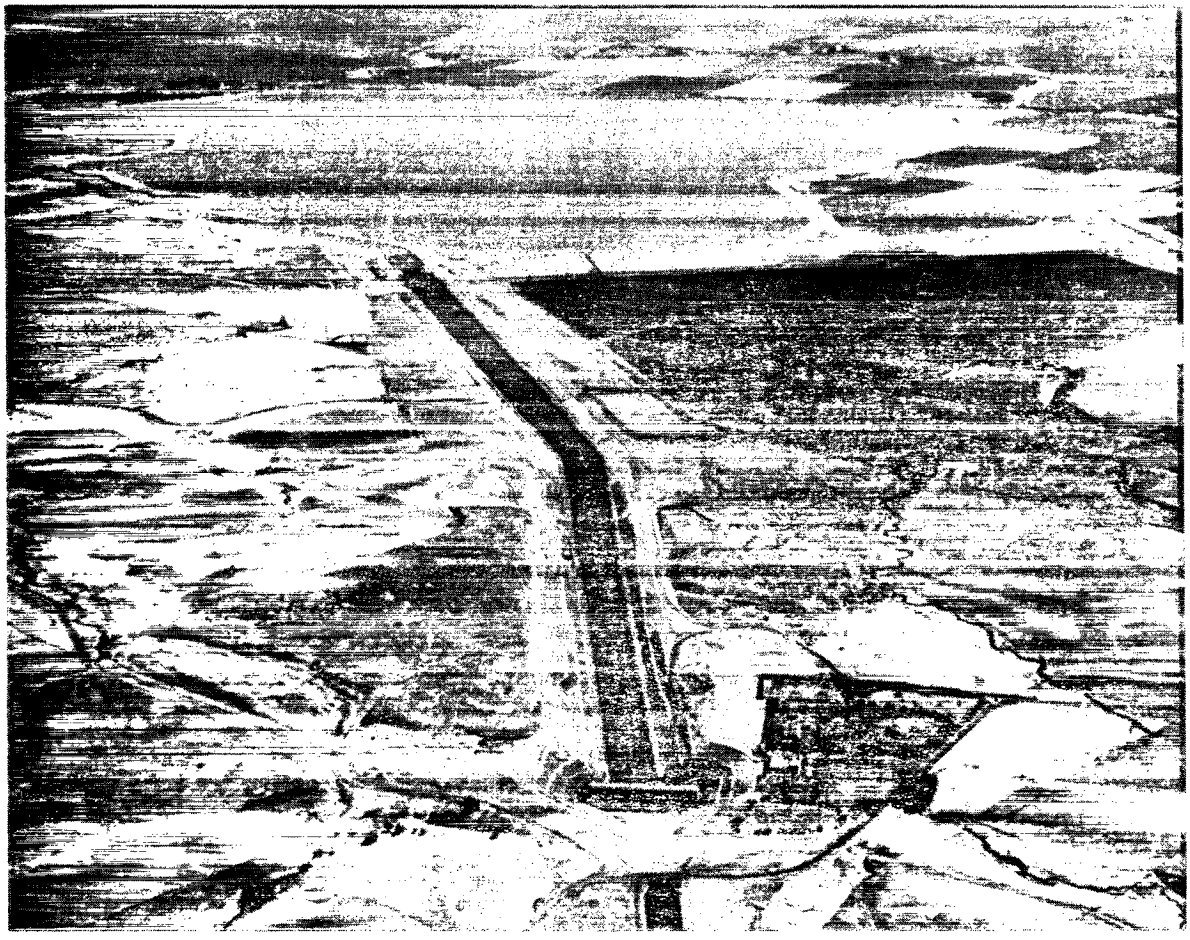
FINAL ENVIRONMENTAL IMPACT REPORT
on the proposed
ADDITIONAL PUMPING UNITS
Harvey O. Banks Delta Pumping Plant



STATE OF CALIFORNIA George Deukmejian, Governor
THE RESOURCES AGENCY Gordon K. Van Vleck, Secretary for Resources
DEPARTMENT OF WATER RESOURCES David N. Kennedy, Director

January 1986

C—105271

C-105271

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

FINAL ENVIRONMENTAL IMPACT REPORT FOR

ADDITIONAL PUMPING UNITS AT HARVEY O. BANKS DELTA PUMPING PLANT

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C—105272

C-105272

EXECUTIVE SUMMARY

The Department of Water Resources proposes to install four additional pumping units at the Harvey O. Banks Delta Pumping Plant, which now has seven pumping units installed. The additional pumps will require 5 years for manufacturing and installation. The pumping plant and Clifton Court Forebay, facilities of the State Water Project, are located at the beginning of the California Aqueduct and divert water from the Sacramento-San Joaquin Delta.

This Final Environmental Impact Report provides information for the public, government agencies, and decision makers in the Department of Water Resources about the potential significant environmental effects of operating the additional pumping units. In addition, this report identifies alternatives and possible ways to reduce or avoid possible environmental damage.

Summary points of the report are:

- Operations with the added pumps include limits on State Water Project diversions to historical levels on export operations in most months.

- Operations with the additional pumps can shift some project exports away from summer months of high fish abundance toward winter months of low abundance and reduce existing fish impacts for many species, including striped bass. However, salmon impacts would increase significantly and would be compensated with the preferred mitigation option.

