CHAPTER IX. ENVIRONMENTAL EFFECTS OF IMPLEMENTING SOUTHERN DELTA SALINITY ALTERNATIVES (OTHER THAN VERNALIS)

The 1995 Bay/Delta Plan (SWRCB 1995a) contains salinity objectives for the protection of agricultural beneficial uses of water in the channels of the southern Delta. This chapter describes three alternatives for achieving the southern Delta salinity objectives and discusses the environmental effects of implementing the alternatives. The chapter is divided into the following sections: (A) background, (B) alternatives for implementing the objectives, and (C) environmental impacts of the alternatives.

A. BACKGROUND

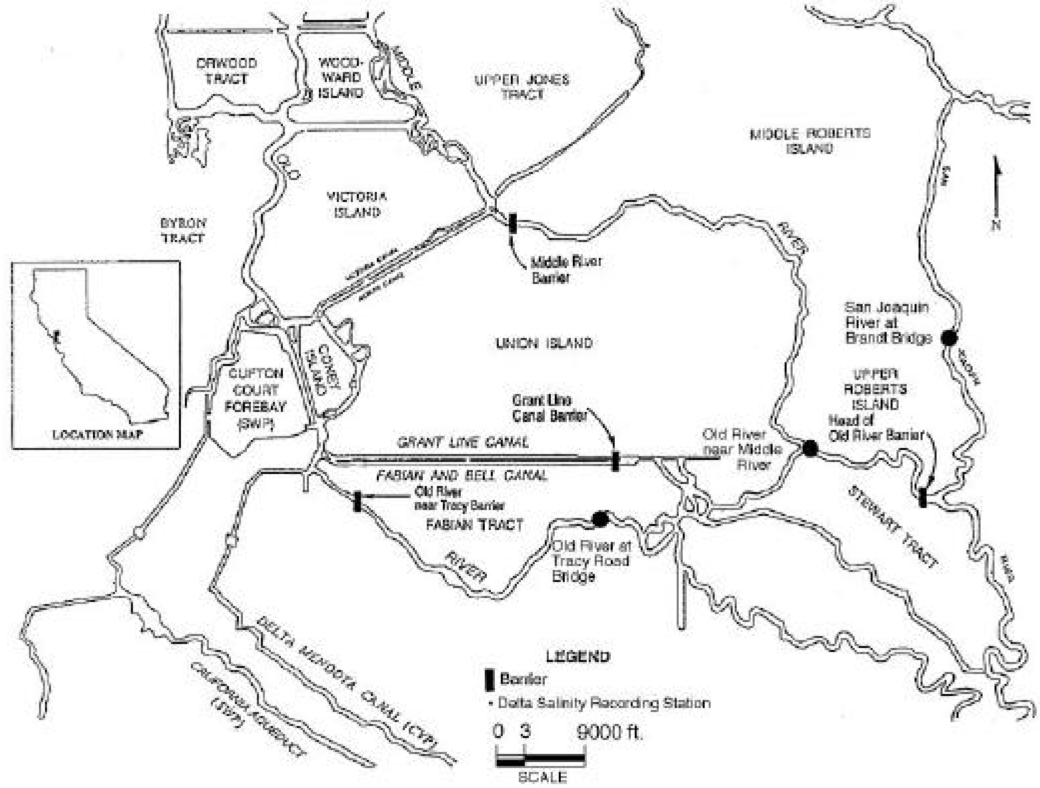
The southern Delta area generally encompasses the lands and channels of the Delta southwest of Stockton (Figure IX-1). Of its 150,000 acres, 120,000 acres are used for irrigated agriculture. The remainder consists of waterways, berms, channel islands, levees, and lands devoted to homes and industries. About 450,000 acre-feet of water are diverted from the 75 miles of southern Delta channels each year to irrigate the fully developed and highly productive agricultural land. In addition to the local agricultural diversions, the area includes the SWP and CVP pumping facilities and the intake to Contra Costa Water District's Los Vaqueros Project. For more detail, see the discussion in Chapter III - Environmental Setting.

Water conditions in the southern Delta are influenced by San Joaquin River inflow; tidal action; SWP, CVP, and local pump diversions; agricultural return flows; channel capacity; and upstream development. Tidal action and Delta outflow work to create a long and gradual salinity gradient from the Pacific Ocean into the Delta (DWR 1995A). Salinity control is necessary because the Delta is contiguous with the ocean, and its channels are at sea level. Unless repelled by continuous seaward flow of fresh water, seawater will advance up the Estuary into the Delta and degrade water quality (SWRCB 1995b).

The extent of salinity intrusion into the Delta is determined by the relative magnitude of the opposing forces of tidal action and Delta outflow (SWRCB 1978b). During the winter and early spring, flows through the Delta are usually above the minimum required to control salinity. When Delta inflow is low, however, salt water tends to move inland from the ocean, which can cause problems for agricultural diverters within the southern Delta. Agricultural crops are sensitive to salt, and increases in salinity of applied water can be detrimental to crop production.

The southern Delta has a long history of water quality problems. By 1905, streamflow, always low during the summer, was significantly depleted by the diversion of water for irrigation. Water was first applied to the land along the Merced River in 1852, and by 1870, so much water was being taken from the San Joaquin River and its tributaries that streamflow was noticeably reduced. Because it had less rainfall than the Sacramento Valley, agricultural development in the San Joaquin Valley depended heavily on irrigation. As a result, virtually the entire summer flow of the San Joaquin River was appropriated, and had it not been for the return of some water applied to but not used by crops, the river might have been entirely dry (Jackson and Paterson 1977).

Figure IX-1
Southern Delta Area



At present, salinity problems occur mainly during years of below normal runoff. In the southeastern Delta, these problems are largely associated with the high concentrations of salts carried by the San Joaquin River into the Delta. Operation of the SWP and CVP pumping plants near Tracy draws higher quality Sacramento River water across the Delta and restricts the low quality area in the southern Delta to the southeast corner (SWRCB 1995b).

Land-derived salts and local agricultural return flows further impact water quality. Irrigation practices concentrate the salts of the applied water, and the irrigation drainage in the channels degrades the channel water accordingly. In major channels that carry large flows, local diversions and discharges generally exert only moderate influences on flow and quality, but in the shallow, low capacity channels common in the southern Delta, diversions from the channel can begin to equal or exceed the flows entering the channel at the upstream end. At times, local saline discharges do not move downstream and out of the area but instead become trapped and concentrated in "null zones" of zero flow. This, in turn, can result in water quality degradation irrespective of how fresh the water flowing into the Delta may be.

During heavy irrigation periods, the agricultural drainage can be reapplied to the land several times, further concentrating the salts and degrading water quality.

1. Regulatory History

The SWRCB established water quality objectives for the protection of beneficial uses through a series of water quality control plans and water right decisions. The following is a brief summary of the plans and decisions as they pertain to southern Delta objectives.

a. **D-1275**. D-1275 approved permits for operation of the SWP. D-1275 conditioned the permits with water quality criteria contained in Exhibit A of Exhibit 17 submitted by the Sacramento River and Delta Water Association insofar as the criteria did not conflict with other terms in the permits. Exhibit 17 is an agreement dated November 19, 1965 between the State of California and Sacramento River and Delta Water Association, Delta Water Users Association, San Joaquin County Flood Control and Water Users Conservation District, and John A. Wilson. Among other provisions, the agreement established water quality criteria at several locations in the Delta, including Old River at Clifton Court in the southern Delta. The criteria called for a mean daily total dissolved solids (TDS) of 700 ppm or less for any 10 consecutive days, a mean monthly TDS of 500 ppm or less for any calendar month, and a mean annual TDS of 450 ppm or less for any calendar year. However, under dry water-year conditions, TDS criteria were increased to 800, 600, and 500 ppm, respectively. Upon construction and operation of the Peripheral Canal, the same criteria were to apply at the bifurcation of Old and Middle rivers.

b. **D-1422**. In 1973, the SWRCB adopted D-1422, which approved the USBR's water right applications to appropriate water from the Stanislaus River at New Melones Reservoir for power generation, preservation and enhancement of fish and wildlife, recreation, and water quality control. D-1422 requires the USBR to release water to maintain a mean monthly TDS of 500 ppm or less in the San Joaquin River at Vernalis.

c. **The 1978 Bay/Delta Plan and D-1485**. The 1978 Bay/Delta Plan included salinity objectives at four southern Delta stations (San Joaquin River at Vernalis; Old River near Middle River; Old River at Tracy Road Bridge; and San Joaquin River at Brandt Bridge) for the protection of agricultural beneficial uses. With the adoption of the 1978 Bay/Delta Plan, objectives were expressed in terms of electrical conductivity (EC). While total dissolved solids and chloride ion concentration had been employed traditionally as measures of Delta water quality, electrical conductivity is more closely related to osmotic pressure (to which the plant responds) than other measures of salinity.

The approach used in developing the agricultural standards involved a determination of the water quality needs of significant crops. The University of California Guidelines provide equations for determining the maximum salinity of the applied water that provides a 100 percent yield of specific crops. Beans and alfalfa, the two most widely grown salt-sensitive crops in the southern Delta, were chosen as target crops for the purpose of setting the southern Delta objectives. Meeting the objectives for bean and alfalfa crops would also protect the less salt-sensitive crops. An applied water quality of 0.7 mmhos EC at the monitoring stations in the southern Delta protected beans during the summer irrigation season (April through August), and the objective of 1.0 mmhos/cm EC protected alfalfa during the winter irrigation season (September through March) (SWRCB 1978a).

The SWRCB was of the opinion that the most practical solution for long-term protection of southern Delta agriculture was the construction of physical facilities to provide adequate circulation and substitute supplies, but negotiations concerning these facilities were underway at the time D-1485 was under consideration, and the facilities had not been constructed. Therefore, D-1485 did not allocate responsibility for the EC objectives contained in the 1978 Bay/Delta Plan. The Plan included the note: "If contracts to ensure such facilities and water supplies are not executed by January 1, 1980, the Board will take appropriate enforcement actions to prevent encroachment on riparian rights in the southern Delta." D-1485 contains a similar statement. Contracts were not executed, but the South Delta Water Agency (SDWA) asked the SWRCB to delay taking action.

d. 1991 Bay/Delta Plan. The SWRCB did not change the southern Delta objectives for the protection of agricultural beneficial uses when it adopted the 1991 Bay/Delta Plan. However, because of on-going negotiations among the DWR, USBR, and SDWA, the SWRCB established a staged implementation plan for the objectives, which included two interim stages and a final stage.

Interim Stage 1. (to be implemented upon adoption of the 1991 Bay/Delta Plan) The mean monthly TDS was limited to 500 ppm at Vernalis.

Interim Stage 2. (to be implemented no later than 1994) The 30-day average EC objectives of 0.7 mmhos/cm between April 1 and August 31 and 1.0 mmhos/cm EC between September 1 and March 31 were to apply at two locations (Vernalis and Brandt Bridge stations) for all year types.

Final Stage. (to be implemented no later than 1996) The 30-day average EC objectives of 0.7 mmhos/cm between April 1 and August 31 and 1.0 mmhos/cm EC between September 1 and March 31 were to apply at four locations (Vernalis, Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge) for all year-types.

The 1991 Bay/Delta Plan also stated that "if a three-party contract has been implemented among the DWR, USBR, and SDWA, that contract will be reviewed prior to implementation of the above and, after also considering the needs of other beneficial uses, revisions will be made to the objectives and compliance/monitoring locations noted, as appropriate."

e. 1995 Bay/Delta Plan. The 1995 Bay/Delta Plan objectives in the southern Delta for agricultural beneficial uses were unchanged from the 1991 Plan except that the effective date of the objectives on Old River was extended from January 1, 1996 to December 31, 1997. The 1995 Bay/Delta Plan includes the same condition as the 1991 Bay/Delta Plan regarding review of the objectives upon execution of a three-party agreement.

f. Order WR 95-6. On June 8, 1995, the SWRCB adopted Order WR 95-6, which temporarily makes the existing water rights of the SWP and the CVP consistent with their meeting the 1995 Bay/Delta Plan. This action allows the SWP and the CVP to operate their facilities in accordance with the 1995 Bay/Delta Plan while the SWRCB prepares a long-term water right decision to implement the plan. Among other provisions, Order WR 95-6 requires the USBR to release conserved water from New Melones Reservoir to comply with 1995 Bay/Delta Plan salinity objectives at Vernalis. The order was to expire on December 31, 1998 or upon adoption by the SWRCB of a long-term water right decision implementing the 1995 Bay/Delta Plan.

g. Order WR 98-9.On December 3, 1998, the SWRCB adopted Order WR 98-9 which continued the temporary terms and conditions set forth in Order WR 95-6. Order 98-9 added new temporary conditions to the water rights of the SWP and the CVP. The order expires on December 31, 1999 or upon adoption by the SWRCB of a long-term water right decision implementing the 1995 Bay/Delta Plan.

h. Regional Water Quality Control Board (RWQCB) Basin Plans. Each of the RWQCBs has adopted regional water quality control plans. The southern Delta is included in the basin plan for the Sacramento-San Joaquin Delta Basin (Basin 5B Plan), adopted by the Central Valley RWQCB. The 1995 revision of the Basin 5B Plan incorporates the southern Delta salinity objectives found in the 1991 Bay/Delta Plan. Further revisions of the Basin 5B Plan regarding San Joaquin River salinity are being evaluated and this process is expected to be completed in December 1999. In the event of any conflict, the objectives adopted by the SWRCB supersede objectives adopted by the RWQCBs.

2. Historical Salinity Conditions in the Southern Delta

Figures IX-2 through IX-4 depict recent salinity conditions for each of the three southern Delta stations listed in the 1995 Bay/Delta Plan (see Figure IX-1 for locations of EC monitoring stations). The EC limit, first introduced in the 1978 Plan and retained in the 1995 Bay/Delta Plan, is also shown on each plot--700 µmhos/cm during April through August and 1000 µmhos/cm during September through March. The plots show that the objectives are frequently exceeded at all three of the stations listed in the 1991 and 1995 plans.

Water quality patterns appear to follow the same trends from one location to another, but in general, EC data at Tracy Road Bridge are higher than data recorded at Old River near Middle River, which are in turn higher than Brandt Bridge data, for any given year. That is, the limits are exceeded more severely the further the station is from San Joaquin River inflows. Not surprisingly, years with more precipitation (1986 and 1993) correspond with lower EC levels at all three stations.

3. Existing Salinity Management Programs in the Southern Delta

Salinity management programs have been initiated to improve salinity conditions in the San Joaquin River and the southern Delta. A discussion of the programs that could affect salinity at Vernalis can be found in Chapter VIII; salinity management programs within the southern Delta are discussed below.

The SDWA represents the agricultural diverters within the southern Delta. In July 1982, the SDWA filed a lawsuit concerning the effects of SWP and CVP operations on the southern Delta. The suit sought a declaration of the rights of the parties, a preliminary injunction, and a permanent injunction requiring that the projects be operated to protect the southern Delta. Since 1985, there has been an on-going effort, via temporary measures, to resolve water level and circulation problems in the southern Delta.

In October 1986, a framework agreement among the DWR, USBR, and SDWA committed the parties to work together to develop a mutually acceptable, long-term solution to the water supply problems of SDWA water users. In 1990, the parties agreed to a draft settlement which contained short-term and long-term actions to resolve the water supply problems in the southern Delta. The settlement provided for interim releases by the USBR from New Melones Reservoir to resolve the portion of the litigation relating to San Joaquin River flows, and it set forth the framework for the USBR and SDWA to negotiate an amendment to the agreement. A more recent draft contract has been proposed to resolve the portion of the SDWA's lawsuit relating to the effects of CVP and SWP export pumps and operations on water levels within SDWA channels. The SDWA has approved the contract, the DWR expects to obtain authority to sign, and the USBR is currently seeking authorization from Congress to sign.

As a result of the litigation and framework agreement, the DWR took the following steps to partially relieve the problem in certain channels: (1) Tom Paine Slough was dredged and siphons were installed to improve the water level in the slough; (2) the Temporary Barriers Project was initiated to test and construct barrier facilities in southern Delta channels for the purpose of improving channel water levels and water quality within SDWA boundaries; and (3) the South Delta Water Management Program (SDWMP) was initiated to bring permanent improvements to the area. In June 1990, a draft EIR/EIS for the SDWMP was released for public review; however, the draft was not finalized due to the controversy surrounding a variety of unresolved Delta issues.

a. <u>Temporary Barriers Project</u>. The purpose of the draft contract among the DWR, USBR, and SDWA was, in part, to provide for the design, construction, operation, testing, and evaluation of barrier facilities to afford the SDWA an adequate agricultural water supply. The barriers testing program, referred to as the South Delta Temporary Barriers Project, was initiated in 1991. Its objectives are the short-term improvement of water conditions for the southern Delta and the development of data for the design of permanent barriers. The project involves the seasonal installation of four barriers: one in Middle River, two in Old River, and one in Grant Line Canal. Three of the barriers are designed to improve water levels and circulation for agricultural diversions, and they are to be in place during the growing season.

