection to prevent by-pass of the facility by river meandering. Figure 3.1-9 clearly depicts highly erodable soils and recent channel deposits north, east and south of the gradient facility which could easily facilitate river meander and bypass of the facility. The natural tendency for river meander will require more bank protection upstream and downstream of the facility, in addition to the 10,600 feet of rock rip-rap bank protection already required for the river and oxbow. This additional rip-rap will result in additional impacts on shaded riverine aquatic (SRA) habitat, riparian habitat, and critical habitat for TES fish species. This impact is not addressed in the EIR/EIS.

E

V. THE IMPACTS ON SHADED RIVERINE AQUATIC HABITAT ARE NOT ADEQUATELY MITIGATED.

The project's impact on SRA and riparian habitat is considered significant and unavoidable, although the document claims that this impact will be "substantially offset" by enhancing and restoring existing habitat (pg. 4-174). This claim is largely unsupported in terms of feasibility. Most riparian restoration sites never produce the same level of biological diversity and integrity as natural habitat. There is a long history of riparian mitigation on the Sacramento River that has failed to fully and adequately achieve replacement and restoration goals intended to mitigate the impacts of bank protection and other riverside development. The issue of adequacy and feasibility of SRA and riparian mitigation is not even addressed. Furthermore, the legality of destroying more than 6,500 feet of SRA habitat -- a Resource Category 1 habitat which the USFWS considers irreplaceable -- is legally questionable.

F

VI. THE GRADIENT FACILITY WILL CREATE A DANGEROUS NAVIGATION HAZARD.

The potential for the gradient facility to create a dangerous navigation hazard to power boaters, paddle boaters, and tubers on the Sacramento River is understated. The EIR/EIS provides very little data on boating use in the affected segment, although all indications are that this type of recreational use is increasing in popularity and will continue to increase in the future. No detailed analysis of the potential of the gradient facility to endanger boaters -- particular paddle boaters and tubers -- is provided. Given that the palisades bank protection project was just removed by the State of California at considerable expense in response to boating safety concerns, the EIR/EIS failure to adequately address this important public safety issue in regard to the gradient facility is puzzling.

G

VII. THE GRADIENT FACILITY VIOLATES STATE AND FEDERAL POLICIES TO CREATE A RIPARIAN MEANDERBELT ALONG THE SACRAMENTO RIVER.

State and federal agencies have adopted policies in support of establishing a riparian meanderbelt along the Sacramento River to restore and enhance habitat for several TES

Tehama-Colusa Canal) due to less flow in the Sacramento River between Red Bluff and Hamilton City. Figures 2.4-2 and 4.1-1 illustrate how fish screen approach velocities affect GCID's capability to divert water through the existing fish screen under no-project, existing, and historic fish screen approach velocity criteria.

C Significant and unavoidable impacts from the project are identified in Section 4.20 (Significant and Unavoidable Impacts) and in Section 5.1.2 (Aquatic Resources). The lead agencies agree that riprap reduces the value of rearing habitat of juvenile salmonids.

The project has been designed to minimize impacts on aquatic resources, including considerations for rearing habitat (e.g., minimizing the amount of riprap along the banks of the upper oxbow and avoiding dredging within 10-15 feet of oxbow banks upstream of the riprap). The design would also minimize the potential for predation. Certain project design features, such as the lower oxbow trapezoidal channel and the gradient facility, have been specifically developed to minimize predation. The lower oxbow design would minimize predator holding areas and the gradient facility would provide the hydraulic head for returning fish to the river and at sufficient velocities (greater than 2 feet per second) to prevent predators from occupying the lower oxbow. The winter-run chinook salmon (Federal- and State-listed endangered), steelhead (proposed for listing as endangered under the Federal Endangered Species Act), and spring-run chinook salmon (State Species of Special Concern) were considered in the impact analyses. The net result of the project would be substantial improvements to fish migration and survival in the vicinity of the HCPP.

Use of the Sacramento River by salmonid fish in this location includes migration and some rearing. Mitigation for the loss of SRA Cover, which would occur through the placement of riprap, has been included in the project description, as described in Section 2.4.2.3 and Section 2.4.3.3. The amount of habitat value lost through placement of riprap would be replaced either on-site or at an off-site location to the extent feasible.