- The preferred mitigation, an agreement for the preservation of fish at Banks Pumping Plant, would provide mitigation for more than the incremental impacts caused by the pumps. It includes State Water Project funding of new projects to improve the Delta fishery to compensate for fish that would have been in the estuary if the pumping plant had not been constructed. Also included is ongoing annual mitigation for future Banks Pumping Plant exports. Other mitigation options could use the operational flexibility of the additional pumps to reduce fish impacts by reducing the power and water delivery reliability advantages of the additional pumps.

- The improved operational capability of the additional pumps would improve project electrical load management to allow more off-peak operations. This is consistent with long-range Department energy programs to reduce costs, better utilize the capacity of existing power generating facilities, and avoid inefficient, wasteful, or unnecessary energy consumption. This can delay construction of future power generating facilities.

- The additional pumps can increase the reliability of project water supply deliveries to partially offset the frequency and severity of project shortages from: (1) lost supplies due to upstream development, (2) lost Colorado River supplies due to the Arizona Project, and (3) increasing service area urban demands in excess of supplies after conservation efforts.

- The additional pumps could eliminate outage problems that arise due to emergencies, and this could save up to 15,000 acre-feet per week if the outage corresponded to a critical time when supplies would not be recoverable.

- Under the preferred operation, the net benefits are greatest for the alterna-

C—105273

C-105273

tive of four additional pumping units, showing economic justification independent of future project development.

- Many factors were investigated, and except for impacts on salmon, which would be compensated with the preferred mitigation options, effects were judged not significant. Scientific information was not sufficient to fully determine overall effects on fish food supply and on San Francisco Bay. Studies funded by the State Water Project continue to investigate potential impacts. Service area and cumulative impacts could be significant in some areas, and measures are available to mitigate such potential impacts.

A Notice of Determination document to be filed with the State Office of Planning and Research will specify final determinations by the Department of Water Resources for the project. This notice, with the Final Environmental Impact Report, will explain the reasons and the manner in which the Department approved the project and will meet the basic purposes of the California Environmental Quality Act.

Input from various governmental and private entities was used to prepare this report. A draft environmental impact report on this project was distributed in November 1982, and written comments were received from 30 Federal, State, and local agencies; 8 environmental groups; and 3 individuals. In February 1983, a public hearing was held; 11 individuals testified.

Comments on the draft report led to changes for this final report, including updating:

- Statewide project operation studies using recent water resources planning assumptions and a more efficient operation of the State Water Project for diversion of unregulated flows.
- Direct fish impact calculations with estimates for predation, handling and hauling, and losses of eggs and larvae.
- Discussions to describe water resources planning activities and their relationship to the additional pumps.
- Reevaluation of economics to account for increased Department of Water Resources experience operating as an independent utility.

Discussions in this report focus on the project, alternatives, economic evaluation, environmental evaluation, and mitigation measures.

The purpose of the additional pumping units is to provide the State Water Project with lower power costs, standby pumping capacity, and increased reliability of project water supply deliveries. Alternative methods of operation for the additional pumps were evaluated, and the preferred alternative is to operate the Harvey O. Banks Delta Pumping Plant to constraining criteria set forth in U. S. Army Corps of Engineers Public Notice 5820A, Amended, dated October 1981. Operations will also meet protective water right standards set by the State Water Resources Control Board.

The four additional pumps would increase Banks Pumping Plant export capacity from 6,400 cubic feet per second to the State Water Project aqueduct capacity of 10,300 cubic feet per second. However, the Corps' constraining criteria will restrict Delta diversions to historical limits except in winter. In winter months when the San Joaquin River flows are high, increased exports are allowed. Under this preferred method of operation, the Corps of Engineers determined that there was no increased effect on the navigable capacity of Delta waterways and, therefore, no Federal regulatory permit for navigation is required.

C—105274

C-105274

However, the Corps of Engineers will monitor operations when the four additional pumps are installed, and may take other action, if needed. This decision was upheld by the U. S. District Court in December 1982.

Channel hydraulic constraints and San Joaquin River inflow constraints will limit the average winter period monthly export rates nearly all the time to less than 10,300 cubic feet per second with current project facilities and four additional pumps. Hydraulic constraints consist of southern Delta channel size and Clifton Court Forebay inlet and volume capacity. Even assuming no hydraulic constraints for the preferred operation, winter exports could reach 10,300 cubic feet per second less than 1 percent of the time because of the low frequency of occurrence of high San Joaquin River inflow conditions.

Installation and operation of the four additional pumps according to the preferred alternative provides benefits that justify the project even if the pumps are never used to their full capacity. However, action taken in connection with this environmental document to install and operate four additional pumps according to the Corps constraints should not be interpreted as precluding the Department of Water Resources from future action to operate the plant without such constraints. Use of the pumps, in the future, for more deliveries without the Corps constraints will require environmental review and documentation pursuant to the California Environmental Quality Act and National Environmental Policy Act as well as consideration of the Corps of Engineers permit process. This would allow the State Water Project to further increase pumping in the winter months for filling offstream storage reservoirs and ground water basins south of the Delta.

Planning activities related to the Delta are complex; therefore, implementation of specific long-range planning measures is difficult to predict. Although it is likely that the additional pumps eventually will be operated in conjunction with future project facilities, the decision on proceeding with the additional pumps needs to account for potential delays by considering economic justification and environmental impacts of the pumps independent of future water resource development. Evaluation of the preferred alternative showed that, without future development and with constrained operations, the pumps can provide economic benefits above costs and some environmental advantages due to more favorable export patterns without reliance on any particular future project facility or expanded operations.