Figure IX-2
Actual average monthly water quality for San Joaquin River at Brandt Bridge Station for WY 1985-1993

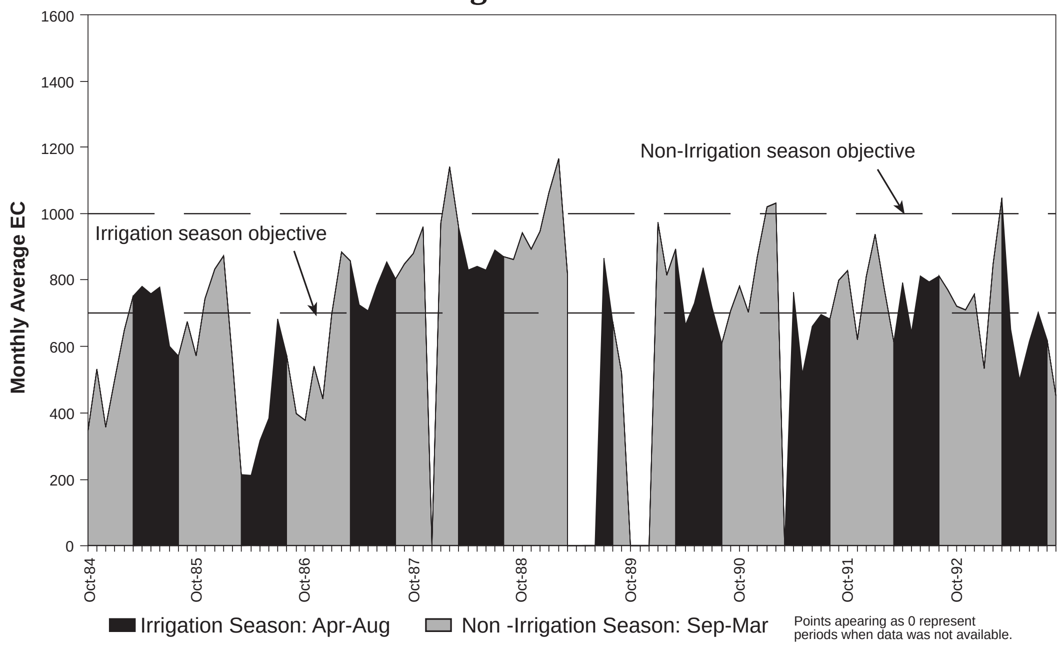


Figure IX-3
Actual average monthly water quality for Old River at Tracy Road Bridge Station for WY 1984-1992

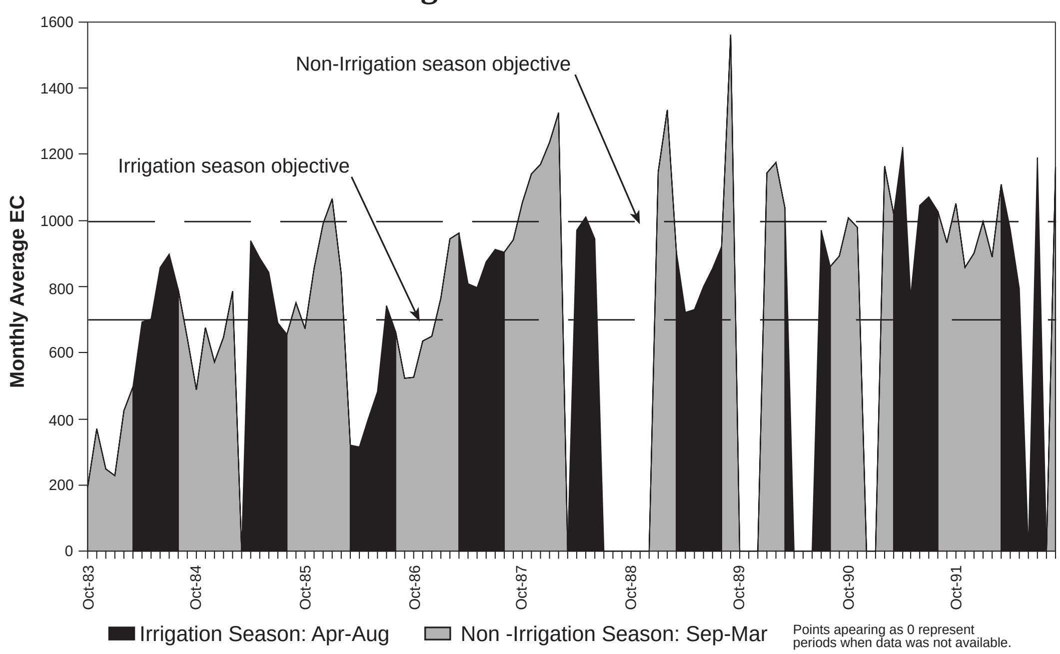
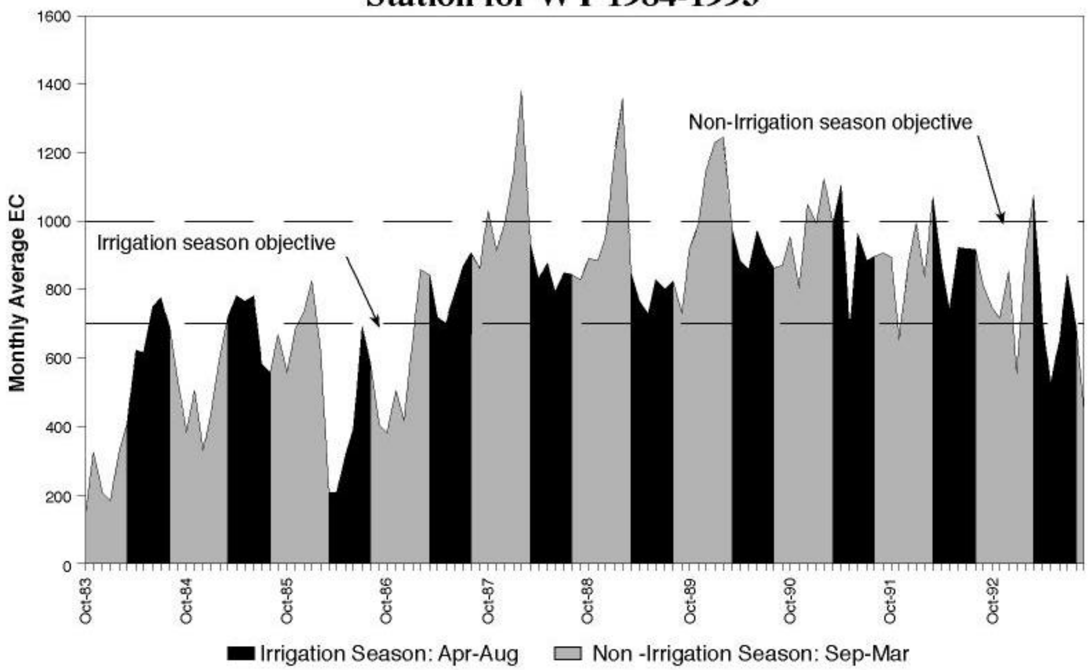


Figure IX-4
Actual average monthly water quality for Union Island Station for WY 1984-1993



Of those, the temporary barrier on Middle River was installed every year beginning in 1987; and the temporary barrier in Old River near Tracy, east of the Delta-Mendota Canal, was installed for various periods every year since 1991. The barrier in Grant Line Canal was installed for the first time in 1996. The fourth barrier, at the head of Old River at San Joaquin River, is designed to assist fish migration on the San Joaquin River. This barrier has been installed intermittently during the fall since 1963 to improve flow and dissolved oxygen conditions in the lower San Joaquin River, principally for the benefit of adult fall-run chinook salmon migrating to upstream spawning locations. As part of the Temporary Barriers Project, it was also installed during the spring in 1992, 1994, and 1997 to assist outmigrating salmon smolts, but it was not installed in 1993, 1995, or 1999 and only briefly in 1996, due to high San Joaquin River flows and/or concerns regarding Delta smelt.

The DWR and USBR proposed the installation of permanent barriers through the Interim South Delta Program (ISDP) to improve water levels and circulation in the southern Delta. The barriers were to be designed and operated based on information developed by the Temporary Barriers Project. In May 1999 the ISDP was rolled into the CALFED South Delta Improvements Program (SDIP). A revised CALFED Draft EIS/EIR was issued in June 1999, and a Final EIS/EIR is expected by summer, 2000. The CALFED document contains a programmatic discussion of the SDIP. A project-specific EIS/EIR for the SDIP will follow release of the CALFED's Final EIS/EIR and prior to implementation of the ISDP/SDIP. Consequently discussion in this chapter regarding southern delta salinity improvements is subject to change.

b. **ISDP**. The purpose of the ISDP was to: (1) improve water levels and circulation in the southern Delta for local agricultural diversions; and (2) improve southern Delta hydraulic conditions to increase diversions into Clifton Court Forebay to maximize the frequency of full pumping capability at DWR's Banks Pumping Plant. The program is consistent with a number of recent State and federal policies and laws. In l992, Governor Pete Wilson issued a water policy statement, declaring that "the Delta is broken" and that "we need to take immediate interim actions in the southern Delta that will help restore the environment and improve the water supply." Also in 1992, the CVPIA was approved. Section 3406(b)(15) of this law directs the Secretary of Interior to "construct...a barrier at the head of Old River...to increase the survival of young out-migrating salmon...in a manner that does not significantly impair the ability of local entities to divert water" (CVPIA 1992). More recently, on December 15, 1994, officials of several State and federal agencies, and some stakeholders, signed the Principles Agreement, a plan for the protection of the Bay Delta Estuary. One of the elements in the Principles Agreement is to install a barrier at the head of Old River to protect San Joaquin River salmon during April and May of all water year types. The DWR and the USBR released a draft EIR/EIS for the ISDP on August 19, 1996. The draft EIR/EIS analyzes the effects of eight alternatives. The ISDP preferred alternative is comprised of channel dredging, the construction of a new intake to Clifton Court Forebay, a fish barrier, and three agricultural flow control structures, as discussed below (see Figure IX-1 for locations of ISDP project components).

The ISDP preferred alternative would result in approximately 1.25 million cubic yards of material being dredged from a 4.9-mile reach of Old River to increase the channel capacity north of the new intake. The proposed intake would be operated either in conjunction with, or independent of, the existing intake, depending on water quality, specific tidal conditions, the amount of water to be diverted into the forebay, and other factors. Together, the channel dredging and the new intake would facilitate diversions from the Delta in amounts that would support the full pumping capacity of 10,300 cfs at Banks Pumping Plant. Channel modification would require a permit from the U.S. Army Corps of Engineers (USCOE).

A permanent barrier would be constructed at the head of Old River near its confluence with the San Joaquin River, and would be operated only during the spring and fall each year. During the rest of the year, the gates would remain fully raised. The barrier would improve dissolved oxygen levels in the fall along the portion of the San Joaquin River from its confluence with Old River downstream to the Port of Stockton, and it would enhance the survival of migrating San Joaquin River salmon smolts by lessening the chances of exposure to the influences of project and local diversions during the spring.

Agricultural flow control structures would improve water levels and circulation in the southern Delta by "tidal pumping." The radial gates would be raised to allow uni-directional flow into the channels upstream of the barriers during incoming tides (flood tide) and lowered to impede water movement out of these areas during outgoing tides (ebb tide). These operations would retain flood tide flows in southern Delta channels for a longer period of time to raise water levels.

Permanent flow control structures were originally proposed for three locations. The Middle River structure would be located on Middle River, near the confluence of Middle River, North Canal, Victoria Canal and Trapper Slough, approximately 13 miles east of Stockton. This barrier would consist of two radial gates housed in a reinforced concrete gate bay structure and a boat ramp. The boat ramp would be used to transfer boats and people across the structure. The Grant Line Canal and Old River flow control structures are very similar in design. However, the ISDP/SDIP is presently evaluating the option of not including a barrier on Grant Line canal. The Old River structure, east of the Delta Mendota Canal, is approximately 4,000 feet southeast of the intersection of the Alameda, Contra Costa, and San Joaquin county lines. The two barriers would consist of concrete control structures with radial gates. A 50-foot-wide by 105-foot-long boat lock would also be included in each structure. All of the flow control structures would be operated only during the agricultural irrigation season (April to September) to increase flows from the northwest direction to the southeast direction (DWR and USBR 1996).

B. ALTERNATIVES FOR IMPLEMENTING SOUTHERN DELTA SALINITY OBJECTIVES IN THE 1995 BAY/DELTA PLAN

There are two general categories of alternatives for implementing the southern Delta salinity objectives: (1) actions to improve the salinity of water entering the Delta at Vernalis and (2) water management actions within the Delta. The first category of alternatives is analyzed in Chapter VI (provision of dilution water) and Chapter VIII (salinity control actions) of this report. The second category of alternatives is analyzed in the draft EIR for the ISDP.

This chapter will analyze the effect on southern Delta salinity of both meeting the flow objectives and constructing and operating the barriers proposed in the ISDP. The analysis for construction of the barriers will be programmatic only. CALFED will need to complete an EIS/EIR on the project prior to its implementation.

As described above, shallow, low capacity channels are common in the southern Delta, and local diversions from the channels can exert a major influence on flow and quality. At times, local saline discharges do not move downstream and out of the area but instead become trapped and concentrated in "null zones" of zero flow. Facilities designed to improve southern Delta circulation can alleviate high-salinity problems associated with agricultural return flows. The flow control structures proposed in the ISDP are such facilities, and much study has gone into their development; therefore, it is reasonable to assume they represent a likely facility.

The three alternatives currently being considered to implement the southern Delta agricultural objectives in the 1995 Bay/Delta Plan are listed below.

1. Southern Delta Salinity Control Alternative 1 - Base Case

The SWP and the CVP are responsible for meeting D-1485 requirements. The CVP is responsible for meeting the D-1422 salinity objective at Vernalis. Existing temporary barriers in the southern Delta are installed and operated to improve salinity conditions in the southern Delta. No further action is taken to implement the southern Delta salinity objectives.

2. Southern Delta Salinity Control Alternative 2 - 1995 Bay/Delta Plan

The 1995 Bay/Delta Plan flow objectives are met by implementation of one of the flow objective alternatives. Existing temporary barriers in the southern Delta are installed and operated by the SWP and the CVP to improve salinity conditions in the southern Delta. No further action is taken to implement the southern Delta salinity objectives.

3. Southern Delta Salinity Control Alternative 3 - Permanent Barrier Construction

The 1995 Bay/Delta Plan flow objectives are met by implementation of one of the flow objective alternatives. The barriers proposed in the ISDP preferred alternative are constructed and operated by the SWP and CVP to achieve the southern Delta salinity objectives to the extent feasible. Other elements of the ISDP not necessary to support barrier operation are not constructed.

These three alternatives were modeled for the entire 73-year period of record. Alternatives 2 and 3 assume that the Bay/Delta Plan flow objectives are fully met. To model these two alternatives, the SWRCB used an operations study in which the objectives are being met to the extent possible by the DWR and the USBR. When necessary to meet Vernalis flow objectives, additional water is acquired from tributary sources on the San Joaquin River. This study is intended to be representative of the Delta hydrology that would result from full implementation of the objectives. In order to fully analyze the effect of different flow alternatives on Delta salinity, however, Flow Alternatives 3 through 7 are modeled for the period 1976-1992, and the results are discussed in Chapter VI of this EIR.

C. ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

This section describes the environmental impacts of the alternatives being considered to meet southern Delta salinity objectives. Implementation of the southern Delta salinity objectives is analyzed at the project level for Alternatives 1 and 2 and at the programmatic level for Alternative 3. The findings of the Draft EIR/EIS for the ISDP (DWR and USBR 1996) determined that there would be both substantial benefits and significant adverse impacts associated with implementing the ISDP, including constructing the barriers called for under Alternative 3. That document contains detailed analyses of all the ISDP's environmental impacts and lists mitigation measures to reduce the significant impacts to less than significant levels where possible. Fifteen areas of potential impact are listed and discussed in the Draft EIR/EIS for the ISDP, including:

- Aesthetics, Light, and Glare
- Air Quality
- Aquatic Resources
- Cultural Resources
- Energy
- Geological Conditions
- Hazards
- Land Use Planning
- Navigation and Transportation
- Noise
- Public Services and Utilities
- Recreation
- Socioeconomic Impacts
- Terrestrial Biological Resources
- Water Quality

For this report, the discussion is divided into the following topics: (1) impacts caused by construction; (2) impacts to water levels and water quality; (3) impacts to aquatic resources; (4) impacts to recreation; and (5) impacts to navigation. Chapter III of this draft EIR describes the existing conditions for each of these topics. Impacts under Alternative 3 are summarized from the ISDP Draft EIR/EIS, but only those impacts pertaining to the construction and operation of the fish and flow control structures are included. The impact of the barriers on dissolved oxygen levels is discussed in Chapter X of this draft EIR.

1. Impacts Caused By Construction

Under Alternatives 1 and 2, impacts will be limited to those associated with seasonal construction of temporary barriers. The DWR Division of Planning prepared an Initial Study for the Temporary Barriers Project in 1995 (DWR 1995b). As part of the ongoing environmental analysis for the Temporary Barriers Project, a USCOE jurisdictional wetland delineation survey was prepared for DWR by a consultant. DWR prepared a biological assessment required as part of the endangered species process, which discussed potential impacts of the project on listed species and species proposed for listing. At the same time, DFG staff prepared an assessment of non-endangered species including assessments of impacts of fish, wildlife, and plant community resources. The studies did not specifically identify any other significant adverse impacts due to the proposed Temporary Barrier installations. They did, however, identify some possible adverse impacts and concluded that it could not be determined that there were no significant impacts based on available data. (DWR 1995b)

Following is an evaluation of the potential consequences of barrier construction under Alternative 3. The discussion is divided into five parts: (a) water quality; (b) aquatic resources; (c) terrestrial biological resources; (d) recreation; (e) navigation; and (f) transportation.

a. Water Quality. This section summarizes the potential water quality consequences of constructing the permanent barriers under Alternative 3, as disclosed in the Draft EIR/EIS for the ISDP.

Two regulatory controls are intended to limit the consequences of the construction activities on water quality. The first is the USCOE, which implements the Rivers and Harbors Act, section 10 and the Clean Water Act, section 404. The second is the SWRCB General Construction Activity Storm Water Permit, which is required for construction activities and associated storm water discharges which occur outside USCOE jurisdiction on upland sites. Sites that are regulated by the USCOE are excluded from the Storm Water Permit process but are subject to the water quality certification requirements of the Clean Water Act, section 401. Construction of the fish and flow control structures in the southern Delta will temporarily affect water quality in southern Delta channels, increasing turbidity and flow velocities.

"Turbidity" refers to the amount of light that is scattered or absorbed by a fluid and is related to the concentration of suspended particulate matter and the amount of dissolved organic matter. Turbidity is a difficult parameter to evaluate because, in nature, it is often highly dynamic, changing rapidly in space and time. In the Delta, turbidity is highly variable, especially when produced by construction activities, and is usually due to the presence of suspended particles of silt and clay, although other materials such as finely divided organic matter, colored organic compounds, plankton, and microorganisms can contribute to turbidity.

Furthermore, turbidity measurements are often reported using a variety of noninterchangeable units. The concentration of suspended particulate matter is typically measured in milligrams per liter (mg/L), whereas light scattering or absorption is measured in Nephelometric Turbidity Units (NTU) or, to a lesser extent, in Jackson Turbidity Units (JTU). Unfortunately, different measures are used in different reports of turbidity levels injurious to fish or of turbidity levels caused by construction activities in the Delta. Turbidities expressed using one of these measures cannot be converted to turbidities using another of the measures. Because of the difficulties associated with evaluating turbidity effects, only a very approximate analysis could be made of the turbidity impacts of the project and alternatives.

The placement and removal of cofferdams to facilitate construction of the control structures, along with construction of the new levee at the Old River site, are expected to result in short-term elevated levels of turbidity. The duration and concentration of the turbidity would depend, in part, on the length of time required to place and remove the cellular cofferdams and the area of sediment disturbed. Minor sediment may also be suspended by barge activities. There would also be a brief introduction of sediment into the channels during breaching of the levees at the Old River control structure during existing levee removal; this is expected to be a short-term event. No substantial increase in suspended sediment is expected during removal of the cofferdams, particularly at the Middle River control structure where construction specifies that cofferdams be cut off at the selected invert depth. Also, the area affected would be minimized using silt curtains.

Based on turbidity increases observed during the Temporary Barriers Program, construction of the permanent structure should not produce significant turbidity. The method of installing the present temporary barriers causes a relatively small increase of 20 to 40 NTU which is considered to be a less-than-significant adverse impact.

Since construction would block half the channel with sheet-pile coffer dams, velocities would increase in the vicinity of the construction area. Since the channel restriction will lead to some flow being routed down the San Joaquin River, water velocities may increase by approximately 50 percent. Velocities are not anticipated to reach values of concern for scouring. These are considered to be less-than-significant adverse impacts.

No significant water quality impacts from the construction of the southern Delta barriers are identified. Therefore, no mitigation is required.

b. **Aquatic Resources**. Construction of the barriers would likely have short-term effects upon aquatic resources. This section summarizes the impacts to aquatic resources caused by constructing the barriers, as disclosed in the Draft EIR/EIS for the ISDP.

The assessment of construction impacts focuses mostly on qualitatively identifying impacts, because useful quantitative data for the affected area are limited. Ecological literature concerning the effects of turbidity, burial, direct removal of organisms and habitat, and alteration of aquatic habitat on aquatic organisms was reviewed and compared to expected background turbidity levels in the Delta, expected turbidity levels associated with construction activities, and estimated amount of aquatic habitat losses resulting from the proposed construction activities.

Potential construction impacts include effects of turbidity, burial, direct removal and alteration of aquatic habitat, and removal of organisms, and would potentially result in loss of aquatic organisms and their habitat. This section summarizes the effects of the proposed construction of the control structures by impact type as disclosed in the ISDP Draft EIR/EIS, and discusses their significance based on criteria from CEQA Guidelines, the Clean Water Act, and NEPA regulations.

Turbidity. Depending upon season, suspended sediment concentrations in Delta channels range up to 1,000 mg. Placement and removal of cellular cofferdams at the fish barrier located at the Head of Old River and at the flow control structures located at Middle

River, Grant Line Canal, and Old River would cause an increase in light attenuation and reduction of water clarity, and would affect plankton, benthic invertebrates, and fish.