The project would be expected to specifically have substantial long-term benefits to juvenile fish because of decreased losses at the fish screen, with the potential for short-term impacts during construction that would be mitigated to the extent feasible.

D The current alignment of the Sacramento River upstream of the gradient facility is controlled by the revetment at RM 208, left bank, and the River Bank formation outcrop that extends from about RM 206, right bank to RM 207, right bank. Revetment installed in 1975 along the west side of Snaden Island is still in place and would prevent channel migration to the east of the proposed gradient facility location. Because the hydraulic effects of the gradient facility are negligible at higher flows, when sediment transport and morphologic changes tend to occur, it would have no effect on upstream channel meandering, relative to the no-project alternative. The gradient facility is not expected to cause the local (RM 206 to RM 207) river alignment to meander outside of its current range of the Modesto/Riverbank Formation and Snaden Island revetment. Ongoing maintenance of the existing upstream revetment, combined with the occurrence of the River Bank formation, are expected to prevent upstream river bypass of the facility.

E The EIR/EIS acknowledges loss of Resource Category 1 SRA Cover habitat as significant and unavoidable (Section 4.20). USFWS policy considers Resource Category 1 habitat as irreplaceable. SRA Cover is not, however, specifically afforded protection under Federal law in this instance. The lead agencies propose to mitigate impacts to SRA Cover to the extent feasible.

The lead and cooperating agencies (including USFWS) have jointly worked to identify how best to provide mitigation that would, to the extent practicable, counter the loss of SRA Cover. Specific mitigation provisions include avoidance, revegetation of on-site bank armament resulting from the project, and enhancement of existing, off-site erodible shoreline and adjacent habitat (e.g., with conversion of orchard land to riparian habitat).

F Minimum flow depth requirements for navigation have not been defined for the project area. Since existing riffles do not pose a barrier to the passage of boat traffic, and the gradient facility is designed with the characteristics of a natural riffle (Section 2.4.3), then the gradient facility riffle is not expected to cause substantially different navigational hazards. The impact analyses presented in Chapter 4 (Impact Analyses) were based on the best available information.

Further, depths within the gradient facility would not fall below 2.5 to 3.0 feet in conjunction with river rates as low as 3,000 to 3,500 cfs. Generally, flows in this part of the river are expected to exceed this range for fisheries purposes (Table 3.1-2). Given the depths within the gradient facility and nearby shallower natural riffles, no increased risk to paddle boaters and tubers would occur. See also the responses to Comments S4 C and S4 D for further information on measures proposed to minimize boating hazards and address contingencies related to the gradient facility.

The gradient facility design is substantially different from the design of the Palisades Bank Protection Project. Based on the design differences, there

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G

terrestrial and aquatic species. Alternatives which include the gradient facility violate this policy by creating a "hard point" along the river which will probably require even more bank protection than the EIR/EIS envisions in order to prevent a river by-pass of the gradient facility.

H

VIII. ALL REASONABLY FORESEEABLE IMPACTS OF THE PROJECT ARE NOT ADDRESSED.

In addition to the gradient facility's likely encouragement of additional rock rip-rap bank protection along the river, the project fails to consider other reasonably foreseeable impacts. For example, GCID's Hamilton City Pumping Plan is considered to be one of two diversion facilities which would divert water for potential off-stream storage in the so called Sites reservoir. The proposed Sites reservoir has been identified as a likely off-stream water storage project north of the Sacramento-San Joaquin Delta which will be considered in the CalFed Delta Plan. The potential for this use of the Hamilton City Pumping Plant and its associated impacts are completely ignored in the EIR/EIS.

I

IX. THE EIR/EIS DOES NOT CONSIDER AN ADEQUATE RANGE OF ALTERNATIVES.

The EIR/EIS fails to consider diversion reductions and increased agricultural water conservation and efficiency as alternatives to the proposed project. Reducing diversions and increasing the conservation and efficiency of agricultural water use in the service area could significantly reduce the environmental impacts of the proposed project. Only the negative impacts of reduced diversion are considered, such as reduced water quality and increased ground water pumping. The positive impacts of switching to less water intensive crops, fallowing areas with marginal soils, installing more efficient irrigation systems are virtually ignored.