The power cost savings and benefits of increased reliability of project water supply deliveries for the additional pumps with the preferred operations and existing project facilities are the main factors contributing to a favorable benefit/cost ratio. The preferred alternative includes mitigation measures for the effects of the additional pumps as well as added measures to mitigate impacts of the existing pumps and measures for fish that would have been in the estuary if Banks Pumping Plant had not been constructed. In addition to this mitigation, operations under the preferred alternative would shift exports toward winter months of low fish abundance and away from summer months of high abundance, resulting in a reduction of fish entrainment losses for many species, including striped bass.

Alternatives to the preferred project in this report include alternative operational plans and water supply and demand reduction alternatives. Also included is a no-project alternative, which involves operation of the existing plant with no additional pumps. The investigation of alternative operational plans considered:

- Different combinations of pump installations.

C—105275

C-105275

- Different monthly maximum export levels.

- Different operating criteria, including operation with and without the Corps' constraining criteria.

This final report discusses water conservation in connection with many areas. Project operation studies include conservation and other water management measures such as waste water reclamation to reduce project demands consistent with contractor requests and consistent with the Urban Water Management Planning Act of 1983. Water conservation planning projects account for a major portion of the reduction of project demands of about 250,000 acre-feet per year by the early 1990s. Conservation is discussed in connection with mitigation options, and extraordinary conservation measures were considered in water supply and demand reduction alternatives. Also, water conservation is a part of the Department's long-range energy programs for efficient and environmentally sensitive energy use.

Water supply and extraordinary demand reduction alternatives evaluated in this report could provide alternatives to the yield benefits of the additional pumps; however, those alternatives could not duplicate the operational advantages of the pumps for power cost savings and standby pumping capacity. While the demand reduction alternatives are the least costly of the alternatives, they would not substitute for the pumps because, under the study assumptions, both demand reductions and the pumps would be needed to balance service area needs and supplies. The water supply and demand reduction alternatives were used to compare unit yield costs to those of the alternative operational plans with the additional pumps and provided the basis for defining the municipal and industrial yield benefits of the additional pumps in the economic evaluation.

All the alternative operational plans with the additional pumping units were found to be economically justified. Net annual benefits ranged from $3.9 million to $47.7 million, with those for the preferred alternative at $23.6 million. Major benefits for the preferred alternative include an annual power cost savings of about $13 million and about 60,000 acre-feet of State Water Project firm yield to increase reliability and offset a portion of future project yield reductions from upstream use. The capital cost of the four additional pumps would be about $46 million.

Environmental impacts of the proposed additional pumps were evaluated for construction activity, San Francisco Bay and the Sacramento-San Joaquin Delta, State Water Project service areas, energy use, and cumulative impacts. In many areas, impacts were judged to be insignificant.

Incremental effects of the additional pumps on important factors such as Delta outflow, State Water Project exports, Bay-Delta fish needs, and growth inducing impacts would be relatively small in comparison to overall conditions with the existing seven pumps at Banks Pumping Plant. For example, the new pumps would increase total average annual exports by 0.7 percent and decrease average annual outflows by 0.4 percent for conditions during the early 1990s.

Impacts on Bay-Delta fish were evaluated according to general and direct impacts. General fish impact assessments were mainly qualitative, considering factors such as:

- Through-Delta flows.
- Monthly export and outflow changes.
- Food sources.
- Salinity gradients.

Direct fish impacts consider losses at the Delta complex, which includes the Banks Pumping Plant, Clifton Court Forebay, and the John E. Skinner Delta Fish Protective Facility. Such impacts include losses at the fish screens, handling and hauling, predation in

C—105276

C-105276

Clifton Court Forebay, and losses of entrained eggs and larvae.

These direct impacts do not correlate directly to total Bay-Delta impacts because of many complex factors, including normal fish losses at various life cycle stages.

A significant incremental direct impact was determined for chinook salmon, with an estimated average annual loss increase of 17,000 yearlings for conditions during the early 1990s assuming no new facilities other than the four additional pumps. This loss is about 5 percent greater than with the no-project alternative.

The direct fish impacts in the final report differ from those in the draft report because updated operation studies were used, which included more effective export operations. The incremental effect of the additional pumps under the preferred operation would reduce direct losses at the Delta complex for 23 fish species, including striped bass, American shad, and white catfish, when compared to the no-project alternative. The loss reductions would be greatest during conditions of early 1990s and decrease in the late 1990s because of a buildup of project delivery schedules. New project facilities expected during the next 15 years would have other changes.

Direct annual average losses of striped bass for the no-project alternative for the early 1990s were computed at 1.569 million yearlings, representing about 15 percent of the yearling population. Under the preferred alternative, losses would be reduced to 1.427 million yearlings. These values are based on estuary fish populations during the 1960s and 1970s. Existing mitigation for operation of the existing plant includes water right protection of outflow requirements, summer export limits, and construction and operation of the improved Skinner Fish Facility.

The preferred mitigation with the additional pumps is an agreement between the Department of Water Resources and the Department of Fish and Game for preservation of fish at Banks Pumping Plant. This agreement, being negotiated with the assistance of fishery interest groups and the State Water Project contractors, would include provisions for mitigating the additional pumps and added provisions for the existing pumps. These provisions would probably include: (1) funding of fish protective programs of about $15 million to compensate for fish that would have been in the estuary if Banks Pumping Plant had not been constructed; (2) additional year-by-year mitigation in relation to export volumes (export increases would mandate mitigation increases); (3) Clifton Court Forebay predation control studies; (4) contractual guarantees for the Corps constrained operating criteria; and (5) added limitations on export rates during critical fish abundance periods. Mitigation wuld give priority to non-hatchery protective measures.