Phytoplankton and zooplankton are important food sources for many organisms, including the early life stages of most fish species. Phytoplankton growth is dependent on light; where light has been limiting, growth and production by phytoplankton may be reduced locally. Low levels of turbidity, however, may improve phytoplankton production in areas where nutrients are limiting if suspended material contains and releases the limiting nutrients.

Prolonged periods of relatively high turbidity levels (primarily suspended particulate matter) can lead to a measurable reduction in the number of species of benthic invertebrates that settle and develop in affected communities. Eggs and larvae of some bivalve species develop abnormally when silt levels are high. Organisms that can protect themselves from turbid flows may survive temporarily. For example, bivalve mollusks can close organs that circulate water through their system, and polychaetes and some crustaceans can burrow into the sediment to avoid turbidity temporarily. Delta invertebrates that would be affected include amphipods and isopods, which provide food for fish.

High concentrations of suspended sediment may adversely affect fish and their eggs. The most important factors determining the lethal concentration of suspended solids to fish include the species and age of the fish, the type of particulate matter, the time of exposure, and the size distribution of the particles. A high concentration of smaller-sized particles is more likely to cause gill clogging and asphyxia than a similar concentration of larger particles.

The expected turbidity levels caused by dredging and construction activities would affect fish that are in areas near the proposed dredging operations. Potential effects of high concentrations of suspended particulate matter on fish include unsuccessful development of fish eggs and larvae; reduced availability of food; reduced feeding efficiency; reduced growth rate and resistance to disease; alteration of fish migrations; exposure to toxic sediments released into the water column; and direct mortality.

Turbidities as low as 1,000 mg/l may negatively affect fish eggs of some species. Although fish eggs and larvae may be adversely affected by turbidity increases, embryos of some fish species are tolerant of relatively high-suspended particle concentrations. No detectable effect on hatching success was found for embryos of yellow perch, white perch, striped bass, and alewife exposed to concentrations of suspended material up to 500 mg/l. Eggs and embryos of Delta fish species may be affected differently because actual turbidity levels resulting from construction activities in the Delta may be higher than 500 mg/l.

Turbidity can affect feeding efficiency. According to studies, several fish species appear to prefer turbid over clear water during early life, so increased turbidity resulting from increased suspended sediments may attract some fish species to construction areas where elevated turbidity levels are expected. Other fish species, however, avoid cloudy water. Striped bass larvae feeding on natural prey consumed similar quantities of zooplankton at turbidity levels between 0 and 75 mg/l, but 40 percent fewer prey were consumed in suspended solids concentrations of 200 and 500 mg/l. Juvenile chinook salmon foraging rates (for surface and benthic prey) were low in clear water and higher at intermediate turbidity levels (35 to 150 NTU). In contrast, turbidity levels influenced the reactive distance at which largemouth bass noticed prey and caused reduced activity (at turbidity of 14 to 16 JTU) of juvenile largemouth bass and green sunfish. The actual turbidity (suspended particulate matter and water cloudiness) observed during construction activities in the Delta may be higher than the turbidity measurements and values reported by these investigators.

Extremely high turbidity concentrations could cause direct mortality to adult fish species. Fish species found in the Delta, such as largemouth bass, sunfish, and catfish, experienced direct mortality when exposed to turbidities exceeding 69,000 mg/l. Other Delta fish species that would be affected by increased turbidity levels include Sacramento splittail and Delta smelt. Turbidity levels observed in the Delta during construction activities may be higher than the reported turbidity values affecting fish.

As noted earlier, the impacts of turbidity on aquatic resources in the affected area are difficult to evaluate, but turbidity would be caused mostly by dredging, and dredging would be conducted when sensitive species are unlikely to inhabit the affected area. The effects would be temporary because the suspended material would settle out. Therefore, the proposed construction activities are expected to have a less-than-significant impact with respect to turbidity effects on aquatic resources.

Burial. Placement and removal of the cofferdams and construction of the new levee at the proposed Old River Flow Control Structure will also increase sedimentation; however, expected sedimentation rates have not been estimated. Increased sedimentation results in the burial of aquatic vegetation, less mobile invertebrates, and benthic fish eggs and larvae in the vicinity of construction activities. Benthic fish eggs and larvae are those found near the bottom of the water column. The extent of the area affected would depend on a variety of factors such as the concentration of suspended sediment, water temperature, flow direction and strength, length of operations causing sedimentation, and tidal influences.

The rapid settling of suspended material on channel bottoms may result in smothering of benthic invertebrates and may influence invertebrate distribution. Burial may result in the complete loss of some benthic species within the affected area, followed by their recolonization of the new bottom materials. Benthic organisms, such as bacteria, protozoans, mollusks, and arthropods, represent a food source for many animals. This temporary reduction in benthic prey and degradation of habitat quality can be adverse to species that reside in or migrate through the southern Delta such as striped bass, San Joaquin River fall-run chinook salmon, and delta smelt.

Sedimentation may affect embryos of some fish species. Burial would not affect those species with no habitat in the affected area and is unlikely to affect planktonic fish embryos. Eggs and larvae of species in the southern Delta that spawn on bottom substrates such as largemouth bass, sunfish species, and catfish species, however, may be buried by rapid sedimentation and suffocated. Sacramento splittail, which attach eggs on submersed aquatic vegetation, would also be susceptible to sedimentation.

Burial effects would generally be temporary because plants and invertebrates would rapidly recolonize most of the disturbed sediments. However, the CEQA Guidelines indicate that an action is significant if "in regard to threatened or endangered species, smothering, impairment or destruction of the habitat to which the species is limited" occurs. This criterion applies directly to Delta smelt because burial would cause smothering of habitat within the federally designated limits of critical habitat for Delta smelt. Therefore, the proposed construction activities are considered to have a significant adverse impact with respect to burial of habitat and food web organisms.

Direct Removal and Habitat Alteration. Direct removal and alteration of habitat and removal of the organisms occupying the habitat would result from the removal of streambank and levees at the construction sites and the installation of riprap to protect new levees. The direct removal and alteration of habitat and removal of food web organisms in the area of the proposed construction activities would affect those fish species that reside in the southern Delta or pass through the area during migrations. These species include striped bass, splittail, and fall-run chinook salmon. Other resident fish that would be affected are largemouth bass and species of sunfish and catfish.

The construction of the fish and flow control structures would permanently alter near-shore shallow-water habitat. The near-shore vegetation and woody debris would be permanently lost, since existing levees would be removed and the new levee sections would be protected by riprap. Riprap produces lower-quality habitat for most Delta species, compared with shorelines supporting vegetation. The nearshore, shallow-water habitats are especially important because they are used by fish and invertebrates as foraging sites and as shelter and rearing habitats. This alteration of habitat could cause local reductions in the survival of those life stages of species that depend upon shoreline habitats.

The construction of the proposed Old River Fish Control Structure would result in permanent loss of about 450 feet of nearshore habitat on each side of the channel. The construction of the Middle River Flow Control Structure would result in the permanent loss of approximately 150 feet of shoreline habitat on one side of Middle River and little loss on the other side of the channel. If constructed, the Grant Line Canal Flow Control Structure would result in the loss of approximately 500 feet of shoreline habitat on each side of the canal. The construction of the Old River Flow Control Structure east of the Delta-Mendota Canal would result in the loss of about 400 feet of nearshore aquatic habitat on each side of the channel. Thus, the permanent loss of nearshore habitat resulting from construction of the fish and flow control structures would total about 2,850 feet.

Removal of aquatic organisms would occur in the same areas described for loss of aquatic habitat. Aquatic organisms, particularly benthic invertebrates and some lifestages of some fish species, will be lost when they are removed along with streambank habitat, or when they are stranded in dewatered areas behind the cofferdams. The impact of benthic invertebrate removal may be temporary, since rapid recolonization of the substrate by benthic invertebrates is expected. Some reported rates of recolonization range from about one month to 45 days in the freshwater environment, and 28 days for recolonization of dredged areas within a bay.

The quantities of habitat and organisms lost as a result of direct removal would be small relative to their total quantities in the Delta. However, despite the relatively small amount of habitat loss expected from direct removal and habitat alteration, the loss would be permanent. Furthermore, direct removal and habitat alteration would result in a permanent loss of designated critical habitat of Delta smelt. Therefore, the direct removal and alteration of habitat and the associated removal of organisms is considered to be a significant adverse impact.

Mitigation. Elimination of habitat for Delta smelt, splittail, and striped bass as a result of levee removal and installation of riprap would be reduced to less-than-significant levels by the adoption of the following mitigation measures. Agricultural and other lands in the western, central or northern portion of the Delta would be purchased by the DWR and restored to produce spawning and rearing habitat for Delta smelt, splittail, and striped bass. Acreages restored would equal or exceed the acreages of habitats adversely affected by the project. Habitats in the area affected by the proposed construction activities are now marginally suited, at best, for these species.

c. Terrestrial Biological Resources. This section summarizes the impacts to terrestrial biological resources caused by construction of the barriers under Alternative 3, as disclosed in the Draft EIR/EIS for the ISDP.

Construction of the barriers is expected to disturb the habitats adjacent to the construction sites. Expected disturbances include noise associated with grading and operation of other heavy equipment, increased truck and barge traffic, erosion and sedimentation associated with grading, and human intrusion. During the summer months, dust from grading and truck traffic on dirt roads would be expected to drift and coat adjacent vegetation and reduce the quality of these habitats for resident wildlife. Due to local farming activities, these sites currently experience noise associated with heavy equipment on a periodic basis. However, the construction activities at these sites would be expected to continue daily for prolonged periods of time. Impacts to plant and wildlife habitat could occur from the exposure of construction-related solvents, fuels, and other toxic materials including diesel, oil, gasoline, and raw concrete.

Potential adverse impacts to the following species or habitat types are considered significant:

Active Raptor Nests. Construction of the barriers could affect nesting raptors. Specific areas of concern include the following barrier sites: (1) Grant Line Canal: disturbance of two nesting Swainson's hawks and one great horned owl nest; (2) Old River: disturbance of a nesting Swainson's hawk; and (3) Middle River: disturbance of a nesting Swainson's hawk and a red-tailed hawk. Because of changes in raptor populations, nesting sites may change from year to year. The current nests could be unused in future years in favor of other locations. Exact nesting sites could change prior to proposed project construction.

Swainson's Hawk. Project implementation has the potential to reduce the number of Swainson's hawks within the area. The potential significant adverse impacts that may occur at the flow barrier sites include disturbance to active nest sites and the loss of 5.8 acres of cropland habitat that provide suitable foraging habitat for nesting pairs.

Mason's Lilaeopsis. The construction of the proposed Old River flow control structure is expected to remove most of a 1,000-foot colony of Mason's lilaeopsis.

Western Pond Turtle. The construction of the proposed barriers could result in the inadvertent destruction of turtles and nest sites.

San Joaquin Kit Fox. Potential kit fox occurrences are limited to the Old River flow barrier site. While surveys of this area have not confirmed the presence of kit fox at or near the barrier site, resource agencies have indicated that the kit fox may sporadically occur within this area. Construction efforts within kit fox territories may result in the loss of individuals due to den entrapment, vehicular conflict, and other construction site hazards.

Riparian (Willow) Scrub Habitat. The ISDP proposed construction of a Grant Line barrier. If constructed, the Grant Line barrier would result in the loss of 1.36 acres of riparian scrub habitat. Construction of the Old River flow control structure would result in the loss of 0.61 acres of blackberry scrub, for a total loss 1.97 acres of habitat.

Mitigation. Detailed mitigation for all of these impacts is proposed in the draft EIR/EIS for the ISDP. Much of the mitigation entails close coordination with DFG and USFWS, and the use of standard protocols developed by these agencies to avoid significant impacts.

d. Recreation. This section summarizes the impacts to recreation caused by constructing the barriers under Alternative 3, as disclosed in the Draft EIR/EIS for the ISDP.

Construction of the Head of Old River, Grant Line Canal, and Old River Tracy barriers will conflict with San Joaquin County's recreation-oriented goals and policies, which generally encourage the protection of the natural resources that support the area’s recreational uses, including the Delta waterways. The goals and policies also encourage adequate public access to, and the navigability of, the waterways. The construction and operation of the control structures would not be consistent with these goals and policies of the San Joaquin County’s General Plan. This is considered a significant adverse impact.

At the Middle River location, there are natural constraints to public access and navigability. Accordingly, the construction and operation of the proposed control structure would not conflict with the goals and policies of the General Plan. This is considered a less-than-significant adverse impact.

Mitigation. According to the Draft EIR/EIS for the ISDP, the DWR should take the following actions to mitigate for the impacts discussed above: (1) avoid construction work on the Old River fish control structure and the Grant Line flow control structure during major summer holiday periods; (2) post warning signs and buoys in the channels of the San Joaquin River and Old River (for the fish control structure) and within Grant Line Canal near all construction equipment and operations during construction of the barrier; (3) set up an information telephone hotline and a homepage on the internet to provide updates on the construction activities and operation of the barriers; and (4) provide adequate warning about activities and equipment to minimize disruption of boating movement during the barrier construction process.

e. Navigation. Review of the proposed facilities determined that the construction of the ISDP facilities would likely have short-term effects upon navigation in the immediate project area. Navigation conditions are typically related to the absence or presence of obstacles to travel on area waterways. Therefore, the proposed barriers will affect navigation. The following discussion provides an evaluation of the construction-related potential consequences of the ISDP upon navigation as disclosed in the ISDP Draft EIR/EIS.

Middle River Control Structure. Navigation along the 10-mile stretch of the Middle River (from about the Borden Highway Bridge at Victoria Canal and Trapper Slough to the confluence of Middle River with Old River) would be affected by the construction of the Middle River barrier. Construction would likely severely limit navigation, and once construction is complete, the barrier would prevent navigation. Boat ramps are to be constructed and used to transfer small craft from one side of the barrier to the other to allow access to Middle River. This portion of Middle River is little used by small craft due to the occurrence of shallows and abundant snags. The barrier is not considered to have a significant adverse impact upon navigation because of the infrequent use of the river in this location.

Old River Fish Control Structure. The construction of a barrier at the head of Old River would be expected to severely limit or prevent navigation for the 30-month construction period. The barrier would use radial gates, similar to other agricultural flow control structures. The barrier would prevent navigation during its operational period, from April 16 through May, and October through November, but would allow navigation the rest of the year. The creation of a seasonal barrier to navigation is considered to be an unavoidable significant adverse impact.

Old River Flow Control Structure East of the Delta-Mendota Canal. The construction period for the control structure and associated boat lock would last approximately 30 months. Navigation is expected to be severely limited or prevented during the 30-month construction period. This is considered to result in a significant adverse impact upon navigation. Once constructed, the barrier would allow passage through a boat lock. Notwithstanding the availability of a boat lock, the creation of a barrier to navigation is considered to be an unavoidable significant adverse impact.

Grant Line Canal Flow Control Structure. The Grant Line barrier would be located at the western end of an 8-mile stretch of Grant Line Canal. The proposed boat lock would be constructed first, followed by the construction of the radial gate structure and the other components of the barrier, in several phases over the 36-month construction period. The boat lock would be available early in the construction period, and then would be available during the operation of the structure to allow boat passage. Notwithstanding the availability of a boat lock, the creation of a barrier to navigation is considered an unavoidable significant adverse impact.

Mitigation. All the fish and flow control structures would severely limit navigation during the 30 to 36 month construction periods. Thereafter, the structures would have facilities available to transport most watercraft around the barriers. Notwithstanding the availability of these facilities, the creation of barriers to navigation is considered an unavoidable significant impact, with the exception of the Middle River Flow Control Structure, due to the low volume of use by small craft. These impacts cannot be mitigated to a level below significance.

f. Transportation. Construction of the barriers facilities would also likely have short-term effects upon transportation in the immediate project area. The following discussion provides an evaluation of the construction-related potential consequences of the ISDP upon transportation as disclosed in the ISDP Draft EIR/EIS (DWR and USBR 1996).

Implementation of the proposed project would add a maximum of 288 vehicles per day (256 commute trips plus 32 truck trips) to area roadways. Construction traffic would add a maximum of about 72 vehicles per day (vpd) to Highway 4, 25 vpd to Byron Highway, 82 vpd to I-205 and I-5, and 99 vpd to Tracy Boulevard. (Chapter 16 of the ISDP Draft EIR/EIS includes tables showing the duration of construction activity for each project element, and the amount of truck and employee traffic on a typical weekday.) The maximum level of construction traffic would occur over an 18-month period, when all of the facilities are simultaneously under construction.

All southern Delta roadways studied are currently operating at acceptable or better levels of service. The addition of construction traffic associated with the proposed barrier facilities would cause a less-than-significant adverse impact on the level of service on affected roads. The presence of numerous slow-moving trucks would, however, present a safety hazard. This hazard would be apparent on Tracy Boulevard and Clifton Court Road. This is considered a significant adverse impact.

The construction-related truck traffic on Byron Highway has the potential to inadvertently leave debris in the Class II bike lane. The debris, which could include spilled construction materials such as aggregate or sand, or dirt tracked up from private access roads, would create a potential hazard to cyclists. This is considered a significant adverse impact.

Mitigation. To minimize safety hazards to motorists in the ISDP construction traffic routes, the contractor should install “Truck Crossing” warning signs in advance of each access point to alert drivers to the presence of slow-moving trucks. These signs should be maintained for the duration of construction activity. Implementation of this mitigation measure would reduce this adverse impact to a less-than-significant level.

To minimize bicycle safety hazards within the Byron Highway bike lane, the contractor should regularly inspect the bike path and traveled way throughout the duration of construction activity. The contractor should maintain the bike path and traveled way in a clear condition with a scraper, street sweeper, or equivalent method, as necessary to assure safety. Implementation of this mitigation measure would reduce this adverse impact to a less-than-significant level.

2. Impacts to Water Levels and Salinity

This section discusses the effects of implementing the alternatives on water conditions in the southern Delta. Output from the DWRSIM and DWRDSM models, described in Chapter IV, together with results from the Temporary Barriers Project, are the basis for evaluating the environmental impacts of each alternative on water levels and water quality. DWRDSM is a mathematical simulation model used to evaluate flow, salinity, and water levels in the Delta. The model is not intended to provide absolute predictions of future Delta hydrodynamic and water quality conditions; rather the modeling is meant to be used as a tool to compare Delta conditions under various alternative actions.

For the purposes of analyzing the effects of barrier operations on water levels and salinity, barrier operations were modeled according to the schedule shown in Table IX-1. Operation of the barriers for the full duration of the spring and fall periods may not always occur due to Endangered Species Act and other requirements.