X. CONCLUSION

J

Because of the issues raised above, Friends of the River believes that the EIR/EIS fails to meet the requirements of the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). In addition, the project's impacts on TES fish habitat probably violates both the state and federal Endangered Species Acts. For these reasons, we believe the document should be withdrawn and a revised EIR/EIS released which adequately addresses all direct and reasonably foreseeable impacts, provides adequate and feasible mitigation, considers a full range of alternatives, and avoids adverse impacts on TES fish habitat.

Please provide Friends of the River with any further decision documents concerning this project.

Sincerely,

Steven L. Evans
Conservation Director

are no similarities in the potential for increased boating hazards resulting from the use of steel sheet piles.

G Design criteria would minimize unavoidable impacts to riverine and adjacent riparian and wetland habitats. This facility would represent a new "hard point" in the river and would limit the river's meandering along this reach. However, the "hard point" to be established by the gradient facility is recognized as an important goal to the success of the fish screen at HCPP and is specifically supported by three fisheries/riparian restoration programs: the SB 1086 Program (see Section 4.16.3.7), the CVPIA (See Section 1.5.2, History of Fish Screens), and the Department of Fish and Game's Plan of Action. No aquatic or terrestrial habitat programs or policies are known that would be in conflict with the project with the exception of USFWS's policy for SRA Cover. See Sections 4.2.2, 4.5.2, and 4.16 of the EIR/EIS. See also the response to comment G3 E.

H Section 4.16 acknowledges other water planning efforts and the potential future use of HCPP for increasing non-irrigation season diversions, such as for off-stream storage purposes. The scope of the proposed project does not include diversions for this purpose, and therefore does not address potential impacts. Many alternative water management programs are under consideration in the region. An attempt to address them all would be speculative. If a proposal is ultimately presented to use HCPP for conveyance of off-stream storage, then the potential impacts of the specific proposal would be properly addressed through appropriate CEQA and NEPA review processes. See also responses to Comments G2 D and S3 A.

I The range of alternatives was developed to meet the purposes and objectives of the project (Section 1.2, Purpose of the Project and Section 1.4, Project Objectives). Existing conditions represent diversion reductions from historical conditions (Figures 1.5-1 and 1.5-2). The no-project alternative represents a scenario where further diversion reductions would result (Figure 4.1-1). Conservation was considered as an alternative, but dismissed (Table 2.5-1) due to its adverse effects on water quality and soils (salinity build up) as illustrated by recent years of degradation associated with existing pumping plant restrictions (Section 1.5.1, History of HCPP Diversions). Further substantial efficiencies in irrigation are not feasible. Further reductions in supply would be expected to promote conversions from rice to less water intensive crops such as cotton (Section 2.4.1, No-Project Alternative), but would not be expected to result in substantial fallowing of lands. Such conversions, no anticipated fallowing, groundwater level declines, and increased diversions at RBDD would not be expected to have positive impacts.

J See responses to specific comments above.

COLUSA BASIN DRAINAGE DISTRICT

P.O. Box 312, Woodland, California 95776 Phone: (916) 795-3038 Fax: (916) 795-4745

D1

November 14, 1997

GCID Fish Screen Improvement Project
Draft EIR/EIS Comments
455 Capitol Mall, Suite 600
Sacramento, CA 95814

Attention: Mr. Rick Lind

Dear Mr. Lind:

A The Board of Directors of Colusa Basin Drainage District (CBDD) supports acceptance of the Draft EIR/EIS for the Glenn-Colusa Irrigation District fish screen and river gradient project.

GCID is located within the Colusa Basin Drainage District, and members of the CBDD Board and staff have observed the many meetings over the past eight years (and participated in some) which has culminated in this extensive document. The proposed solution has been jointly selected by the District and all regulatory agencies through years of meetings considering a number of alternatives and impacts.

GCID is of major importance to the economy of northern California, and the sooner the District can maximize its capability to divert the full quantity of water it is entitled to divert while protecting salmon and other fish, the better.

Yours very truly,

Jack Wallace

Jack Wallace
Chairman

cc: Glenn-Colusa Irrigation District

BOARD OF DIRECTORS

Jack Wallace • Anthony Azevedo • Harold Myers • Keith Hansen • Kempton Clark • Frank Sieferman • Michael Vereschagin • Rick Massa • William Waite

Colusa Basin Drainage District - D1

A The lead agencies acknowledge the Colusa Basin Drainage District's support for acceptance of the EIR/EIS.