For two important concerns related to the Bay-Delta estuary there is not adequate information to enable assessment of either absolute or incremental impacts of the additional pumps. These are: overall fish food supply, and San Francisco Bay biological resources. Various investigations for unknown environmental impacts are funded by the State Water Project.

Service area impacts such as socioeconomic and growth inducing impacts were investigated. By itself, the water supply provided by the additional pumps is not considered to cause growth; however, it is possible that a lack of water can hinder economic growth. In addition, a portion of the added water supply from the additional pumps, along with other State Water Project increases between 1990 and 2035, will be needed to replace Southern California water supplies from the Colorado River that will be diverted to the Central Arizona Project.

C—105277

C-105277

Under these conditions, the estimated impacts in the service areas for the preferred operation of the additional pumps include an income increase of $282 million (0.2 percent of statewide total projections) and a population increase of about 68,000 (0.9 percent increase of project service area projected totals), mainly in Southern California. In the San Joaquin service area there could be an incremental increase of cultivation of 4,500 acres (1 percent of total acreage cultivated in this service area).

Where these service area impacts are significant individually or cumulatively, they can and should be mitigated by local agencies and others, using measures such as habitat protection programs, adopted plans for local management, and implementation of water conservation plans.

To the extent water deliveries increase with additional pumps, State Water Project energy requirements will also increase. However, this effect was judged insignificant based on two points when comparing future operations with and without the additional pumps.

The first is improved efficiency of electrical load management provided by the additional pumps. The added pumps allow more capability to use off-peak supplies, reducing costs and better utilizing the capacity of existing power generating facilities. This displaces the need for new generating facilities, which is beneficial both economically and environmentally.

The second point is the Department of Water Resources' long-range energy program for State Water Project operations. The additional pumps reinforce this program, which is aimed at eliminating wasteful, inefficient, and unnecessary consumption of energy. This program has the objective of providing energy and transmission resources in a manner that is economically sound, has the highest regard for the environment, and best utilizes existing power generating facilities. Along with the added capability of the additional pumps, this program includes measures such as water conservation, energy recovery along the aqueduct system, use of renewable energy sources, and minimization of on-peak energy use.

Incremental effects of the proposed additional pumps under the preferred operation would be relatively small; however, they can cumulatively add to other factors that now impact the complex Bay-Delta system. These other factors include:

- Commercial, sport, and illegal fishing.
- Unscreened Delta diversions by agricultural, municipal, and industrial water users.
- Waste water effluent, surface runoff, oil spills, and agricultural leaching sources.
- Projects such as the State Water Project, Central Valley Project, Hetch-Hetchy Project, Mokelumne River Aqueduct, and existing and new in-basin uses.

Also, the additional pumps are part of the broader water resources planning activity to increase State Water Project storage and export operations. Such increases can affect Delta flows, water quality, and fish. All future water resource development proposals will require appropriate environmental documentation and mitigation.

Present and potential mitigation for cumulative impacts generally consists of:

- Safeguards by laws, regulations, and water right standards.
- Contracts between project operators and various interests such as Delta agricultural and industrial users.

C—105278

C-105278

- Physical measures such as fish hatcheries, fish screens, and stocking programs.
- Water management programs.
- Agreements such as the Coordinated Operation Agreement, which includes Delta protective measures, and the Suisun Marsh Preservation Agreement, which mitigates cumulative impacts of State and Federal projects in the marsh.

The preferred mitigation for the additional pumps includes measures to compensate for cumulative impacts. The agreement is being negotiated to include provisions to compensate for fish that would have been in the estuary if Banks Pumping Plant had not been constructed and also a method to increase mitigation requirements as project entitlement requests increase.

The Department recognizes the beneficial uses of water resources in the Delta and Suisun Marsh, including fish and wildlife, agriculture, and municipal and industrial needs. Project operations recognize these needs and recognize that future development will require additional mitigation measures. Studies being funded by the State Water Project will help to better understand environmental needs.

Many areas of concern were evaluated for the additional pumps and judged not to be significant. Some of these include:

- Monthly and annual Delta outflows and outflow surges.
- Delta agricultural, municipal, and industrial uses.
- Channel velocities, scour, and siltation.
- 23 species of Delta fish, including striped bass, American shad, and white catfish.
- Suisun Marsh.
- Recreation and wildlife at Clifton Court Forebay.
- Operation of Tracy Pumping Plant.
- *Neomysis* abundance and entrainment.

General Issues

Following are 11 general issues raised on the November 1982 draft report by commenting entities, with a summary of responses by the Department of Water Resources. The issues summarize statements by commenting agencies, and do not represent the position of the Department. Chapter 7 of the final report discusses the general issues in detail.

Issue 1

It is unwise for the Department of Water Resources to proceed with additional pumping units until the Delta fish problem is resolved.

Response

The Department of Water Resources recognizes the importance of the Delta fish problem and has spent over $20 million in advancing knowledge to better understand the needs of this important resource.

The Department is continuing to fund millions of dollars of studies, experiments, and monitoring to provide more information on project-related factors affecting fish, and this effort is independent of the installation of more pumps. A recent outcome of such studies was the installation of a $5 million advanced fish screen design to reduce fish losses at the Skinner Fish Protective Facility. Toxic pollution in the Bay-Delta estuary also requires further study. While all of these studies lead to better understanding of the Delta

C—105279

C-105279

fish problem, resolution of that problem may be a long way off.