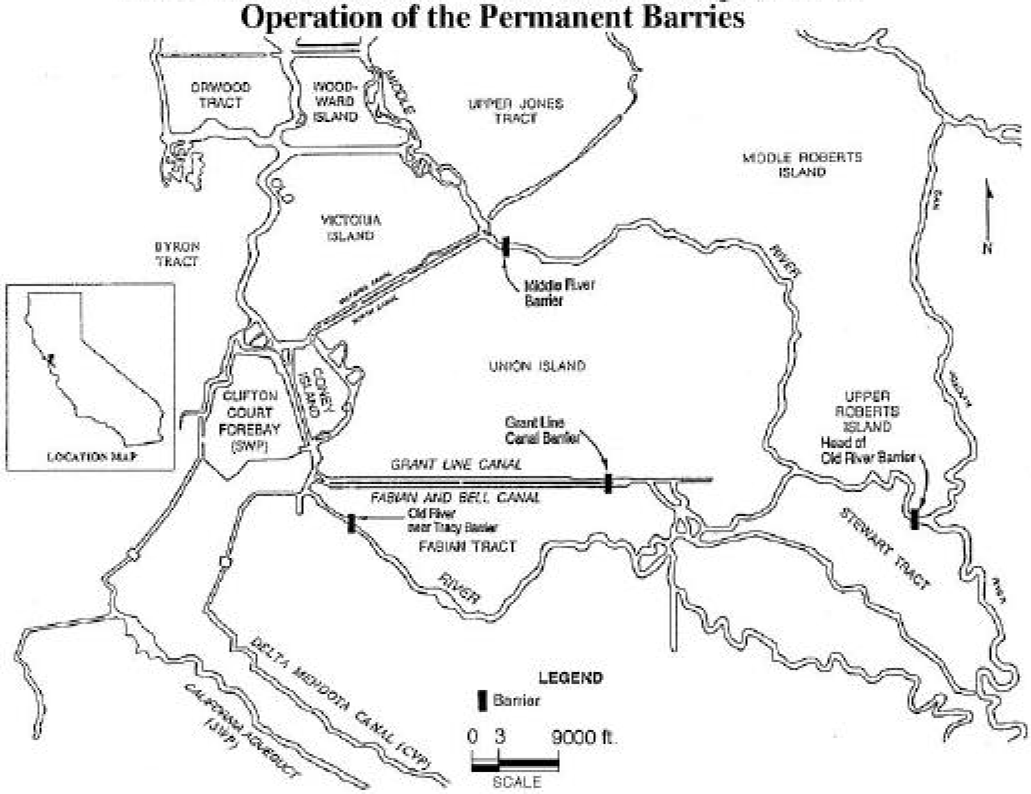
Table IX-1
Schedule of Temporary Barrier Installation and Permanent Barrier Operation

Time Period	Temporary Barriers	Permanent Barriers
October	Head of Old River	Old River, Middle River, Head of Old River
November	Head of Old River	Head of Old River
December	No Barriers	None Operating
January	No Barriers	None Operating
February	No Barriers	None Operating
March	No Barriers	None Operating
April 1 - 15	No Barriers	Old River, Middle River
April 16 - 30	No Barriers	Old River, Middle River, Head of Old River
May	Old River near Tracy, Middle River, Head Old River	Old River, Middle River, Head of Old River
June	Old River near Tracy, Middle River	Old River, Middle River, Grant Line Canal
July	Old River near Tracy, Middle River	Old River, Middle River, Grant Line Canal
August	Old River near Tracy, Middle River	Old River, Middle River, Grant Line Canal
September	Old River near Tracy, Middle River, Head of Old River	Old River, Middle River, Head of Old River

The following section is organized in three parts: (a) impacts to water levels; (b) impacts to salinity; and (c) mitigation for impacts.

a. Minimum Water Levels. Figures IX-6 through IX-16 depict water levels under the three alternatives at eleven locations in the southern Delta. Locations were selected upstream and downstream of temporary and permanent barrier sites (see Figure IX-5 for locations) in addition to other sites in the southern Delta. Each time period along the x-axis represents a constant condition during which the barrier combination does not change. The heights of the bars show minimum water levels averaged over the period. When a temporary barrier is installed or removed, or a permanent barrier is opened or closed, the change creates a new condition and a new time period begins.

Figure IX-5
Locations Examined for Water Level Changes Due to Operation of the Permanent Barries



Middle River Barrier Site Model output shown in Figure IX-6 shows predicted water levels downstream of the Middle River barrier site. Outputs indicate that installation of the temporary barrier and operation of the permanent barrier have very little effect on minimum water levels downstream of the barrier site.

Immediately upstream of the Middle River barrier site, minimum water levels change dramatically with the operation of the permanent barrier under Alternative 3 in October and again in April, as shown in Figure IX-7. Beginning May 1, minimum water levels at this location rise under all three alternatives, due to the barriers.

Figure IX-6
Average Minimum Water Levels by Period at
Middle River Downstream of Barrier

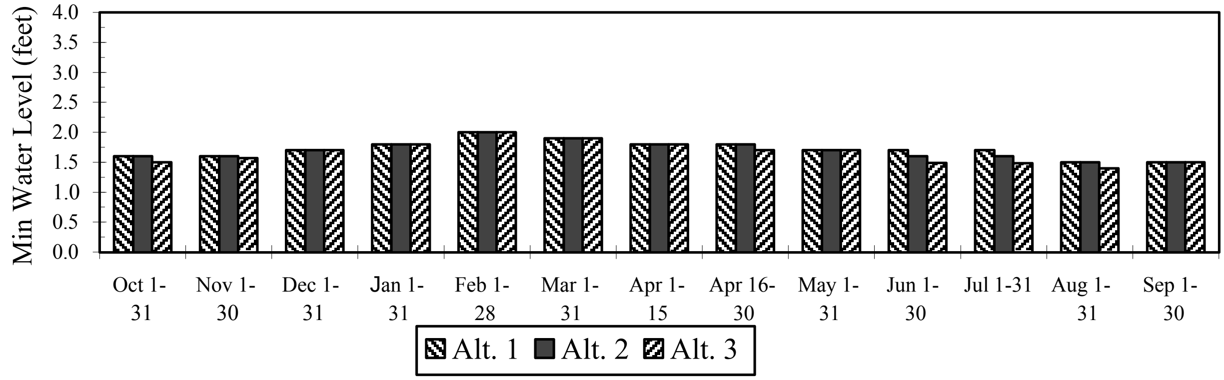


Figure IX-7
Average Minimum Water Levels by Period at
Middle River Upstream of Barrier

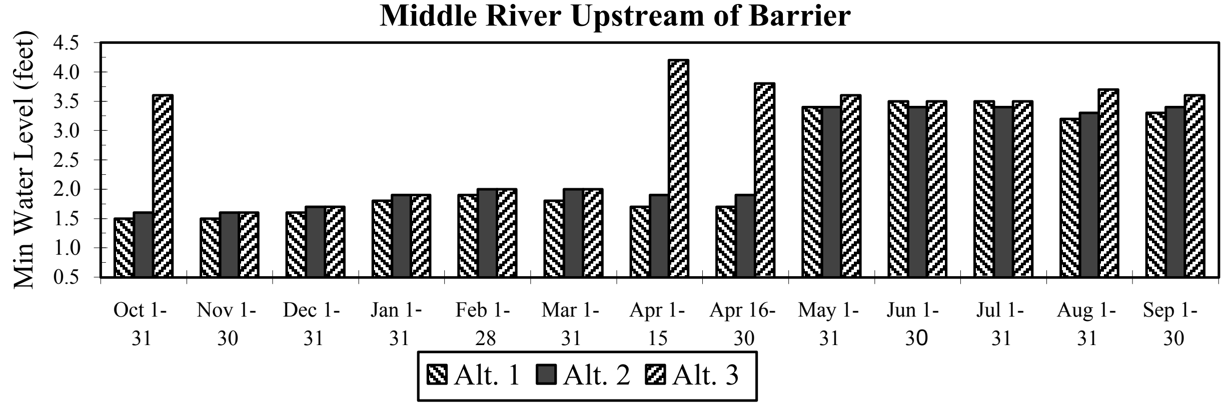


Figure IX-8
Average Minimum Water Levels by Period at
Old River Downstream of Barrier

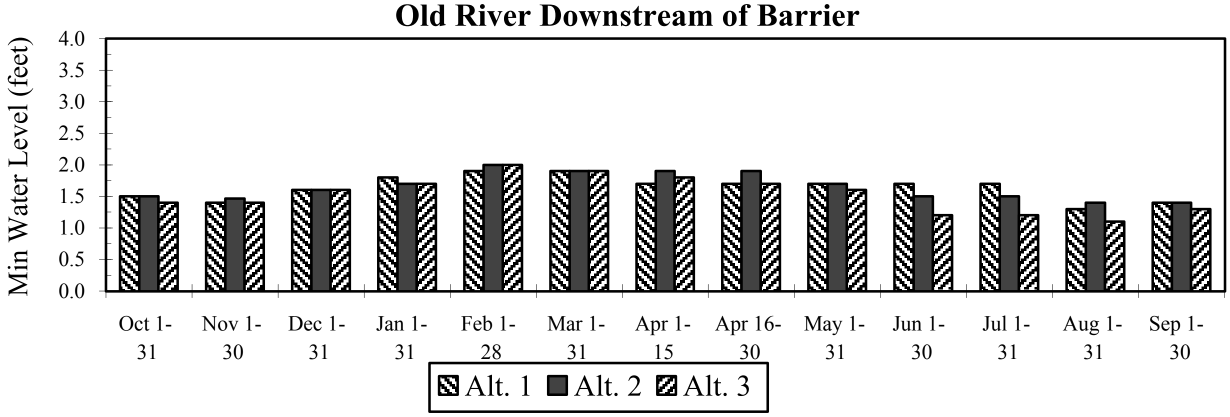


Figure IX-9
Average Minimum Water Levels by Period at
Old River Upstream of Barrier

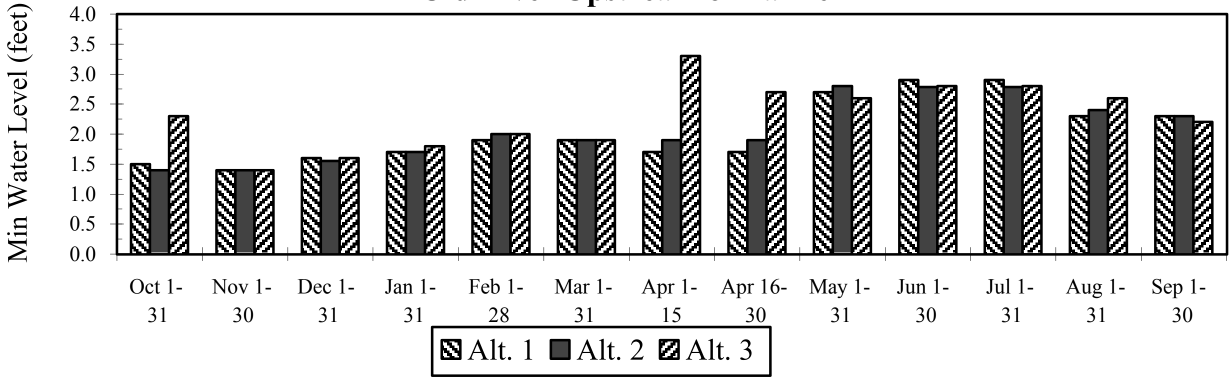


Figure IX-10
Average Minimum Water Levels by Period at
Grant Line West of Tracy Road Bridge

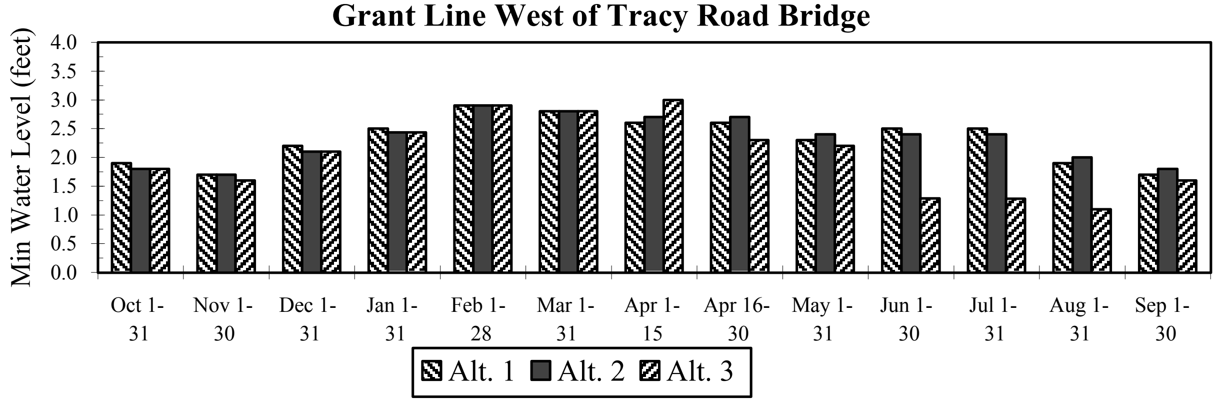


Figure IX-11
Average Minimum Water Levels by Period at
Grant Line East of Tracy Road Bridge

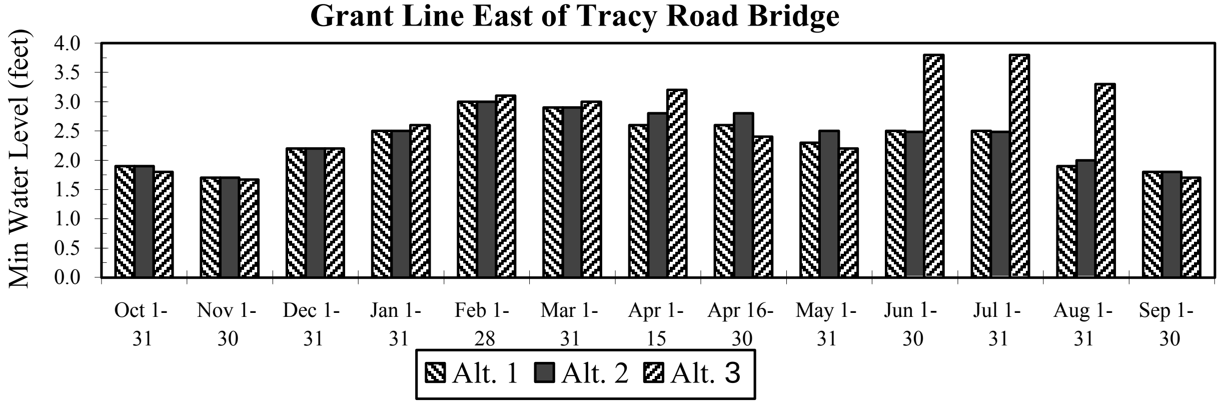


Figure IX-12
Average Minimum Water Levels by Period at Grant Line
Upstream of Grant Line & Old River Confluence

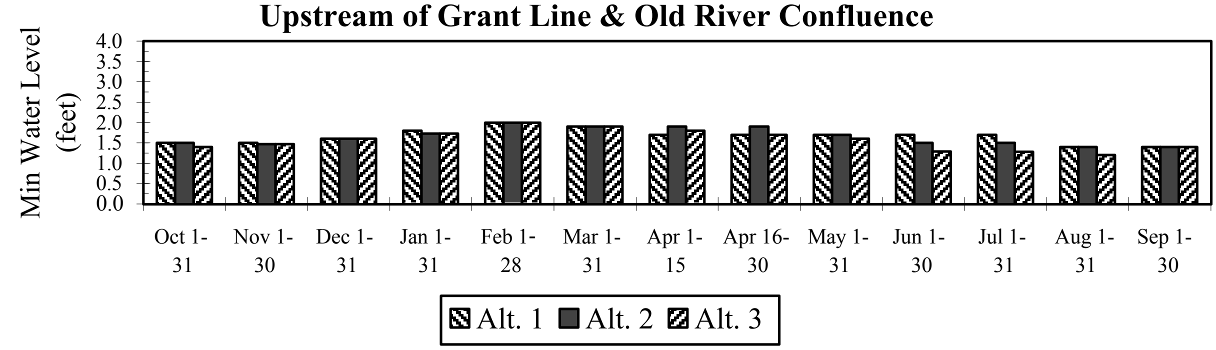


Figure IX-13
Average Minimum Water Levels by Period at
Old River East of Tracy Road Bridge

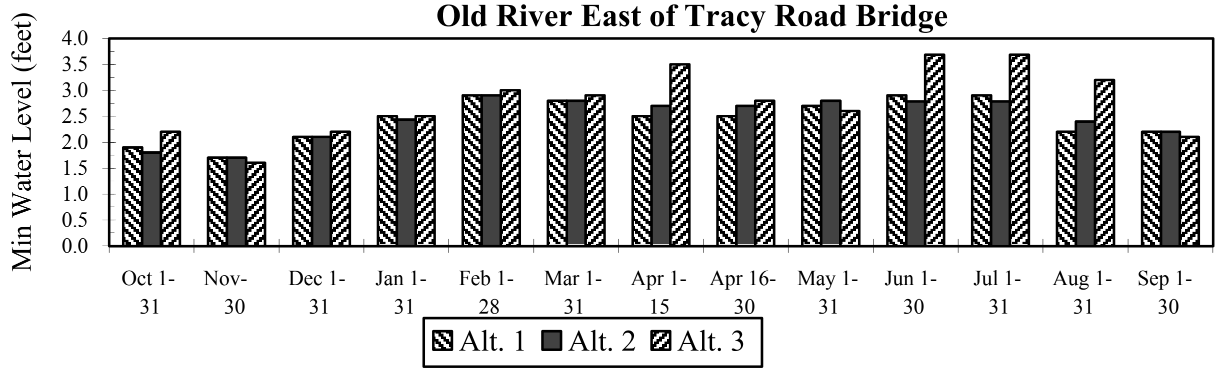


Figure IX-14
Average Minimum Water Levels by Period at
Middle River Near Undine Bridge

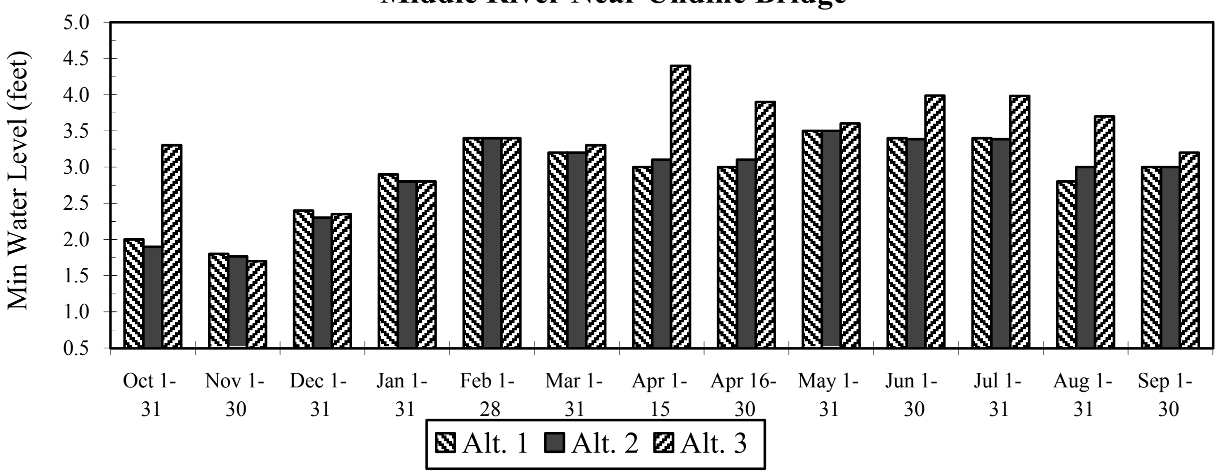


Figure IX-15
Average Minimum Water Levels by Period at Old River Upstream of Old River & Middle River Confluence