RECLAMATION DISTRICT NO. 2047

Situated in Colusa and Glenn Counties
910 K Street, Suite 310, Sacramento, CA 95814
Phone (916) 446-0197, Fax (916) 446-2404

Trustees:
Don Cecil
President
John Garner
Vice-President
Arthur Andreotti
Manuel Barrett, Jr.
James Jarrett
Rick Simson
Frank Torres
Secretary:
Robert Clark
Attorney:
William Baber

November 12, 1997

Fish Screen Improvement Project
Draft EIR/EIS Permit Comments
455 Capitol Mall, Suite 600
Sacramento, CA 95814

Attn: Rick Lind

Gentlemen:

A

On behalf of the Board of Directors of this District I want to express our support for the Hamilton City Pumping Plant Fish Screen Improvement Project Draft EIR/EIS and the selected preferred alternative. We believe the report has thoroughly addressed the environmental issues and alternatives. The agency preferred alternative should proceed to construction as soon as practicable.

The inclusion of the Gradient Restoration Facility in the preferred alternative is an obvious means of providing for the future integrity of the Project. We support the extensive effort which has been made and believe the proposed Project will be a successful solution to the fish passage concerns at the Hamilton City Pumping Plant site.

Sincerely,
Reclamation District No. 2047

By Donald Cecil,
President

A The lead agencies acknowledge the Reclamation District's support for the project, the selected preferred alternative, and the gradient facility.

GLOSSARY/
LIST OF ACRONYMS

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C-085949

GLOSSARY

Acre-foot (ac-ft) - A quantity or volume of water covering one acre to a depth of one foot (43,560 cubic feet).

Agency Preferred Alternative - The alternative which the agency (or agencies) believes would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical, and other factors.

Anadromous - Pertaining to fish that spend a part of their life cycle in the sea and return to freshwater streams to spawn.

Annual Demand - Total yearly amount of water required for irrigation, usually expressed in a volume (acre-feet).

Approach Velocity - The velocity of water flowing towards and perpendicular to a fish screen face.

Avoidance Periods - Time periods of days, weeks, or months that represent critical life history stages for species. Disruption during these stages could harm individuals and/or populations.

Baffle - A device used to direct water flow, often to equalize flow across a boundary surface such as a fish screen.

California Environmental Quality Act (CEQA) - Act requiring California public agency decision makers to document and consider the environmental impacts of their actions. Also requires an agency to identify ways to avoid or reduce environmental damage and to implement those measures where feasible, and provides a means to encourage public participation in the decision-making process.

Conservation - Reduction in applied water due to more efficient water use.

Cooperating Agency - A cooperating agency may be any federal agency other than the lead agency that has jurisdiction by law or special expertise with respect to the environmental impacts expected to result from a proposal.

Critical Habitat - A specific area or type of area considered to be essential for the survival of a species and designated as such under the Endangered Species Act.

Dewater - To remove water.

Diversion - The removing or turning of water from its natural channels.

Drainage Water - Excess surface or subsurface water collected and conveyed from irrigated lands. May be recaptured and reused or conveyed for downstream demands.

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C-085950

Dredging - Widening or deepening of water channel by removing sand, mud, silt, or gravel. Dredging can be accomplished using suction pumps or mechanical scrappers.

Effects - CEQA Guidelines Definition 15358 states: "Effects" and "impacts" are synonymous. Effects include:

(1) Direct or primary effects which are caused by the project and occur at the same time and place.

(2) Indirect or secondary effects which are caused by the project and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect or secondary effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems.

(3) Effects analyzed under CEQA must be related to a physical change.

Electrical Conductivity - Indicator of salt content of water (salinity), measured by the quantity of electricity transferred across a unit area, per potential gradient, per unit of time.

Emigrate - To migrate or move from one habitat to another; in the case of anadromous fish such as salmon, to migrate or move in a downstream direction from freshwater riverine systems to estuarine and marine systems as juveniles.