Proceeding with additional pumps is not inconsistent with planning to resolve the fish problems. The proposed mitigation for the additional pumps, along with operational flexibility with the additional pumps, will actually provide for reduced fish impacts for many species, including striped bass. In addition, the proposed mitigation agreement would go beyond the incremental impacts of the additional pumps and include compensation for all the pumps, including replacing fish that would have been in the Delta if the plant had not been built. It presents improvements over no action. Installation of the pumps will not include revised operations if future studies identify further impacts of the project and ways to avoid adverse impacts. Any such results would be considered by the State Water Resources Control Board in its planned rehearing of Decision 1485, which may result in revised standards.

Delta protection is an important objective of the Department, along with other statewide water resources planning activities. The reliability of the State Water Project in meeting the needs of about 15 million people is decreasing, because of upstream area of origin use, reduction of California's supplies by the Central Arizona Project, and continued population increases. The Governor, Legislature, and Department have all acted to advance important conservation measures; however, the potential for shortages remains. The additional pumps can help reduce such a shortage. One way the new pumps will help is to offset outages of the existing units. Also, the Department must continue to plan for more efficient use of California's energy and implement measures to delay construction of power generating facilities. The additional pumps will allow cost saving and more operational flexibility for the State Water Project to help accomplish this. Also see response to Issue 11.

Issue 2

The draft environmental impact report did not adequately disclose the Department's future intentions regarding operation of the Banks Pumping Plant with the four additional units.

Response

The Department's proposal, identified as the preferred operating plan, is to install and operate the four additional pumps constrained by the U. S. Army Corps of Engineers criteria and the protective standards of State Water Resources Control Board Decision 1485. This plan was clearly noted and discussed in the draft environmental impact report. This preferred alternative and other operational alternatives with higher export capabilities were evaluated using comprehensive project operation studies. The preferred operating plan is the same for the final report.

The additional pumps must make economical and environmental sense on their own merit, independent of how or when they could be used with improved water transfer. The final report presents information showing that with or without other future facilities the additional pumps demonstrate cost benefits for electrical power use and increased reliability of water supply deliveries that are substantially greater than their costs.

The Department is continuing with statewide, Delta, and State Water Project planning, including plans for improving the transfer of water supplies across the Delta. This planning is guided by established management objectives that include meeting the environmental needs of the Delta with project development. The Department studies have demonstrated the need for improving the transfer of project water supplies across the Delta. The Governor, Legislature, and Department have made extensive efforts to gain approval of a water package that would include a defined transfer facility that

C—105280

C-105280

would utilize the additional pumps; however, no package has yet been approved.

Issue 3

The draft environmental impact report for the proposed additional pumps is inadequate in assessing the impacts on fish of the existing pumps and the various alternatives with additional pumps.

Response

The draft environmental impact report assessed in some detail: (1) general estuary effects on migration, survival, and fish screen exposure for various species, and (2) direct losses and salvage from pumping for striped bass and chinook salmon. The final report investigates the same two categories, but the assessments have been updated and modified in response to comments and new information. No new significant adverse impact was determined. Specifics concerning the upgraded investigation are as follows:

- Use of the Striped Bass Index has been eliminated, because the Department of Fish and Game has determined that the correlations are no longer valid for predicting young-of-the-year abundance levels.

- Direct loss estimates for striped bass and chinook salmon include entrainment losses of striped bass eggs and larvae, predation losses in Clifton Court Forebay, and handling and hauling losses for the salvaged fish.

- Salvage estimates are made for all other game and nongame species that have been salvaged at the Delta Complex.

Results of the new assessments with updated operation studies are shown in various tables in Chapter 5. No new significant adverse impact was found. The fish impact assessment has been coordinated between staffs of the Department of Water Resources and Department of Fish and Game, and the evaluation is judged satisfactory within the limits of present knowledge.

Issue 4

The environmental impact report on the proposed additional pumping units needs to account for the uncertainty in authorization of the December 1982 fish agreement, which was assumed to be included as mitigation for the additional pumping units.

The environmental impact report should investigate the potential for operational flexibility of the new pumping units at the Harvey O. Banks Delta Pumping Plant to mitigate direct impacts on fish.

How can water conservation agreements provide mitigation for the additional pumping units, and what does it represent?

Response

These three areas of concern are addressed in the discussion of updated mitigation measures presented in the final report. Following are applicable chapters and sections:

Chapter 5

- Environmental Impacts and Mitigation Measures for Service Area Impacts (page 141)

- Impacts Evaluated With Insufficient Information to Determine Significance (page 145)

- Mitigation for Impacts on Fish (page 148)

Chapter 6

- Mitigation Measures for Cumulative Impacts (page 174)

C—105281

C-105281

Issue 5

Stocking striped bass is experimental; it is uncertain if, or how well, it will supplement the striped bass population.

Response

The certainty of raising large numbers of striped bass is well documented; however, the Department of Water Resources recognizes the uncertainty of survival of these yearling fish once they are stocked in the Delta. The agreement for preservation of fish at Banks Pumping Plant, the preferred mitigation for the additional pumps, is giving priority to fish improvement measures other than stocking. Consideration of measures other than stocking has increased in response to requests by State fishery interests.

Issue 6

The Department of Water Resources should apply for the necessary Federal permits before proceeding with the new pumps. Avoidance of the Federal permit process is neither legally justifiable nor sound public policy.

Response

Planning for the proposed additional pumps at Banks Pumping Plant included close coordination with the U. S. Army Corps of Engineers in connection with the need for additional regulatory permits and the effect the pumps could have on navigable capacity. The determination by the Corps of Engineers was published in its Public Notice 5820A, Amended, to notify interested organizations and respond to their questions.