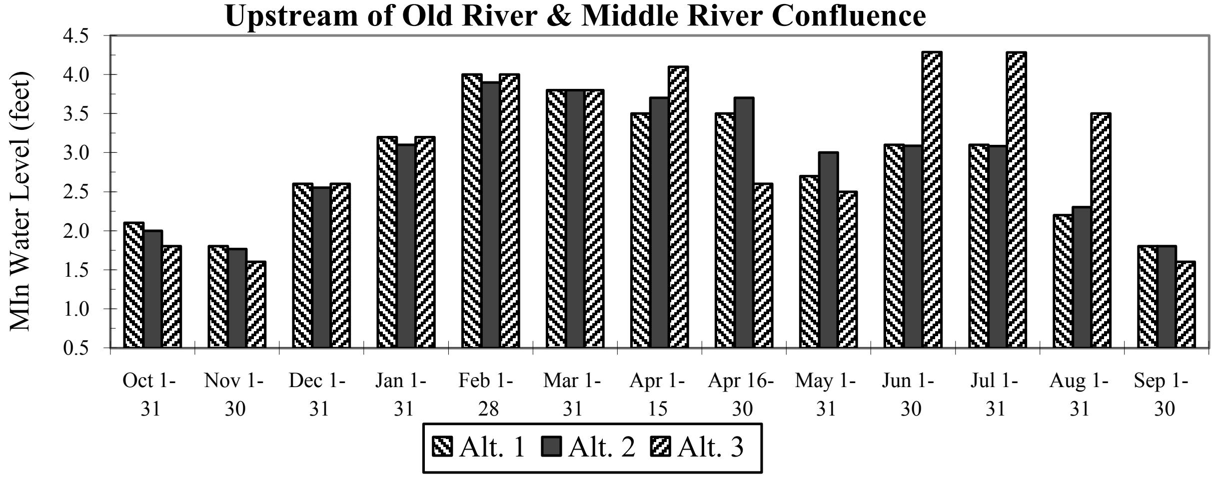
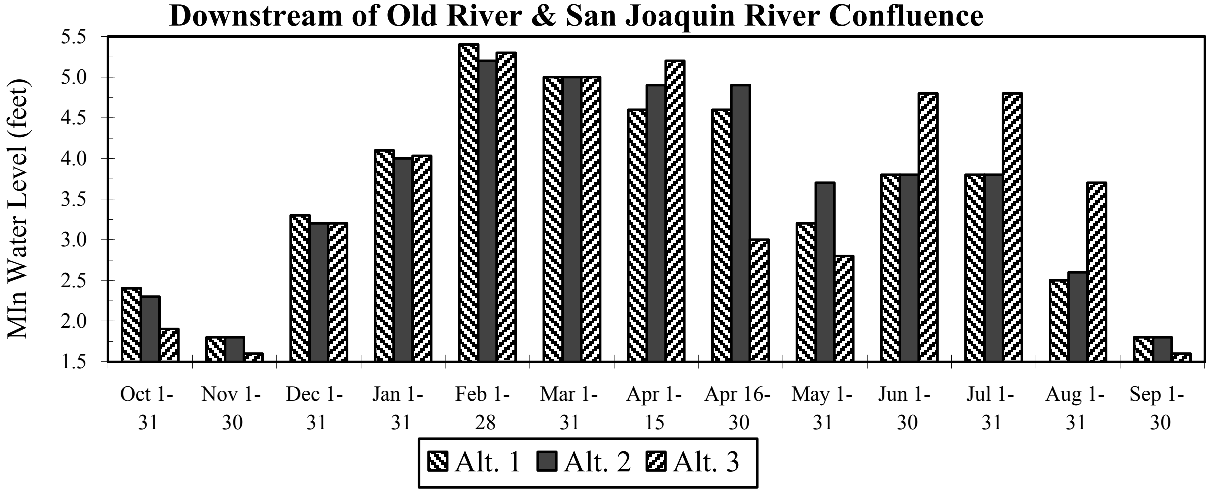


Figure IX-16
Average Minimum Water Levels by Period at Old River Downstream of Old River & San Joaquin River Confluence



Old River Barrier Site. Figure IX-8 shows water levels downstream of the Old River barrier site. As at the Middle River site, the barrier has very little effect on downstream water levels. Immediately upstream of the Old River barrier site, the installation of a temporary barrier from May through September under Alternative 2 causes another significant increase in minimum water levels upstream of the barrier site, particularly during May and June, as shown in Figure IX-9. Minimum water levels change dramatically in April (and to a lesser degree through October) with the operation of the permanent barrier under Alternative 3.

Grant Line Canal Barrier Site. Figure IX-10 shows output for a site downstream of the Grant Line Canal barrier site. The DWRDSM model assumptions include a permanent barrier on the East end of Grant Line Canal. The operation of the permanent barrier under Alternative 3 would reduce minimum water levels by approximately one foot, which may have a potentially significant adverse impact on diverters downstream of the site from June through August. Moving the barrier further west on Grant Line Canal could eliminate this water level reduction.

Figure IX-11 (upstream of the Grant Line Canal barrier site) shows water levels very similar to those in Figure IX-10; however, there is a dramatic increase in Alternative 3 minimum water levels June through August, corresponding to the operation of the permanent Grant Line barrier.

Other Locations. Figure IX-12, shows predicted minimum water levels at a site further downstream of the Grant Line Canal barrier site. Model output indicates that the barrier has very little effect on minimum water levels at this location downstream of Grant Line Canal barrier.

Figure IX-13 shows minimum water levels for a location further upstream from the Tracy barrier site. Overall minimum water levels on Old River East of Tracy Road Bridge appear to be higher under Alternative 3 than under either Alternative 1 or 2, particularly in the first part of April and in June through August.

Minimum water levels for a location further upstream of the Middle River barrier site are shown in Figure IX-14. Alternative 3 provides the highest minimum water levels from April through October.

Figure IX-15 shows that minimum water levels at the confluence of Middle and Old rivers are very similar under all three alternatives from September through March. Relative to the other alternatives, Alternative 3 water levels are lowest in late April through May, then highest for June through August.

Figure IX-16 shows that minimum water levels drop on the Old River downstream of its confluence with the San Joaquin River when the head of Old River barrier is closed. In the summer months water levels rise under Alternative 3 in comparison to the other alternatives because of increased tidal pumping from the downstream permanent barriers.

In conclusion, according to the model output depicted in Figures IX-6 through IX-16, the installation of permanent barriers under Alternative 3 reduces minimum water levels in some cases, but in general minimum water levels rise during the irrigation season at most locations.

b. **Salinity**. Figures IX-17 through IX-26 show the probability of exceedance of the EC or chloride objectives of each of the three alternatives by comparing modeled values under the alternatives to the objectives. The figures use model output from 73-year DWRDSM runs (water years 1922 through 1994). Figures IX-17 and IX-18 show percent-of-time exceedence of year-round chloride objectives at Contra Costa Water District's Pumping Plant # 1/Rock Slough intake and Pumping Plant # 2/Los Vaqueros intake on Old River. Figures IX-19 through IX-26 show exceedance of the EC objectives for the April through August period (objective of 0.7 mmhos/cm) and the September through March period (objective of 1.0 mmhos/cm) for the following four locations identified in the 1995 Bay/Delta Plan: San Joaquin River at Airport Way Bridge (Vernalis); Old River near Middle River (Union Island); San Joaquin River at Brandt Bridge site; and Old River at Tracy Road Bridge.

Contra Costa Water District. Figures IX-17 and IX-18 show frequencies of exceedence for modeled chlorides at Contra Costa Water District's Rock Slough and Los Vaqueros Reservoir intakes (depicted as Pumping Plants # 1 and # 2, respectively). At pumping plant # 1, the modeling indicates that the municipal and industrial (M&I) water quality objective of 250 mg/l chlorides would be exceeded under the base case about 13 percent of the time over the 72 year hydrology. This contrasts with Alternatives 2 and 3, which are nearly identical and would exceed the M&I water quality objective about eight percent of the time. At Pumping Plant 2, the M&I objective would be exceeded about ten percent of the time under the base case while Alternatives 2 and 3 would exceed the M&I objective about seven percent of the time. In the worst two percent of months (i.e., those 18 discreet months over the 72-year hydrology when chlorides are highest), Alternatives 2 and 3 chlorides are somewhat higher than the base case. As described in Chapter VI, in actual operation the chloride objectives are not expected to be exceeded because the SWP and the CVP will operate to meet them. The operations model, DWRSIM, was operated to meet the chloride objective at Rock Slough at all times. The salinity transport model, DWRDSM, however, provides different salinity estimates at Rock Slough. Consequently, the value of the model output is in its comparison of salinity or chloride concentrations among the alternatives rather than comparison of the predicted salinity or chloride concentrations in comparison to the objectives.

Overall, Figures IX-17 and IX-18 indicate that implementation of southern Delta salinity alternatives would not adversely affect chloride levels at the Contra Costa Water District and may improve water quality up to half the time.

Vernalis. Figures IX-19 and IX-20 show frequencies of exceedance for modeled EC at Vernalis on the San Joaquin River during the irrigation and non-irrigation seasons, respectively. Under Alternative 1, the CVP makes releases from New Melones Reservoir to meet an objective of 500 ppm TDS on a year-round basis, which corresponds to an EC of approximately 0.86 mmhos/cm. Consequently, as depicted in Figure IX-19, the EC at Vernalis often exceeds the Bay/Delta Plan objectives of 0.7 mmhos/cm in April through August, as well as the modeled salinity for the other two alternatives during the period. For the September through March period, the salinity objective under Alternative 1 is less than the objective for the other alternatives (1.0 mmhos/cm), and this situation is reflected on Figure IX-20 when the salinity under Alternative 1 is lower at the upper range of salinity conditions.

Modeled EC levels for Alternatives 2 and 3 are identical during both seasons because the Vernalis hydrology for both alternatives comes from the same model study.

Other Southern Delta Locations. Figures IX-21 through IX-26 show the effect of the alternatives on compliance locations downstream of Vernalis. The following observations apply to the figures:

1. The higher upper range salinity at Vernalis under Alternative 1, which is caused by the difference in the objectives, results in higher upper range salinities at the downstream locations as well.
2. Salinity conditions in the three interior stations are worse than salinity conditions at Vernalis. Because the salinity objective at Vernalis is just met about half the time during the summer, substantial noncompliance with the objective at the interior southern Delta are expected even with barrier operation.
3. Overall, Alternative 3 provides the best salinity conditions in the southern Delta.

Salinity conditions in the southern Delta are also portrayed in Figures IX-27 through IX-33. The figures show, by month and year-type, how often EC levels under one of the alternatives will be greater than or less than the base case. For example, Figure IX-27 shows the frequency of change in salinity of Alternatives 2 and 3 compared with Alternative 1 at Vernalis (San Joaquin River at Airport Way Bridge). That is, EC predicted by the model under Alternative 1 (base condition) is used as the baseline salinity, represented by a horizontal 'zero' line, for each month of each year type. The vertical lines show the frequency of any increase or decrease in EC under Alternative 2 compared to EC for Alternative 1. A line above 'zero' represents an increase in EC as a result of implementing Alternative 2, and a line below represents a decrease in EC as a result of implementing Alternative 2. The bars above and below the 'zero' line represent the times when EC under Alternative 2 differs from that of Alternative 1 by more than ten percent.

Figure IX-17
Percent Probability of Exceedence of Water Quality Objectives at Contra Costa Canal Pumping Plant # 1
(72-year model hydrology)

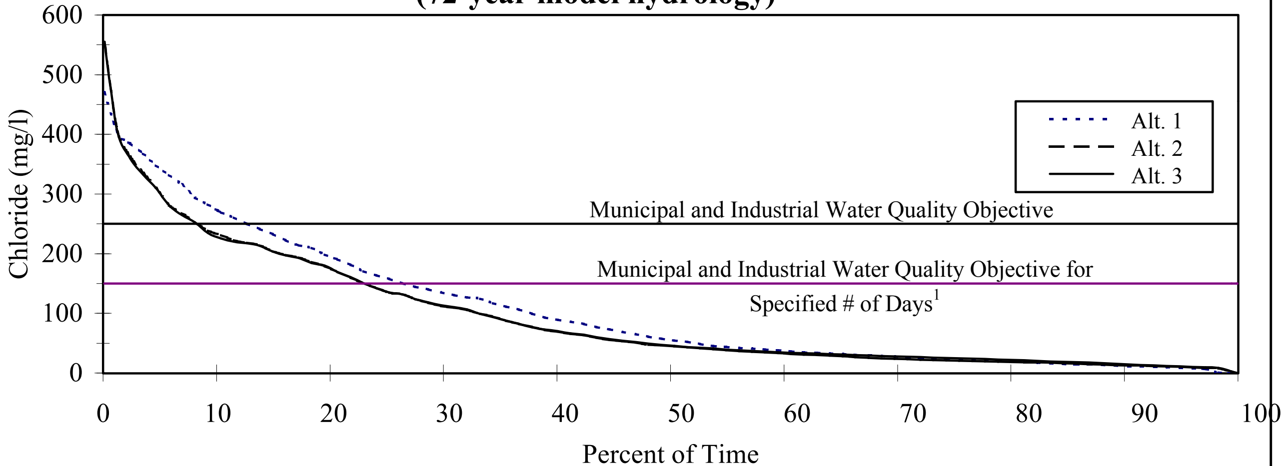
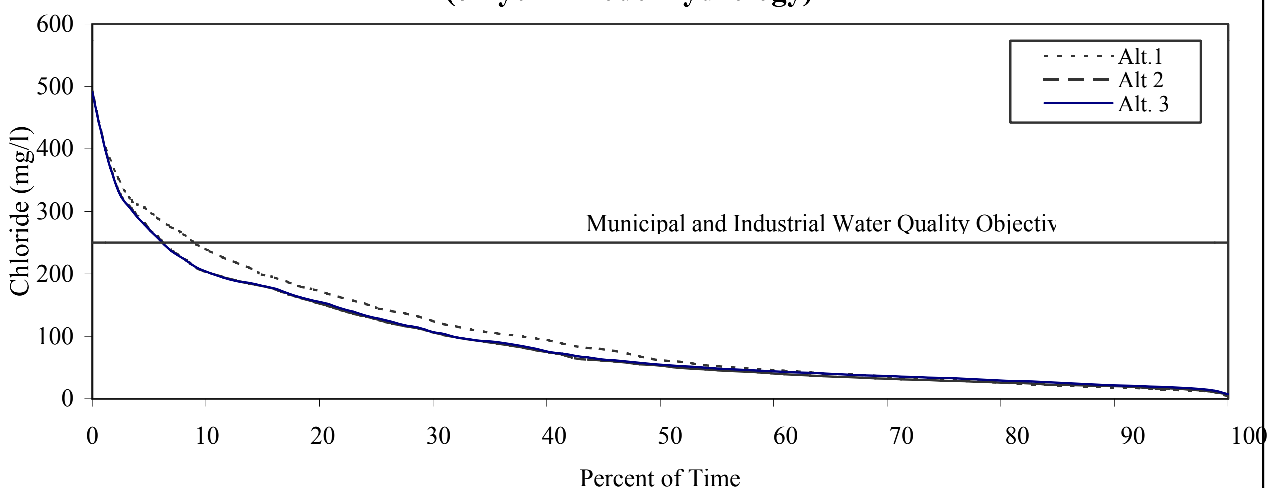


Figure IX-18
Percent Probability of Exceedence of Water Quality Objectiv
Contra Costa Water District Pumping Plant # 2
(72-year model hydrology)



[1] Minimum number of days that mean daily chlorides <= 150 mg/l must be provided in intervals of not less than two weeks duration. Standard applies at Contra Costa Canal Intake

Year Type	Wet	Above Normal	Below Normal	Dry	Critical
# Days	240	190	175	165	155

Figure IX-19
Percent Probability of Exceedance
of Plan Salinity Objectives at SJR at Airport Way Bridge (Vernalis)
For April - August

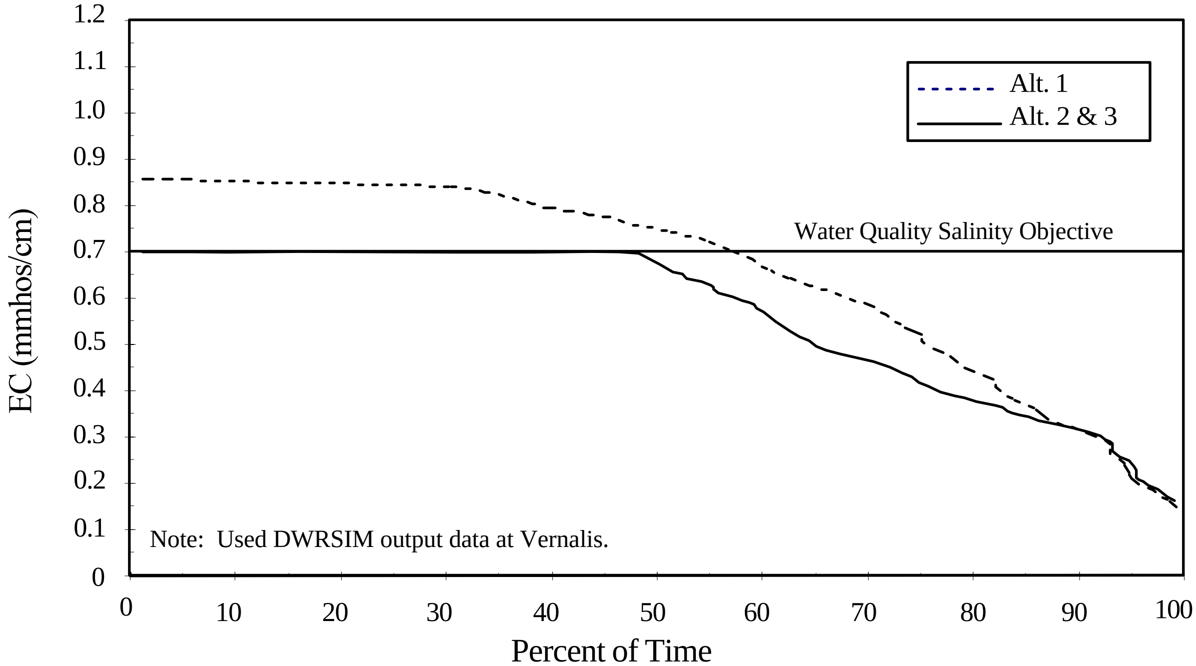


Figure IX-20
Percent Probability of Exceedance
of Plan Salinity Objectives at SJR at Airport Way Bridge (Vernalis)
For September - March

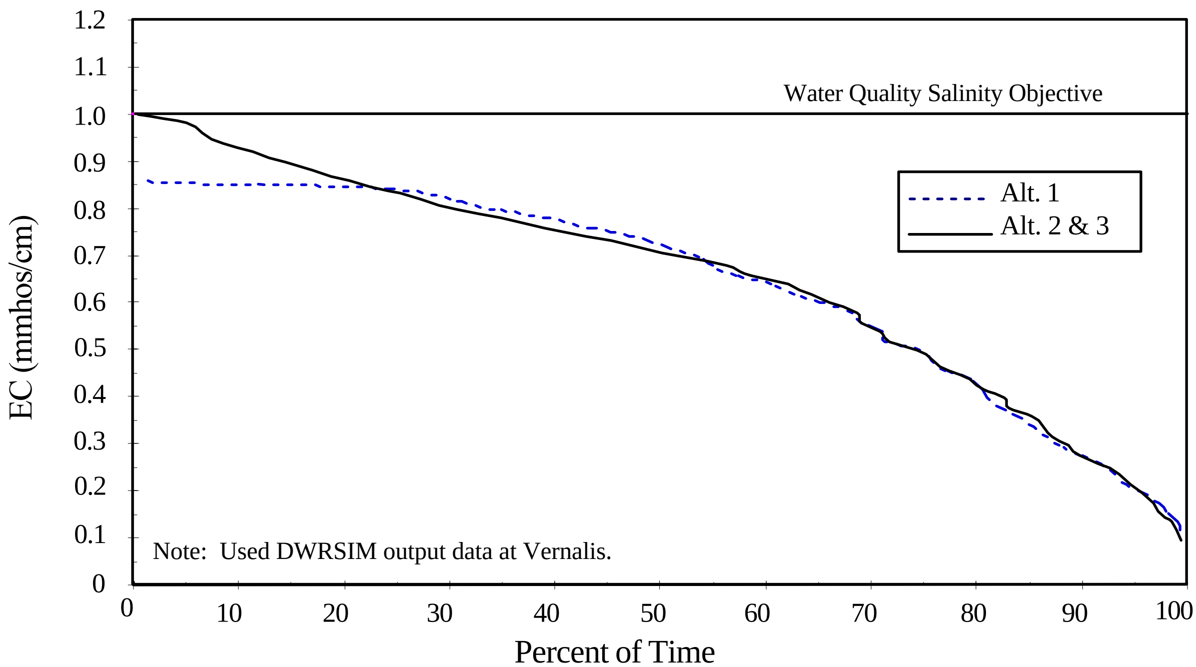


Figure IX-21
Percent Probability of Exceedance of Plan Salinity Objectives at Union Island For April - August