Endangered Species Act - State and Federal laws which authorize and establish the process for the protection of habitats and populations of species threatened with extinction. The stated purposes of the Endangered Species Act are to provide conservation of the ecosystems upon which endangered and threatened species depend and to establish and implement a program to conserve these species.

Enhancement - Actions that improve the quality of existing habitat beyond its originally designed purpose or condition.

Entrainment - Process by which fish are pulled through or around the fish screen face and are carried into the intake channel.

Entrapment - Fish become trapped in eddies from which they cannot escape.

Environmentally Superior Alternative - That alternative which minimizes adverse environmental effects. If the no-project alternative is identified as environmentally superior, CEQA Guidelines 15126(d)(4) indicates the EIR shall also identify an environmentally superior alternative among the other alternatives.

Exposure Time - The average length of time fish would be exposed to the fish screen face.

Fallow - To leave land unplanted after plowing.

C —0 8 5 9 5 1

C-085951

Feasible - CEQA Guidelines Definition 15364 states: "Feasible" means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

Fish and Wildlife Coordination Act - The Fish and Wildlife Coordination Act and related acts express the policy of Congress to protect the quality of the environment as it affects the conservation, improvement, and enjoyment of fish and wildlife resources. Under this act, any federal agency that proposes to control or modify any body of water, or to issue a permit allowing control or modification of a body of water, must first consult with the U.S. Fish and Wildlife Service and State fish and game officials.

Fish Migration - Movement of fish from one aquatic habitat to another; in the case of anadromous fish, such as salmon, movement from freshwater to estuarine and marine habitats or vice versa.

Floodplain - Nearly level land, susceptible to floods, that forms the bottom of a valley.

Flow - The volume of water passing a given point per unit of time. Same as streamflow.

Fry - Life stage of fish between the egg and fingerling stages.

Geomorphology - The form or shape of the earth or landscape.

Gradient Facility - A project feature that would be located at approximately River Mile 205.6 with characteristics similar to a natural riffle. Its function would be to provide a nominal increase in water surface elevation at the fish screen, reduce risk of local river gradient change, and provide the head differential necessary to efficiently and reliably operate the fish bypass facility.

Groundwater - Water contained beneath the land surface of the earth that can be collected with wells, or drainage galleries, or water that flows naturally to the earth's surface via seeps or springs.

Hydrologic Hydraulic "Hot Spot" - An area along the screen face that is subject to velocities or unusual flow patterns that could impinge, entrain, or entrap small fish.

Immigrate - To migrate or move from one habitat to another; in the case of anadromous fish such as salmon, to migrate or move in an upstream direction from estuarine and marine systems to freshwater riverine systems as adults.

Impacts - "Impacts" and "Effects" are synonymous. See "Effects" for a complete description.

Impingement - Flows causing fish to become stuck to the face of the fish screen.

Instantaneous (Peak) Demand - Peak daily amount of water required to meet near-term irrigation needs. This is usually expressed as flow (cubic feet per second).

C—085952

C-085952

Intake Channel - Referring to the upper oxbow channel upstream of the Hamilton City Pumping Plant diversion.

Internal Fish Bypass - Openings (bays) along the screen face that lead to pipelines which take juvenile fish downstream of the fish screen. Its purpose is to minimize fish screen exposure time.

Lead Agency - CEQA Guidelines Definition 15367 states: "Lead Agency" means the public agency which has the principal responsibility for carrying out or approving a project.

Mainstem - The principal channel of the river.

Meander - A turn or winding in a river or streambed that changes over time.

Mitigation - CEQA Guidelines Definition 15370 states: "Mitigation" includes: (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the impacted environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments.

Mortality - The rate or proportion of deaths.

National Environmental Policy Act (NEPA) - Directs federal agencies to prepare an environmental impact statement for all major federal actions which may have a significant effect on the human environment. States that it is the goal of the federal government to use all practicable means, consistent with other considerations of national policy, to protect and enhance the quality of the environment. Requires all federal agencies to consider the environmental impacts of their proposed actions during the planning and decision-making processes.

Outflanking - In this EIR/EIS, refers to a river deviating from its normal course, as might occur during a flood event.

Overwinter - To remain in a particular habitat through the winter season.

Oxbow - Crescent shaped bend in the river.

Pacific Flyway - An established air route of waterfowl and other birds migrating between wintering grounds in Central and South America and nesting grounds in Pacific Coast states and provinces of North America.