The Corps of Engineers' decision regarding permit requirements for the proposed additional pumps was endorsed by the U. S. District Court decision on December 30, 1982. The decision stated that if, after installation and operation of the four additional pumps, the evidence establishes that their limited operation will affect navigable capacity, then such evidence will be grounds for requiring the Department of Water Resources to apply for a permit.

Increased use of the additional pumps much beyond the Corps constraints would require additional Federal review for a regulatory permit and new considerations for environmental documentation. The action being taken in connection with the final report should not be interpreted as eliminating the Department's future option of applying for a Federal regulatory permit to operate the additional pumps to divert additional water when planning uncertainties regarding future State Water Project facilities are resolved.

Issue 7

There is no assurance that: (1) permanent facilities will be constructed to protect Suisun Marsh, and (2) if the protective facilities are built, that there will be available water supplies of adequate quality at Collinsville for distribution by the facilities throughout the marsh. Impacts on Suisun Marsh should be reassessed based on a condition that assumes no protective facilities and relaxed water quality standards for the marsh.

Response

The Suisun Marsh Plan of Protection is a separate program of the Department being implemented independently of the proposed four pumps. Protection of Suisun Marsh is an ongoing part of the Department's planning and has produced a plan of protection that has been approved by Federal, State, and local interests. A final environmental impact report and plan of protection for Suisun Marsh, completed in February 1984, describes overall protective facilities and presents an evaluation of these

C—105282

C-105282

facilities and marsh protection to the year 2000 with the additional pumps installed. The report also describes impacts that could occur in the marsh if no remedial actions were taken or with relaxation criteria.

In August 1985, a Suisun Marsh Preservation Agreement was negotiated to assure that a dependable water supply is maintained to mitigate adverse effects on the marsh of the Central Valley Project and State Water Project, as well as part of the adverse effects of other upstream diversions. Mitigation is based on full State Water Project operations including the additional pumps. This will be accomplished by implementing the plan of protection and constructing facilities. This agreement is consistent with assumptions made for evaluating the additional pumps and requires construction and operation of protective facilities for the marsh to meet the water quality standards contained in the agreement. Cost of the initial facilities has been $12 million; total facility costs may reach $125 million. The agreement will be signed by the four parties as soon as Federal authorization is available. Pending execution of the agreement, the Department has agreed to construct the Montezuma Slough Control Structure, to be operational in 1988 at a cost of $20 million, which will provide as much as 80 percent of the benefits of the marsh plan.

Issue 8

The economic analysis in the draft environmental impact report shows a better benefit/cost ratio with two new pumps than with four pumps for operations under the Corps of Engineers constraints. The justification for proceeding with all four pumps is not clear.

Response

The preferred alternative was four additional pumps operated to meet the constraints of Decision 1485 and the Corps of Engineers' diversion limits established in Public Notice 5820A, Amended. The economic assessment in the draft showed favorable benefit/cost ratios for all the alternatives operated under the Corps constraints with a higher ratio for the two-pump alternative. The four-pump preferred alternative, retained for the final report, is supported by an updated economic assessment with, again, a favorable benefit/cost ratio and higher net benefits than the two-pump alternative.

For this final report, the economic analysis was revised to reflect the Department's increased operating experience as a utility, the costs of purchasing capacity, and energy and cost escalation. The revised analysis showed added power benefits for the additional pumps.

Issue 9

The use of water conservation in the environmental documentation process is not adequately explained.

Response

Water conservation is discussed in the environmental impact report in connection with:

- Project operation studies to evaluate the impacts of the ten alternative operational plans for the additional pumps.
- Water supply and demand reduction alternatives.
- Mitigation.

The demands assumed in the project operation studies incorporated an estimated 250,000 acre-feet per year for conservation by the early 1990s. This demand is consistent with contractors' requested deliveries and the Department's recom-

C—105283

C-105283

mended water management plans for State Water Project contractors.

Water conservation measures (additional toilet and shower retrofit and free home landscaping) were also included in the water supply and demand reduction alternatives. These are extraordinary conservation measures that go beyond the specific conservation measures in the water management plans. The extraordinary measures are assumed to be achievable under conditions of significant State Water Project deficiencies.

These extraordinary measures provide alternatives to the water supply reliability provided by the additional pumps, since they provide reliability independent of the pumps; however, they do not duplicate the operational advantages of the pumps for power saving and protection against outages. The extraordinary conservation measures were used in the benefit/cost analysis of the pumps to define the value of future yield to the State Water Project. Under the study assumptions of added project water supply facilities, these measures would be needed before the pumps could be installed and, therefore, did not compete with the additional pumps.

Commitment to water conservation goals through a contractual agreement of the contractors and the Department is also discussed in the final environmental impact report as a potential mitigation option.

Issue 10

The proposed project will increase water export by about 61 percent, more than 2.8 million acre-feet per year.

Response

Actual operation of the State Water Project with the additional pumps will not increase water export by 61 percent. This comment incorrectly assumes that the new pumps will be operated at full capacity all the time. As explained in the environmental impact report, the additional pumps would be used on a much more limited basis. A major use is to enable the project to shift its pumping from on-peak to off-peak. Under the Corps constraints, historical maximums would be required except in high-flow winter months.