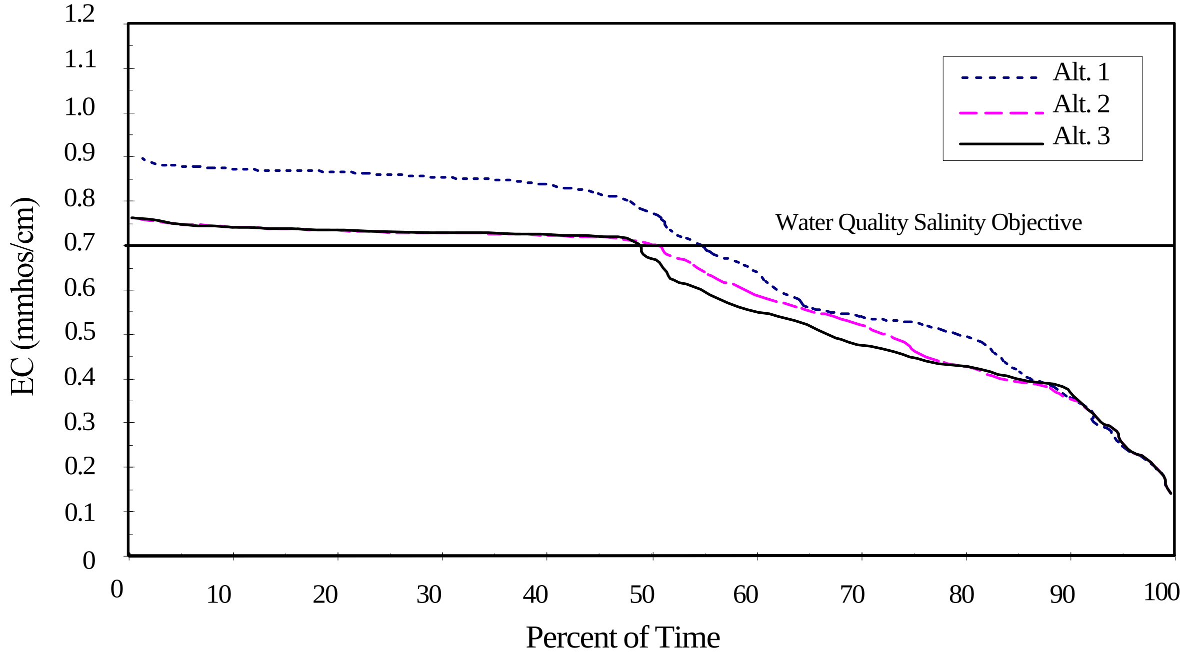


Figure IX-22
Percent Probability of Exceedance of Plan Salinity Objectives at Union Island For September - March

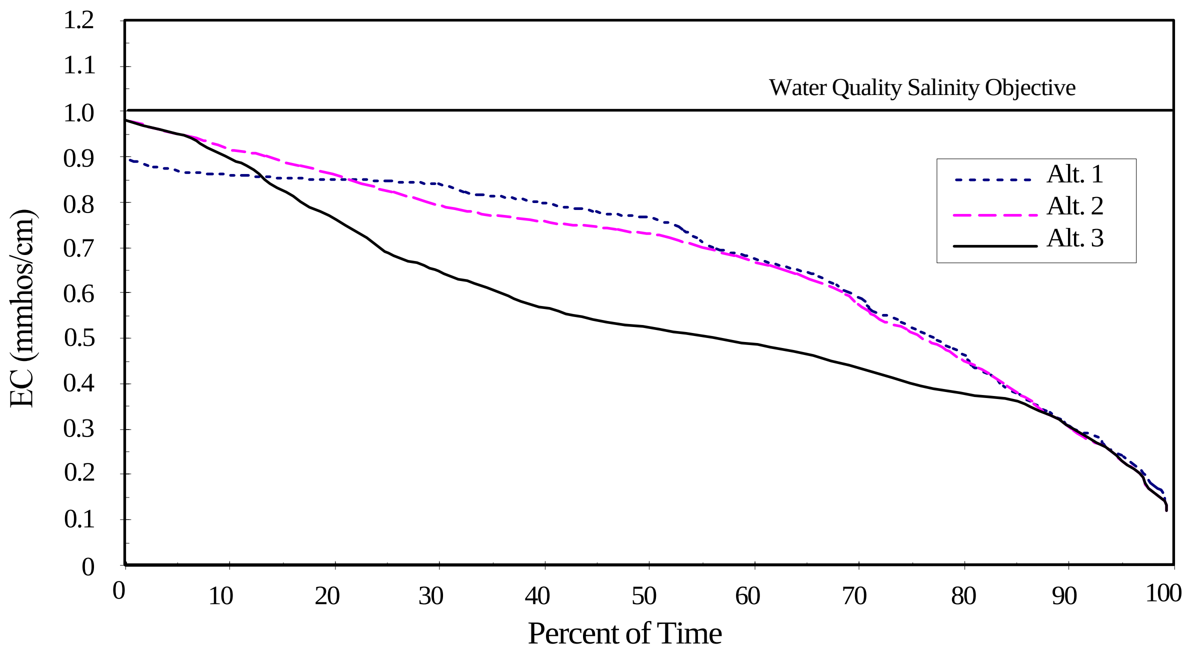


Figure IX-23
Percent Probability of Exceedance of Plan Salinity Objectives at Brandt Bridge on SJR For April - August

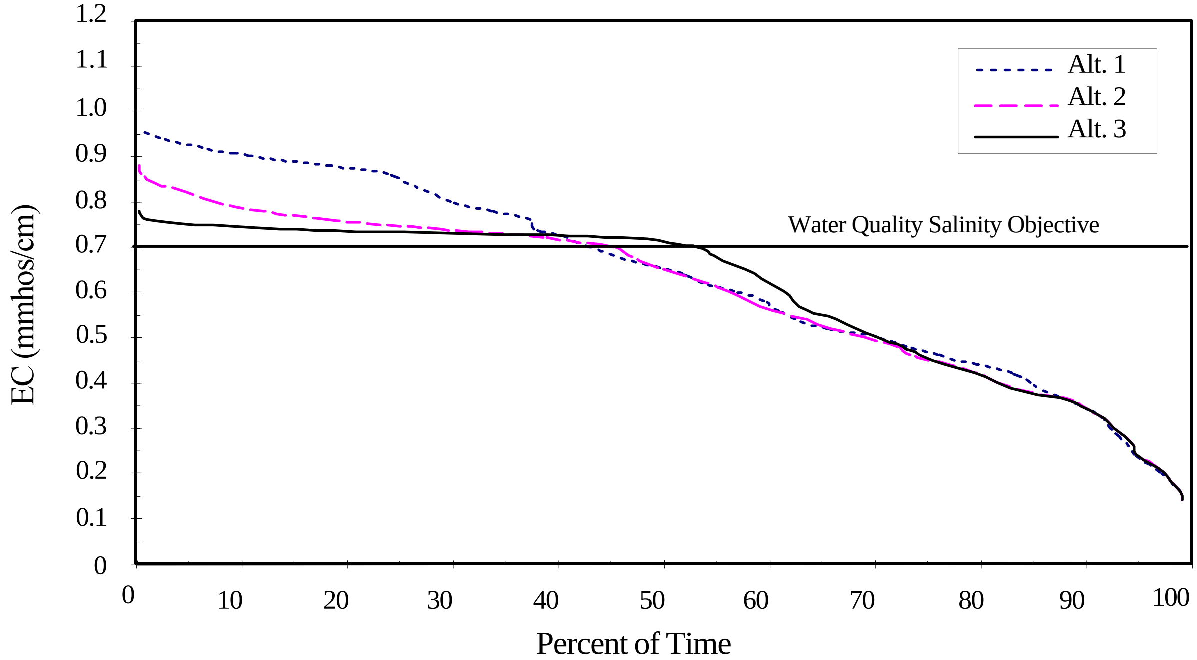


Figure IX-24
Percent Probability of Exceedance of Plan Salinity Objectives at Brandt Bridge on SJR For September - March

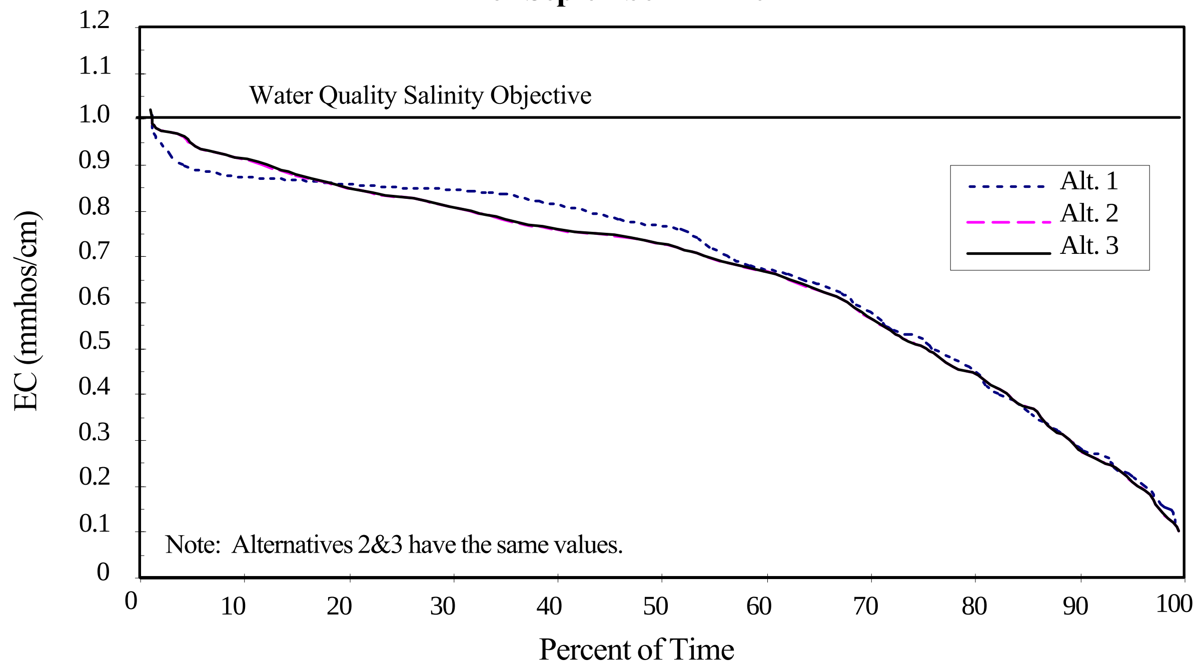


Figure IX-25

Percent Probability of Exceedance of Plan Salinity Objectives at Old River at Tracy Road Bridge For April - August

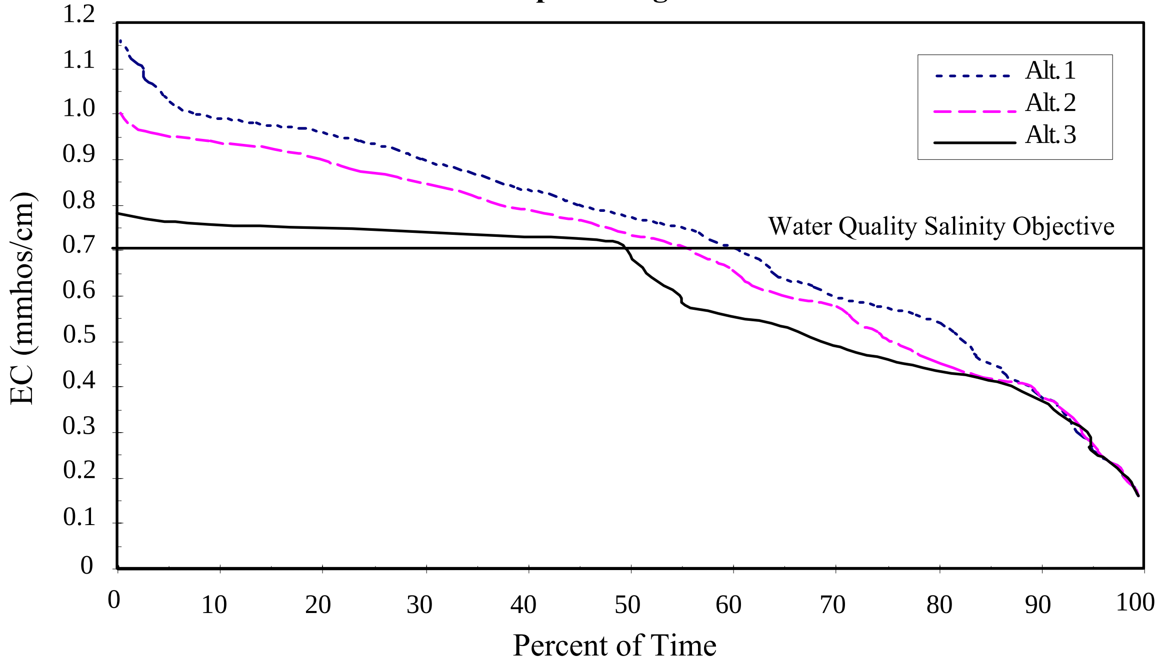
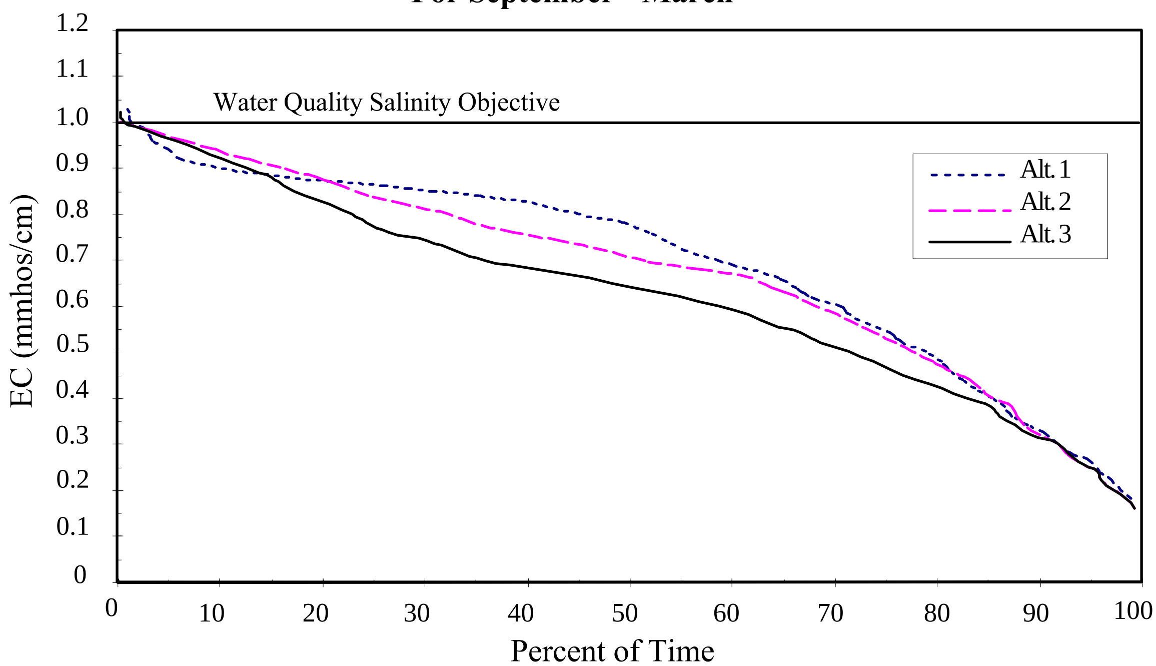


Figure IX-26

Percent Probability of Exceedance of Plan Salinity Objectives at Old River at Tracy Road Bridge For September - March



Vernalis. Figure IX-27 shows the relative EC at Vernalis for each year-type for Alternatives 2 and 3 compared with Alternative 1 by month for all the years on record. Alternatives 2 and 3 have exactly the same EC at Vernalis because they use the same DWRSIM input study. During October of wet years, the figure shows that EC for Alternatives 2 and 3 exceeds EC for Alternative 1 approximately 48 percent of the time--the vertical line above 'zero' for wet years ends at 48 percent along the y-axis. That is, the model predicted an increase in EC under Alternatives 2 and 3 in 48 percent of all the wet-year Octobers on record.
Figure IX-25 also shows that October EC levels in wet years under Alternatives 2 and 3 are at least ten percent greater than EC levels for Alternative 1 approximately six percent of all the wet-year Octobers on record (solid bar above 'zero'). On the other hand, the model predicts that October EC levels will be lower under Alternatives 2 and 3 than under Alternative 1 in about 52 percent of the wet-year Octobers on record, and will be at least ten percent lower than for Alternative 1 in about 38 percent of those Octobers. This suggests that overall, in wet years, October EC levels can be expected to decrease under Alternatives 2 and 3 (vs. Alternative 1). All of Figure IX-25 can be interpreted in this manner. In general, Alternative 1 provides lower salinity conditions than Alternatives 2 and 3 during the November through March period at Vernalis, since EC levels under Alternatives 2 and 3 fall almost completely above the line representing EC under Alternative 1. The difference in salinity between Alternative 1 compared to Alternatives 2 and 3 is caused by the difference in flow and EC objectives at Vernalis, not by implementation of temporary or permanent barriers. The most dramatic differences occur during critically dry years. However, beginning in April, Alternatives 2 and 3 provide better salinity conditions than Alternative 1, again because of the difference in objectives.

Union Island. Figure IX-28 shows the frequency of change in salinity for Union Island station between Alternatives 1 and 2. As at Vernalis, Alternative 1 EC is lower than that of Alternative 2 during the November through March period, and Alternative 2 is better overall than Alternative 1 between April and October. In fact, the frequencies of change shown in Figure IX-28 are almost identical to those for Vernalis (Figure IX-27), with the exception of May. According to model results, May salinity under Alternative 2 is likely to be higher than that of Alternative 1 salinity in dry and critically dry years. The difference in salinity between Alternative 1 compared to Alternative 2 is driven principally by the difference in flow and EC objectives at Vernalis.

Figure IX-29 shows a substantial improvement in EC conditions in October, November, April and September under Alternative 3 in comparison to Alternatives 1 and 2. This improvement is caused by the permanent barrier operation.