Piscivourous - Fish that eat other fish.

Pumping - To draw water from a river.

Recapture - Water diverted for reuse from runoff of agricultural fields.

Redd - A depression dug by spawning salmon in gravel into which eggs are laid.

C-085953

C-085953

Responsible Agency - CEQA Guidelines 15381 states "Responsible Agency" means a public agency which proposes to carry out or approve a project, for which a Lead Agency is preparing or has prepared an EIR or Negative Declaration. For the purposes of CEQA, the term "Responsible Agency" includes all public agencies other than the Lead Agency which have discretionary approval over the project.

Restoration/Revegetation - Reestablishing a habitat or plant community in an area that historically supported it.

Revetment - Materials (e.g., rock, riprap, or matting) or a structure placed to restrain underlying material from being transported away.

Revetted Bank - Shoreline protected by riprap.

Riffle - The topographic high points on a streambed profile composed of the coarsest bed material being transported by the river.

Riparian - Located on the banks of a stream, river, lake, or pond.

Riprap - A foundation or wall made of broken stones or other erosion-resistant material (e.g., concrete).

Riverine - Relating to, formed by, or situated on a river.

Sacramento River Water Management System - The upper Sacramento River, its tributaries, and facilities affecting the timing and amounts of flows in the river.

Salinity - The quality, state, or degree of saltiness.

Salmonid - A fish or species of the salmon and trout family.

Scoping - An early, open process for determining the scope of issues to be addressed and identifying the significant issues related to a proposed action.

Screen Extension - The feature or alternative that would lengthen the existing fish screen.

Screen Extension with Gradient Facility - The project alternative that includes a gradient control structure on the main channel of the river.

Screen Extension with Gradient Facility and Internal Fish Bypass - The project alternative that includes an internal fish bypass to minimize screen exposure time for fry. The internal fish bypass options include returning the fish via closed pipe to either the lower oxbow or to the river.

Sedimentation - Soil or gravel transported by water from other streams and bodies of water that settle out of the water and are deposited.

Sensitive Receptor - Defined in this EIR/EIS as residences for purposes of noise impact analyses.

Sensitivity Level - Generally defined in this EIR/EIS as the threshold at which rice growth and/or yield is adversely affected.

Shaded Riverine Aquatic Cover (SRA Cover) - Unique, nearshore aquatic areas occurring at the interface between a river (or stream) and adjacent woody riparian habitat. Characteristics include: the adjacent bank being composed of natural, eroding banks supporting riparian vegetation that either overhangs or protrudes into the water; waters containing variable amounts of woody debris, such as leaves, logs, roots, and branches. This type of habitat has been designated as Resource Category 1 under U.S. Fish and Wildlife Service Mitigation Policy.

Special-Status Species - Any species listed or proposed for listing under the Endangered Species Act.

Streamflow - The volume of water passing a given point per unit of time.

Thalweg - Generally defined as the center line of a river channel that (where uncontrolled) is constantly changing as a function of flow, sedimentation, and erosion processes, and other physical properties.

Turbidity - Suspended matter in water that causes the scattering or absorption of light rays and a cloudy appearance.

Water Supply Levels - Pertaining to National Wildlife Refuge water supplies: Level 1 - existing firm supply; Level 2 - current average annual water supply; Level 3 - supply for full use of existing development; Level 4 - supply for optimum habitat management.

Weir - A structure built across an open stream channel for measuring or controlling water flow.

Wetlands - Lands including swamps or marshes.