Although the physical capability of the Banks Pumping Plant would be increased from 6,400 to 10,300 cubic feet per second under the preferred alternative, many factors will limit the actual increase in export water volume. These factors include:

- Variation in monthly and annual precipitation.
- Operational requirements under Decision 1485 or other regulations.
- Corps of Engineers operational constraints under Public Notice 5820A, Amended.
- Hydraulic constraints inherent with the present method of transporting water across the Delta; i.e., the present channels are too small to carry all the water that would be needed if the pumps were to operate at full capacity.
- State Water Project storage capability and demands.
- State Water Project capacity at the Banks Pumping Plant.
- State Water Project water supply and power contracts.

The operation studies included 57 years of hydrologic data and considered all these factors. Estimated firm yield increase for the preferred alternative was 57,000 to 64,000 acre-feet per year. This is an increase of less than 3 percent (not 61 percent) over present yield with existing project facilities.

C—105284

C-105284

Issue 11

The Department of Water Resources should not increase exports until impacts of Delta outflow on fish are understood.

Response

The Department is proposing to install the additional pumps for reasons such as decreasing expenditures for electrical power by shifting part of its pumping from on-peak to off-peak. The additional pumps would be used to increase the reliability of project deliveries only during high winter flow periods (less than 3 percent of the time). Further actions or projects to increase export pumping would require further environmental documentation.

There are reasons to proceed with the four-pump proposal even though uncertainties remain about outflow needs for biological resources of San Francisco Bay. Bay fish population levels may or may not be related to quantity of fresh water flowing through the lower bays. Even if they are related, the proposal will have only a minimal impact, as shown by evaluation of operations with the Corps criteria. Seasonal changes in outflow for the preferred alternative on an average annual basis amount to about a 0.4 percent decrease. Outflow surges were investigated, and changes were small.

Even with many ongoing studies, it is not expected that a full understanding of the interrelationships between the bay's biological resources and Delta outflow will be obtained for many years, if ever.

The benefits of the additional pumps include power cost savings and increased reliability for water supply deliveries, and these justify proceeding with the pumps. Installation of the pumps will not preclude revised operations if new information shows an adverse relationship of project operation on the bay.

The Department is concerned about fish in the Delta and bay and has participated and provided funding to help solve this problem, including studying outflow relationships. The Department participates in the following programs:

- Interagency Ecological Study, which includes the Delta Outflow/San Francisco Bay Study.
- Advanced tidal hydrodynamic mathematical modeling development.
- Water Right Decision 1485 monitoring.

C—105285

C-105285

CONTENTS

	Page
EXECUTIVE SUMMARY	iii
General Issues	ix
Chapter 1. INTRODUCTION AND BACKGROUND	1
The Existing Central Valley Project and Related Mitigation	2
The Existing State Water Project and Related Mitigation	4
State Water Project Supply Contracts	6
Statutes Affecting State Water Project Development	7
State Water Project Operation	8
Available Water Supply, State Water Project Demands, and Delivery Capabilities	8
Water Availability Studies	10
Water Conservation and Water Management Plans	10
Decision 1485	13
Coordinated Operation Agreement	13
State Water Project Power Operations	14
Regulatory Permits for Banks Pumping Plant, and Related Environmental Documentation	15
Hydraulic Constraints and Banks Pumping Plant Capacity	17
Other Litigation	18
Ecological Studies	18
Fish Studies	20
Fish Facilities and Related Studies	20
Water Quality Studies	21
Suisun Marsh Study	21
San Francisco Bay Outflow Study	21
Related Studies	22
Planning Perspective	22
Public Participation	24

C—105286

C-105286

Page

Chapter 2. PROJECT DESCRIPTION. 27

Purposes 27

Power Savings. 27
Outages 27
Increased Reliability of Water Supply Deliveries . . . 28

Physical Features 29

Pumping Units 29
Construction Activities 29
Southern Delta Modifications. 29

Chapter 3. DESCRIPTION AND COMPARISON OF ALTERNATIVES 31

Operational Considerations 32

Hydraulic Constraints and Banks Pumping Plant Capacity . 32
Efficient Operation of the State Water Project . . . 34

Physical and Operational Comparison of
Alternative Operational Plans 36

Alternative Operational Plan 0-6.4 37
Alternative Operational Plan 2-6.4 37
Alternative Operational Plan 4-6.4 37
Alternatives Operational Plans 2-7.3(Corps),
2-8.5(Corps), 4-7.3(Corps), and 4-10.3(Corps),
Including the Preferred Alternative 38
Alternative Operational Plans 2-8.5 and 4-8.5 40
Alternative Operational Plan 4-10.3 41

Water Supply and Demand Reduction Alternatives 42

Additional Toilet Dam and Showerhead Retrofit 43
Free Residential Landscape Design 44
San Joaquin Valley Drainage Water Desalting 44
Additional Imperial Valley Conservation and Transfer . 46
Riverside County Drainage Water Desalting 47
Ground Water Desalting 47
Imperial Valley Drainage Water Desalting 47

Economic Analysis 48

Median Year Analysis 50
Firm Yield Analysis 50
Fish Mitigation Costs 51
Standby Capacity to Protect Against Outages 51
Sensitivity Analysis 51

C—105287

C-105287

Page

Chapter 4. ENVIRONMENTAL SETTING 53

Local Vicinity 55

Southern Delta 56

Delta Region 59

Suisun Marsh 62

San Francisco Bay Area 63

Sacramento Valley 64

San Joaquin Valley 66

General Setting 66
Agricultural Drainage and Salt Management Studies . . 67

State Water Project Service Areas 69

North Bay Service Area 69
South Bay Service Area 73
Central Coastal Service Area 74
San Joaquin Valley Service Area 76
Southern California Service Area 78