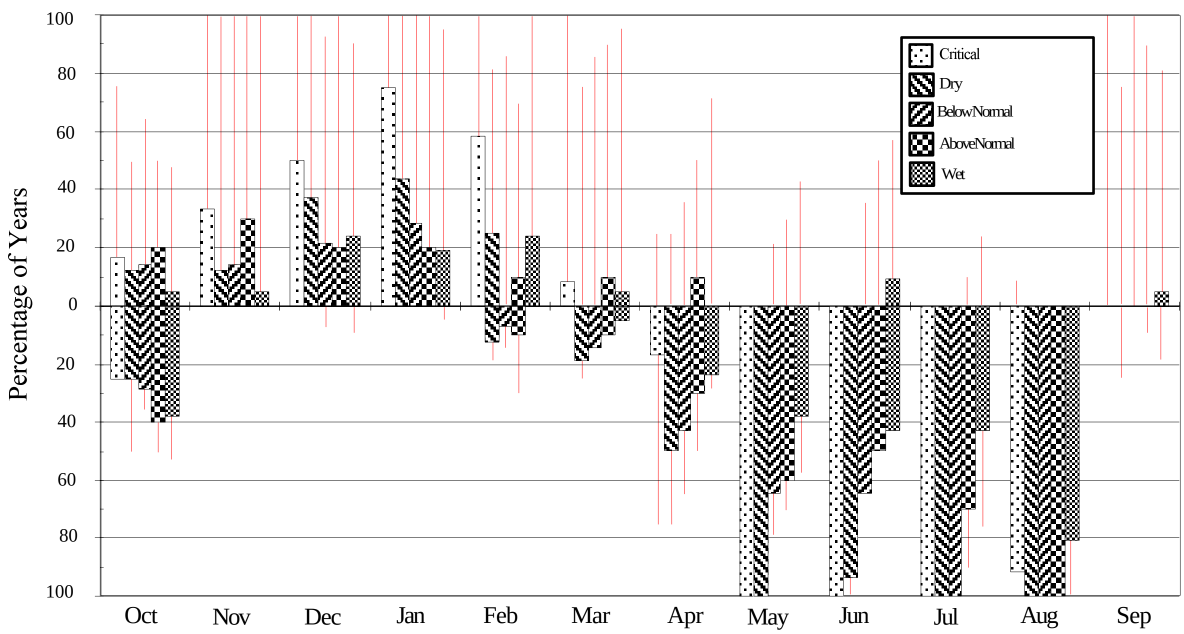
San Joaquin River at Brandt Bridge site. Figures IX-30 and IX-31 provide a comparison of EC conditions at Brandt Bridge under Alternatives 2 and 3 compared to Alternative 1. These two figures show very little difference between Alternatives 2 and 3 relative to Alternative 1. Alternatives 2 and 3 cause improved EC conditions in April through June, worse EC conditions from November through February, and mixed conditions in March and from July through October.

During July and August, both Alternatives 2 and 3 generate higher salinities at this location relative to the no-action alternative than at the other southern Delta locations. (Salinity is at least as likely to increase under Alternative 2 or 3 compared with Alternative 1, whereas at the other stations, Alternatives 2 and 3 appear to improve water quality rather consistently.) The increase in salinity is explained by a change in circulation patterns. Under Alternative 1, reverse flow occurs, taking higher quality (Sacramento River) water from the Delta and carrying it upstream past Brandt Bridge. Alternatives 2 and 3 change the direction of flow past Brandt Bridge, and poorer quality water from Vernalis flows downstream past the station (Ghorbanzadeh, pers. comm.).

Old River at Tracy Road Bridge. Figures IX-32 and IX-33 provide a comparison of EC conditions at Tracy Road Bridge under Alternatives 2 and 3 compared to Alternative 1. The pattern of EC conditions under Alternatives 2 and 3 relative to Alternative 1 is similar to the pattern at Union Station. Overall, Alternative 3 provides the most improvement in EC conditions during the irrigation season.

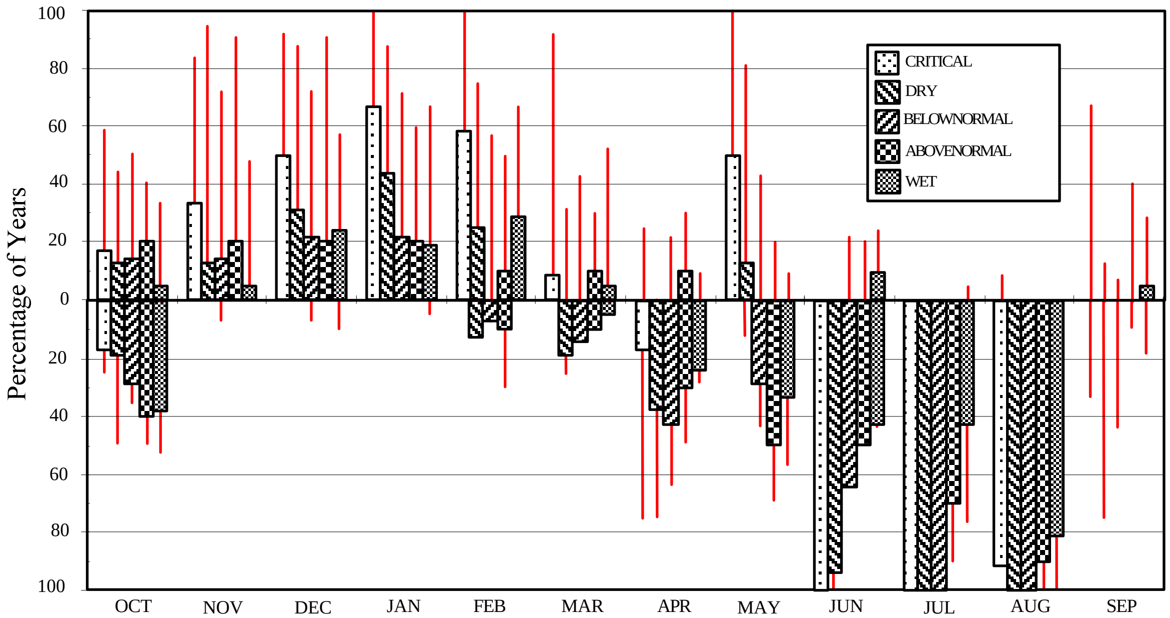
In summary, according to the model output depicted in Figures IX-17 through IX-31, none of the alternatives eliminates exceedances during the irrigation season; in general, however, Alternative 3 appears to be most effective in reducing EC levels at southern Delta stations during the irrigation season (April-August).

Figure IX-27
Frequency of Change
in Salinity of Alternatives 2 & 3 Compared with Alternative 1
San Joaquin River at Airport Way Bridge (Vernalis)



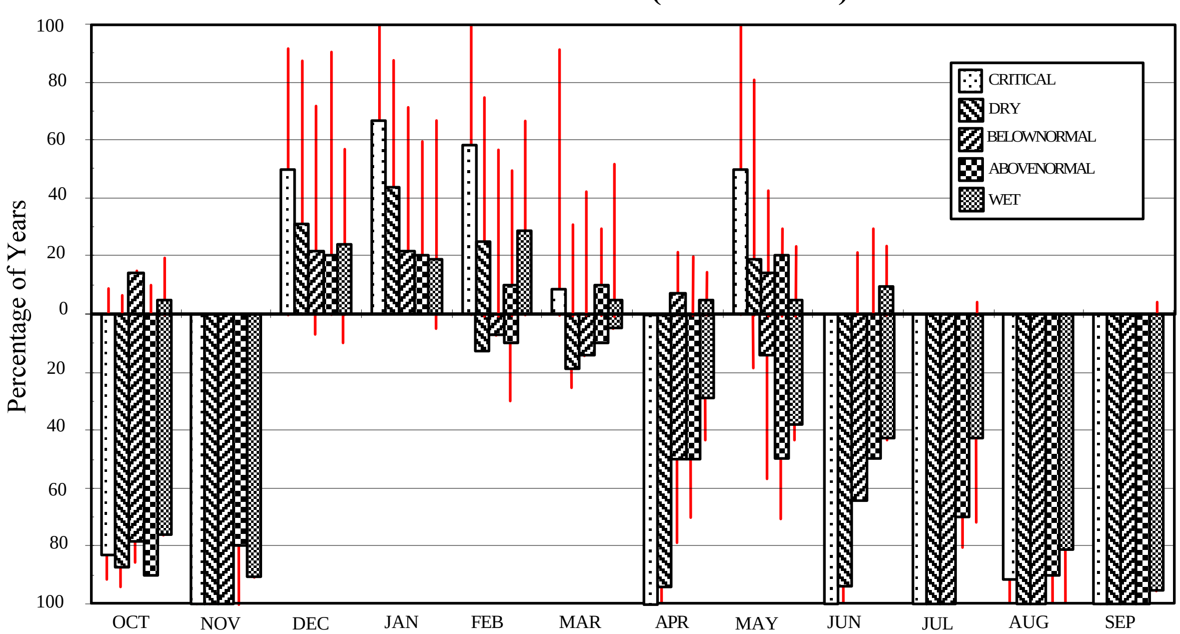
Note: Bars show results for >10% increases and decreases, vertical lines show results for all increases and decreases

Figure IX-28
Frequency of Change
in Salinity of Alternative 2 Compared with Alternative 1
Old River at Middle River (Union Island)



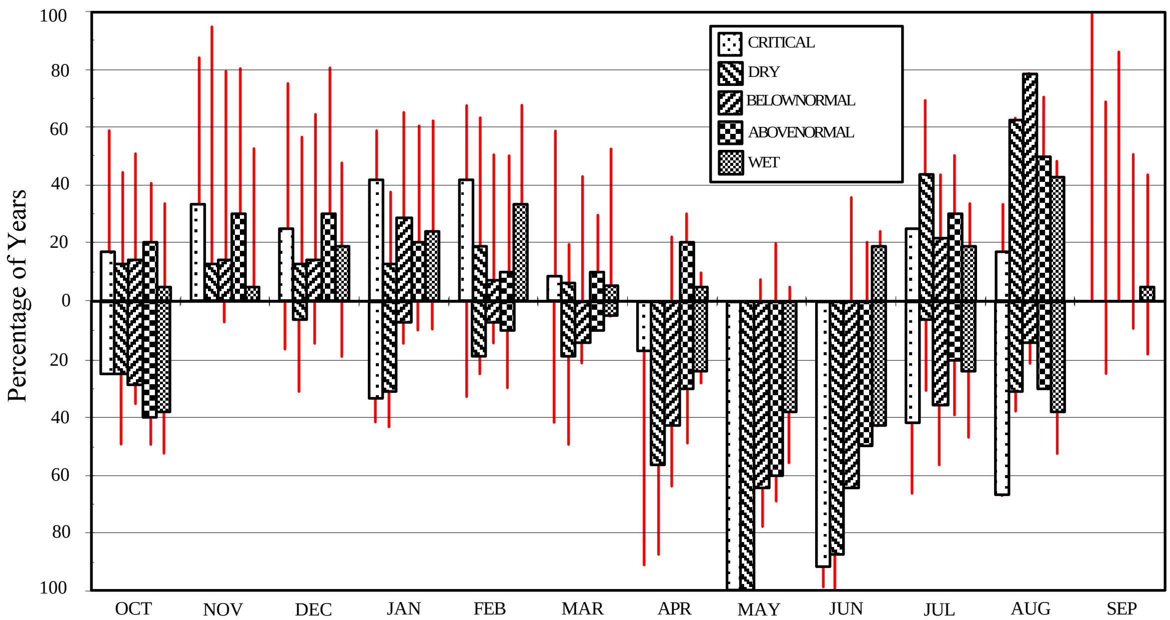
Note: Bars show results for >10% increases and decreases, vertical lines show results for all increases and decreases

Figure IX-29
Frequency of Change
in Salinity of Alternative 3 Compared with Alternative 1
Old River at Middle River (Union Island)



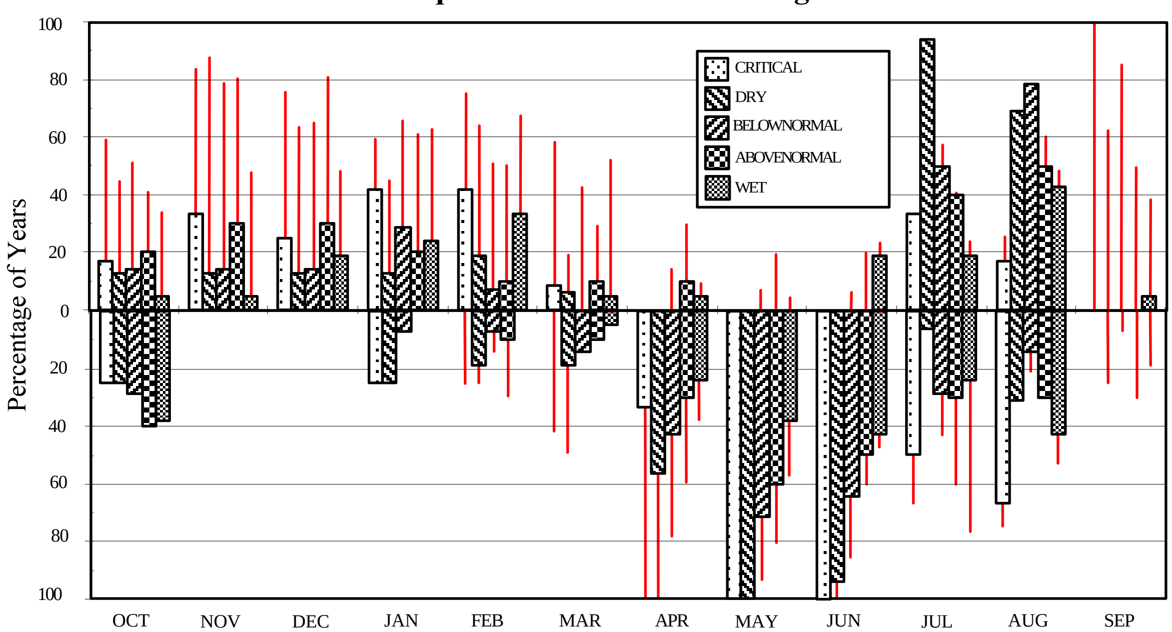
Note: Bars show results for >10% increases and decreases, vertical lines show results for all increases and decreases

Figure IX-30
Frequency of Change
in Salinity of Alternative 2 Compared with Alternative 1
San Joaquin River at Brandt Bridge



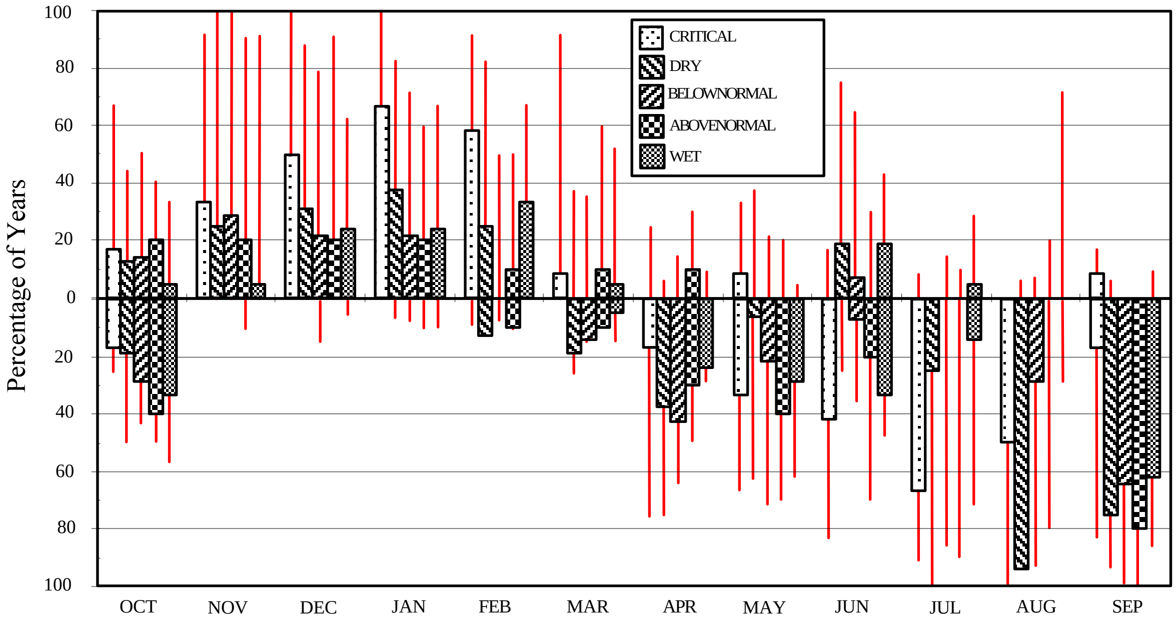
Note: Bars show results for >10% increases and decreases, vertical lines show results for all increases and decreases

Figure IX-31
Frequency of Change
in Salinity of Alternative 3 Compared with Alternative 1
San Joaquin River at Brandt Bridge



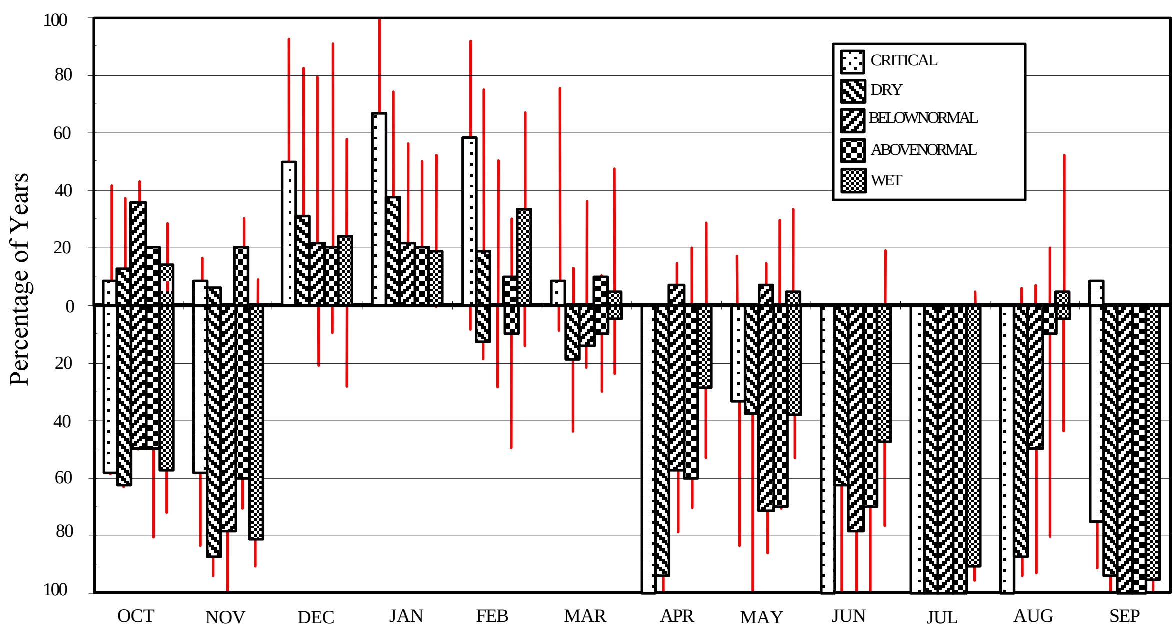
Note: Bars show results for >10% increases and decreases, vertical lines show results for all increases and decreases

Figure IX-32
Frequency of Change
in Salinity of Alternative 2 Compared with Alternative 1
Old River at Tracy Road Bridge



Note: Bars show results for >10% increases and decreases, vertical lines show results for all increases and decreases

Figure IX-33
Frequency of Change
in Salinity of Alternative 3 Compared with Alternative 1
Old River at Tracy Road Bridge



Note: Bars show results for >10% increases and decreases, vertical lines show results for all increases and decreases

c. Mitigation for Impacts. No significant water quality impacts from the operation of the barriers were identified. Therefore, no mitigation is required.

3. Impacts to Aquatic Resources

This section describes the effects of the alternatives on aquatic resources. The discussion of potential impacts under Alternative 3 only includes those impacts that result from the barrier operation. The impacts to aquatic resources from implementing the flow objectives are discussed in Chapter 6 of this draft EIR.