C—085955

C-085955

LIST OF ACRONYMS AND ABBREVIATIONS

AAHU .... Average Annual Habitat Units
ac-ft .... acre-feet
ACID .... Anderson-Cottonwood Irrigation District
afa .... acre-feet annually
AFRP .... Anadromous Fish Restoration Program
AMG .... Agency Management Group
APCD .... Air Pollution Control District
APE .... Area of Potential Effect
BA .... Biological Assessment
BIA .... U.S. Bureau of Indian Affairs
BMPs .... Best Management Practices
CALTRANS .... California Department of Transportation
CARB .... California Air Resources Board
CBD .... Colusa Basin Drain
CCR .... California Code of Regulations
CDBW .... California Department of Boating and Waterways
CDFG .... California Department of Fish and Game
CDPR .... California Department of Pesticide Regulation
CEQA .... California Environmental Quality Act
CESA .... California Endangered Species Act
cfs .... cubic feet per second
CHO .... constant head orifice
cm .... centimeters
CNDDB .... California Natural Diversity Data Base
CNPS .... California Native Plant Society
CO .... Carbon Monoxide
Corps .... U.S. Army Corps of Engineers
CVP .... Central Valley Project
CVPIA .... Central Valley Project Improvement Act
CVRWQCB .... Central Valley Regional Water Quality Control Board
dBA .... daily average decibel levels
Delta .... Sacramento-San Joaquin Delta
dS/m .... deci-Siemens per meter
DWR .... California Department of Water Resources
ECMMP .... Environmental Compliance and Mitigation Monitoring Program
EIR .... Environmental Impact Report
EIS .... Environmental Impact Statement
EPA .... U.S. Environmental Protection Agency
ESA .... Endangered Species Act
EWG .... EIR/EIS Work Group
FPEMP .... Fish Protection Evaluation and Monitoring Program
ft/s .... feet per second

C-085956

C-085956

GCID .... Glenn-Colusa Irrigation District
HCPP .... Hamilton City Pumping Plant
HEP .... Habitat Evaluation Procedures
HSI .... Habitat Suitability Index
HU .... Habitat Unit
Hz .... cycles per second
I-5 .... Interstate 5
Interior .... U.S. Department of Interior
ITA .... Indian Trust Assets
kV .... kilovolts
kW .... kilowatt
lbs/day .... pounds per day
maf .... million acre-feet
mg/l .... milligrams per liter
mgd .... million gallons per day
mm .... millimeter
MOU .... Memorandum of Understanding
mph .... miles per hour
msl .... mean sea level
NAAQS .... National Ambient Air Quality Standards
NEPA .... National Environmental Policy Act
NMFS .... National Marine Fisheries Service
NO_2 .... nitrogen dioxide
NOD .... CEQA Notice of Determination
NOI .... Notice of Intent
NOP .... Notice of Preparation
NO_X .... oxides of nitrogen
NRCS .... Natural Resources Conservation Service
NRHP .... National Register of Historic Places
NSVAB .... Northern Sacramento Valley Air Basin
NTU .... Nephelometric Turbidity Units
OSHA .... Occupational, Safety and Health Administration
PM_{10} .... Particulate Matter up to 10 Microns in Size
PMG .... Project Managers Groups
ppb .... parts per billion
ppm .... parts per million
ppt .... parts per thousand
PROSIM .... Project Simulation Model
RBDD .... Red Bluff Diversion Dam
RCE .... Resource Consultants and Engineers
RD .... Reclamation District
Reclamation .... United States Department of the Interior, Bureau of Reclamation
RM .... River Mile
ROG .... reactive organic gasses
rpm .... revolutions per minute

C—085957

C-085957

SB	Senate Bill
SCAMPI	Sharing of Costs Agreement for Mitigation Projects and Improvements
Secretary	Secretary of the U.S. Department of Interior
SLC	State Lands Commission
SMAQMD	Sacramento Metropolitan Air Quality Management District
SO_2	sulfur dioxide
SO_x	oxides of sulfur
SRA Cover	Shaded Riverine Aquatic Cover
SWP	State Water Project
SWRCB	State Water Resources Control Board
taf	thousand acre-feet
TAG	Technical Advisory Group
TCC	Tehama-Colusa Canal
TCCA	Tehama-Colusa Canal Authority
USC	United States Code
USDI	U.S. Department of Interior
USFWS	U.S. Fish and Wildlife Service
V_a	approach velocity
VELB	valley elderberry longhorn beetle
WQCP	Water Quality Control Plan
WRDA	Water Resources Development Act
WUA	weighted usable area

INDEX

C-085959

C-085959

C-085960

C-085960

L

M

N

O

P

R

S

C—085961
C-085961

Existing Project Area

1. Montgomery Island
2. Sacramento River
3. Upper Oxbow
4. Lower Oxbow
5. Fish Screen
6. Hamilton City Pumping Plant
7. Seasonal Earthen Weir
8. Fish Bypass Outfall