The section is organized in three parts: (a) method for analysis; (b) impacts; and (c) mitigation for impacts.

a. Method for Analysis. This analysis is qualitative and limited to reviewing when various fish species are present in the Delta and how those species could be affected by the operation of the barriers. Qualitative criteria were used to evaluate the significance of the impacts of the alternatives because the available information regarding southern Delta habitats and fish populations is inadequate for developing meaningful quantitative criteria. The effects of the barriers are evaluated based on how they are expected to affect hydrologic variables when a given species is present in the Delta. The time of year of greatest sensitivity for most species is assumed to be during spawning and development of the larvae and young juveniles.

Species selected for evaluation of impacts include: fall-run, winter-run, late fall-run, and spring-run chinook salmon; steelhead; striped bass; American shad; white and green sturgeon; delta smelt; longfin smelt; and Sacramento splittail. The evaluation of impacts for each species is based on general knowledge of the species. Effects of the barriers on fish passage were evaluated on the basis of known historical migration patterns of the fish species.

b. Impacts. This section summarizes the impacts associated with the operation of the fish and flow control structures proposed under Alternative 3. Principally, impacts are straying, transport and entrainment at diversions, and physical obstruction of migratory routes. The impacts as a result of permanent barrier operations under Alternative 3 are examined only in comparison to the operation of temporary barriers under Alternatives 1 and 2. Since barrier operation is the same for Alternatives 1 and 2, no impacts are expected from Alternative 2 relative to Alternative 1.

The impact of the barriers on each species is dependent on the life-stage of the fish during the barrier operation. The life stages for some of these fish are provided in Chapter 3 of this draft EIR. The distribution of these species in the Delta during operation of the barrier is only briefly noted in this chapter. A more detailed description is provided in the Draft ISDP EIR/EIS.

Table IX-2 shows the differences between the periods when the temporary barriers are installed under Alternatives 1 and 2 and the permanent barriers are closed under

Alternative 3. As shown in the table, differences between the barrier operation schedules occur in October, April, and June through August. However, operation of the barriers for the full duration of the spring and fall periods may not always occur due to ESA and other requirements.

Table IX-2
Difference In Periods When Barriers Are Closed Between Temporary and Permanent Barriers

Time Period	Temporary Barriers	Permanent Barriers
October	Head of Old R.	Old R. near Tracy, Middle R., Head of Old R.
April 1 - 15	No Barriers	Old R. near Tracy, Middle R.
April 16 - 30	No Barriers	Old R. near Tracy, Middle R., Head of Old R.
June	Old R.near Tracy, Middle R.	Old R. near Tracy, Middle R., Grant Line Canal
July	Old R. near Tracy, Middle R.	Old R. near Tracy, Middle R., Grant Line Canal
August	Old R. near Tracy, Middle R.	Old R. near Tracy, Middle R., Grant Line Canal

Operation of the barriers would not alter flow conditions in the rivers upstream of the Delta. Therefore, they should have no effect on upstream spawning and/or rearing habitats.

Operation of the fish and flow control structures will change the flow regime in some channels of the central and southern Delta. Closure of the Grant Line Canal and Head of Old River barriers will reduce the net downstream flow in Old River and increase the net downstream flow in the segment of the San Joaquin River immediately downstream of its confluence with Old River. Water that previously had been diverted to the pumps at Old River would instead be diverted from the central Delta through channels such as Turner Cut and Columbia Cut. The risk of egg and larval transport from the Central Delta, as well as straying by juveniles, smolts, and adults, would increase in connection with these changes. The increase in net upstream flow in Central Delta channels would be particularly great during April and May when the Head of Old River barrier would be closed.

During the late spring and summer, installation of the barriers would result in large increases in net upstream flows in channels leading from the central to the southern Delta. These flows are expected to transport eggs and larvae of the estuarine species into the southern Delta, where risks of diversion, predation, and other sources of mortality are higher than in other parts of the Delta. The flows are also expected to cause increased straying of adults and juveniles of all of the fish species evaluated.

Although the barriers are designed to allow upstream passage of fish, they could interfere with movements of fish in the southern Delta. Immigrating adults that stray into the channels leading from the lower San Joaquin River may be less likely to succeed in returning to their natal stream to spawn.

Juveniles straying into the southern Delta from the central Delta may suffer higher mortality rates than those juveniles in upper Old River. Fish from the central Delta are more likely to be entrained by the SWP pumps than by the CVP pumps, and salmon mortality is believed to be higher at the SWP facilities due to predation in Clifton Court Forebay. They may also be entrained through the inlet valves of the flow control structures and be exposed to increased predation and entrainment in agricultural diversions.

Operation of the Old River and Middle River permanent barriers in the first part of April and the Head of Old River barrier in late April coincides with migration of American shad, sturgeon, delta smelt, and longfin smelt, and with the peak downstream migration of fall-run Sacramento River and San Joaquin River chinook salmon, winter-run chinook salmon, and steelhead. Adult late fall-run and spring-run chinook salmon and striped bass may also be migrating through the Delta, and Sacramento splittail are spawning in the upper Delta and lower reaches of the San Joaquin River. Striped bass and Delta smelt spawn and rear in the central or western Delta during this period. Downstream migration of sturgeon larvae typically peaks during April, as does the presence of longfin-smelt larvae and juveniles. The operation of barriers during April have the potential to block the passage of migrating species and change the flow regimes which may impact egg and larval transport leading to increased entrainment at agricultural diversions or export pumps.

Virtually all the species considered can be present during June, July, and August in some years when the Grant Line Canal permanent barrier is operated. Operation of the barrier during this period may cause the same problems as in April.

In October, the operation of the permanent barriers at Middle River and Old River (in addition to the Head of Old River barrier) coincides with upstream migration of adult fall-run Sacramento River and San Joaquin River chinook salmon, steelhead, and the emigration of American shad. The additional operation of these two barriers also has the potential to cause blocked passage, straying, and increased entrainment problems for these species.

The permanent barrier project is considered to have potentially significant adverse impacts with no identifiable benefits for all of the species mentioned above, with the possible exception of San Joaquin fall-run chinook salmon. The barriers provide a potential benefit to San Joaquin fall-run chinook salmon by increasing downstream flows toward the central Delta, rather than through the southern Delta towards the export pumps. Straying of San Joaquin smolts into the southern Delta increases the emigration time out of the Delta which increases potential mortality from predation and entrainment.

The permanent barriers are designed to be operated at higher flows than the temporary barriers. Therefore, they can be operated over a longer period each year. As a result, the permanent barriers provide more protection to San Joaquin fall-run chinook salmon, but extend the period of potential impacts to the other species considered in this analysis.

c. Mitigation for Impacts. This section proposes measures to mitigate for impacts to aquatic resources associated with the operation of the permanent barriers in the southern Delta.

According to the ISDP Draft EIR/EIS, most of the expected changes in flow regimes are caused by the proposed Head of Old River barrier. Hydrologic simulations indicate that reverse flows in the channels leading from the central to the southern Delta would be lessened if the project was implemented without the fish barrier. The proposed flow control structures cause relatively minor increases in net upstream flows in simulations run without the fish barrier. Therefore, the DWR will link operation of the spring barrier at the head of Old River to daily monitoring reports of San Joaquin River chinook salmon smolt abundance at a site upstream of Old River.

Operation of the Head of Old River barrier in the spring is designed to reduce diversion of San Joaquin River fall-run chinook salmon smolts into Old River. Smolts diverted into Old River have a good chance of being entrained by the CVP or SWP export pumps. Under the mitigation plan, smolt abundance would be monitored daily by sampling with a Kodiak trawl and a hydro-acoustic fish detection system. The barrier gates would be left open during April and May except on days when unusually high abundance of salmon smolts are expected based on the Kodiak trawl and hydro-acoustic sampling results. Kodiak trawling has been used successfully to sample smolts in the San Joaquin and Sacramento rivers, and hydro-acoustics using side-facing or upward-facing transducers has been used for many years to sample salmon smolts in rivers in Canada, Alaska, and Washington.

Some smolts are found near the Head of Old River nearly every day during the period of smolt emigration. The barrier gates would be closed only when pulses of outmigrating smolts appear to be present. A behavioral barrier could be deployed in front of the structural barrier to keep smolts out of Old River at other times, if the barrier was shown to be effective at repelling fish. The behavioral barrier would allow San Joaquin River flow to enter Old River, but would be designed to discourage smolts from following this flow. Thus, use of the behavioral barrier would allow barrier gates to be left opened when smolt abundance is low. The effectiveness of acoustic, electrical, or light barriers is not assured, but strategic deployment of such barriers at the head of Old River, possibly accompanied by minor structural modifications of the channel, may reduce entrainment of the smolts.

4. Impacts to Terrestrial Biological Resources

This section summarizes the effects of barrier operations on terrestrial biological resources of the Bay/Delta Estuary as disclosed in Chapter 10 of the ISDP Draft EIR/EIS (DWR and USBR 1996). This discussion only includes those impacts that result from the barrier operation component of the ISDP.

a. **Impacts**. The operation of the barriers could result in significant adverse impacts to the following special status plant species and habitats: populations of Mason's lilaeopsis, along with freshwater marsh and riparian habitat; a population of Delta tule pea in Grant Line Canal; rosemallow populations on Grant Line Canal and Middle River; and Delta mudwort and its habitat in Grant Line Canal.

b. **Mitigation for Impacts**. Measures are proposed in the ISDP Draft EIR/EIS to mitigate for impacts to terrestrial biological resources named above to levels that are less-than-significant.

To identify and quantify adverse impacts to freshwater marsh and riparian habitats, the DWR will continue its vegetation monitoring plan, and the DWR and USBR should locate areas of intertidal habitat that can be enhanced or improved to support Mason's lilaeopsis. Project-related losses of habitat identified by the program will be replaced at other locations within the Delta.

5. Impacts to Recreation

This section considers whether the installation of barriers under the alternatives would increase the demand for recreational facilities or affect existing recreational opportunities. In general, the impacts identified below are relevant for all of the alternatives with the exception of the Grant Line Canal, which is not installed in Alternatives 1 and 2. In addition, the impacts will occur in different periods, as identified in Table XI-2. Impacts of Alternatives 1 and 2 on recreation are also discussed in Chapter VI of this draft EIR.

The analysis is extracted from Chapter 13 of the ISDP Draft EIR/EIS (DWR and USBR 1996). The section is organized in three parts: (a) methods for analysis; (b) impacts; and (c) mitigation for impacts.

a. **Methods for Analysis**. A variety of methods and information sources were used to determine recreation impacts, including recreation surveys, boater surveys, and maps. Quantitative recreation surveys were conducted by DWR from 1991 to 1993 in order to evaluate the types of recreation found in the southern Delta as well as boaters' impressions of the existing temporary barriers and portage facilities. The quantitative survey included the tabulation of all types of recreational activities, boat sizes, and recreationist responses to existing portage facilities on typical weekdays, weekends, and holidays. Qualitative recreation surveys were conducted in 1994, to determine the perceived effects of the proposed barriers. To account for opinions of recreationists throughout the southern Delta, eight major recreation facilities were surveyed: Del's Boat Harbor, the Lazy M Marina, Tracy Oasis Marina, Union Point Resort, Discovery Bay Yacht Club, Cruiser Haven, Dos Reis County Park and Mossdale Marina. The results of these surveys are incorporated in this analysis.

The Contra Costa and San Joaquin County general plans emphasize the preservation and protection of recreational resources, and the provision of adequate public access to those resources. In addition, both counties have policies addressing the protection of water-related recreational resources. Finally, Contra Costa and San Joaquin counties emphasize the protection of the Delta's recreational value for its statewide and international importance, respectively.

In accordance with the CEQA Guidelines and professional standards, impacts are considered "significant" if implementation of the alternatives would: (1) conflict with established recreational uses of the area; (2) result in a substantial need for new, altered or expanded recreational facilities; or (3) not support existing recreation goals and policies of local planning documents.

b. Impacts. Although existing facilities would still draw patrons to participate in camping, picnicking, biking, hiking, bank fishing, and bird watching, introduction of the Old River Fish Control Structure could interfere with boating activities; the presence of the Grant Line Canal Flow Control Structure could hinder travel on the waterway and boaters launching outside the immediate area would be less likely to fish along Grant Line Canal; and although the Old River Flow Control Structure would include a boat lock to facilitate river travel, the structure would still impede boat travel.

The County of San Joaquin's recreation-oriented goals and policies generally encourage the protection of the natural resources that support the area's recreational uses, including the Delta waterways. The goals and policies also encourage adequate public access to, and the navigability of, the waterways. The operation of the proposed control structure would not be consistent with these goals and policies of the County of San Joaquin's General Plan. This is considered a significant adverse impact.

The specific impacts at the four barrier locations are identified below.

Old River Fish Control Structure. The area around the proposed Old River fish control structure site currently supports several marinas and a substantial number of boaters; additional facilities are planned nearby within the proposed Gold Rush City project. The structure would use a radial gate design and include a boat lock. Placement of a barrier in this location could deter boat travel along Old River. Consequently, although existing facilities would still draw patrons to participate in camping, picnicking, biking, hiking, bank fishing and bird watching, introduction of this structure may interfere with boating activities. This is considered a significant adverse impact.

Middle River Flow Control Structure. Surveys conducted by the DWR show that the most frequent recreation activity at the Middle River site is fishing; however, this site receives less usage than many areas of the southern Delta. The nearby Union Point Marina functions as a midday rest stop for boaters during a day on the water. Boaters generally access the marina from the north and west on Middle River, Victoria Canal or North Canal; few venture eastward on Middle River due to the shallow water and snags in the channel. Neither construction nor operation of the proposed barrier is expected to affect recreational activity in the area. This is considered a less-than-significant adverse impact.

Grant Line Canal Flow Control Structure. Some of the best fishing on the Delta is located along Grant Line Canal, which is known for its catfish and striped bass. In addition, the area is heavily used for boating. The presence of the structure could hinder travel on the waterway, and boaters launching outside the immediate area would be less likely to fish along Grant Line Canal. This would be considered a significant adverse impact.

Old River Flow Control Structure. The Old River flow control structure site lies in a preferred fishing and boating area, near several existing marinas and directly adjacent to one proposed marina. The San Joaquin County General Plan designates the southern bank of Old River adjacent to the barrier site for a 70-acre regional park and a 40-acre marina. These planned uses are expected to draw additional recreationists to this popular area. Although the barrier would include a boat lock to facilitate river travel, the flow control structure would impede boat travel. This is considered a significant adverse impact.

c. Mitigation for Impacts. To mitigate for the impacts discussed above, the DWR should take the following actions: (1) educate boaters about procedures for the boat lock at the Head of Old River structure through a variety of methods (including, but not limited to: posting clearly readable instructional signs on the banks and waterway at all approaches to the barrier site; distributing educational flyers containing maps, operation schedules, portage procedures and alternate routes at marinas and public launching facilities; and classes at local marinas on the use of the devices); and (2) set up an information telephone hotline and a homepage on the internet to provide updates on the operation of the barriers.

Education in the use of the boat lock should make boaters less hesitant to use the facilities, thereby reducing travel restrictions during periods of barrier operation.

6. Impacts to Navigation

This section evaluates the potential effects of Alternative 3 on navigation and recommends mitigation to reduce or eliminate identified significant adverse impacts. Navigation conditions are typically related to the absence or presence of obstacles to travel on area waterways. For the purposes of this analysis, navigation impacts are considered significant if implementation of a proposed action would create a substantial hazard to navigation or substantially affect the ease of navigation.

a. Impacts. The operation of the proposed facilities would affect the movement of small craft in several adjacent waterways and constitute a significant barrier to navigation as described above in the section on recreation.

b. Mitigation for Impacts. All fish and flow control structures would have facilities available to transport watercraft around the barriers. Notwithstanding the availability of these facilities, the creation of obstacles to navigation is considered an unavoidable significant impact with the exception of the Middle River Flow Control Structure, due to the low volume of use by small craft. These impacts cannot be mitigated to a level below significance.

D. SUMMARY

This chapter describes the alternatives for implementing the southern Delta salinity objectives contained in the 1995 Bay/Delta Plan and discusses the environmental effects of implementing the alternatives. Potential significant impacts to aquatic resources, terrestrial biological resources, recreation, navigation and transportation as a result of both construction and operation of the barriers (under Alternative 3) are identified. Much of the discussion contained in this chapter regarding the impacts of barrier construction and operation under Alternative 3 was summarized from the ISDP Draft EIR/EIS. The findings of this chapter are summarized below.

Construction and operation of the permanent barriers under Alternative 3 will potentially have adverse impacts on the following: raptor nests; Swainson's hawks and foraging habitat; western pond turtles and nest sites; potential kit fox territory; Mason's lilaeopsis; Delta tule pea; rose-mallow; Delta mudwort; freshwater marsh habitat; riparian scrub habitat; fall-run (Sacramento River), winter-run, late fall-run, and spring-run chinook salmon; steelhead rainbow trout; striped bass; American shad; white and green sturgeon; Delta smelt; longfin smelt; and Sacramento splittail. San Joaquin fall-run chinook salmon are expected to benefit from the operation of the barriers. Barrier construction is also expected to: cause temporary smothering within critical habitat for Delta smelt; permanently alter near-shore shallow-water habitat; and cause direct removal of aquatic organisms. Measures are proposed to mitigate for or reduce impacts to these resources.

Impacts to recreation, navigation, and transportation include: conflict with the County of San Joaquin's recreation-oriented goals and policies; limited navigation during the 30- to 36-month construction periods; and safety hazards due to debris in the Class II bike lane and the presence of numerous slow-moving trucks. Measures are proposed to mitigate for some of these impacts.

Impacts to aquatic resources, recreation, and navigation expected to result from Alternatives 1 and 2 are discussed in Chapter 6.

Alternative 1 meets water quality objectives at southern Delta stations in the winter months, but frequently exceeds objectives during the summer months. Alternative 2 also meets water quality objectives at southern Delta stations for the September through March period, and reduces the frequency of exceedance of salinity objectives during the summer months. Objectives are still exceeded, however, according to model runs. Alternative 2 consistently improves salinity levels at Vernalis and Union Island stations between April and August. There are also improvements, though to a lesser degree, at Brandt Bridge on the San Joaquin River and Tracy Road Bridge on Old River during the irrigation season. There is no marked improvement in water levels under Alternative 2 compared to Alternative 1. Alternative 3 meets salinity objectives in the southern Delta during the non-irrigation season, and reduces the frequency of exceedance compared to both Alternatives 1 and 2 during the irrigation season. Consistent improvements in salinity compared to the base case can be seen during the April through August period at the Vernalis, Union Island, and Tracy Road Bridge stations.

Many southern Delta locations see significant improvements in minimum water levels at certain times of the year as a result of barrier operations under Alternative 3 as compared to the base case. The following locations have monthly minimum water levels of at least one (+1) foot higher than the base case: The Middle River upstream of Barrier in October and April; The Old River upstream of Barrier in April; The Middle River near Undine Bridge in October and the first half of April; The Old River upstream of its confluence with the Middle River in June, July, and August; The Old River east of Tracy Road Bridge in August and the first half of April; and Grand Line Canal east of Tracy Road Bridge in June, July, and August.

In certain months, at certain locations, Alternative 3 will cause elevations which are lower than the base case. A monthly minimum water level of negative (-) 0.5 feet or lower (with respect to base case water levels) is considered to have a significant adverse impact and occurs on the Old River upstream of its confluence with the Middle River in the second half of April, and on the Grant Line canal west of Tracy Road bridge in June, July, and August.

The relative magnitude of impacts to various species and habitat as a consequence of the barriers cannot be quantified. The barriers would provide a benefit to San Joaquin fall-run salmon, but are expected to be a detriment to other aquatic species. With regard to water quality, Alternative 3 is the preferred alternative, but with regard to water levels, the preferred alternative is dependent on location. As a result, there is no clearly preferred alternative for meeting the southern Delta salinity objectives.

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