Chapter 5. ENVIRONMENTAL IMPACTS OF INSTALLING AND OPERATING ADDITIONAL PUMPS 81

Impacts of Construction 82

Additional Pumping Units 82
Second Clifton Court Forebay Intake 84
Southern Delta Channel Modifications 84

Operational Impacts, Conditions During the Early 1990s . . 85

Monthly Operational Changes 87
Daily Operational Changes at Clifton Court Forebay . . 89
Impacts on Delta Outflows 92
Impacts on Delta Outflow Surges 93
Impacts on Delta Municipal and Industrial Uses . . . 95
Impacts on Delta Agricultural Uses and Water Levels . . 96
Impacts on Channel Velocities, Scour, and Siltation . . 98
Impacts on Cross-Delta Flows and on Levees 99
General Impacts on Salmon and Steelhead 100
General Impacts on Striped Bass 105
General Impacts on American Shad 109
General Impacts on Sturgeon 111
General Impacts on Resident Fish 111

C—105288

C-105288

Page

Overview of Fish Food Supply Impacts 113
Overview of Direct Impacts of the Delta Complex on Fish. 118
Direct Impacts of the Delta Complex on Striped Bass, Including Eggs and Larvae 120
Direct Impacts of the Delta Complex on Chinook Salmon . 124
Direct Impacts of the Delta Complex on Other Fish Species 125
Impacts on Tracy Pumping Plant Operations 128
Impacts on Suisun Marsh 128

Summary Tables of General and Direct Impacts on Bay-Delta Fish, Early 1990 Conditions 130

Operational Impacts, Late-1990 Conditions 133

Seasonal and Annual Exports at Banks Pumping Plant . . 134
Delta Outflow Changes 134
Water Levels Near Clifton Court Forebay 135
Direct Fish Impacts 136

Impacts on State Water Project Service Areas 137

Evaluation of Socioeconomic Impacts 137
Evaluation of Growth-Inducing Impacts 138
Summary of Socioeconomic and Growth-Inducing Impacts . 139
Environmental Impacts and Mitigation Measures for Service Area Impacts 141

Relationship of the Proposed Action to Land Use Plans . . . 143

Energy and Capacity Impacts 143

Summary of Impacts Under the Preferred Alternative 145

Impacts Found to be Insignificant and Factors That Are Favorable 145
Impacts Evaluated with Insufficient Information to Determine Significance 145
Significant Environmental Effects 148
Mitigation for Impacts on Fish 148
Other Mitigation Possibilities 153
Unavoidable Significant Effects 153

Chapter 6. CUMULATIVE IMPACTS 155

General Impacts of Past and Present Development 155

Reclamation 155
Delta Flooding 155
Population 156
Pollution 156

C—105289

C-105289

Page

Delta Hydrology 157
Bay Hydrology and Circulation 157
Other Factors 158
Fish and Wildlife 158
Relationship to Pumps 159

State Water Project Planning and Related Planning 160

Protection Efforts 160
Water Management 160
Delta Levees 162
Alternatives for Delta Water Transfer 162
Other Delta Facilities 163
Coordinated Operation Agreement 164
Offstream Storage South of the Delta 164
Ground Water Storage Program 164
Onstream Storage North of the Delta 165
Local Water Purchases and Transfers 167
State Water Project Conveyance Facilities 167
Mid-Valley Canal 167
Sacramento River Deep Water Ship Channel 167
Barrier Studies 168
Governor's Water Legislation Package 168
General Impacts of Additional Pumps with
Potential Related Projects 169
Post-2000 Operation of Banks Pumping Plant Without
Added Storage or Improved Delta Water Transfer . . . 169

Cumulative Impacts on Service Areas of
of State Water Project Deliveries 172

Growth-Inducing Impacts of the State Water Project 172

Other Cumulative Impacts 174

Mitigation Measures for Cumulative Impacts 174

Safeguards 174
Contracts and Agreements 175
Physical Measures 175
Studies and Water Management Program 176
Energy Programs 176

Chapter 7. COMMENTS AND RESPONSES 177

General Issues and Responses 177

General Issue 1 177
General Issue 2 182
General Issue 3 183
General Issue 4 185

C—105290

C-105290

Page

General Issue 5 188
General Issue 6 189
General Issue 7 190
General Issue 8 191
General Issue 9 192
General Issue 10. 193
General Issue 11. 195

Letter 1, U. S. Department of Commerce,
National Marine Fisheries Service 197
Responses 252

Letter 2, U. S. Department of the Interior,
Bureau of Reclamation 202
Responses 262

Letter 3, U. S. Fish and Wildlife Service 203
Responses 264

Letter 4, State of California, Governor's Office
Office of Planning and Research 204
Responses 268

Letter 4A, Department of Fish and Game 204
Responses 268

Letter 4B, Department of Parks and Recreation 205
Response 272

Letter 5, State of California, Governor's Office
Office of Planning and Research 206
Response 272

Letter 5A, California Regional Water Quality Control Board-
San Francisco Bay Region 206
Response 272

Letter 6, Public Utilities Commission 206
Responses 273

Letter 7, State Water Resources Control Board 207
Responses 274

Letter 8, Alameda County Water District 209
Response 283

Letter 9, Antelope Valley-East Kern Water Agency 209
Response 284

Letter 10, Casitas Municipal Water District 209
Response 284

C—105291

C-105291

Page

Letter 11, Coachella Valley Water District 209
Responses 284

Letter 12, Contra Costa County Water Agency 210
Responses 284

Letter 13, Crestline-Lake Arrowhead Water Agency 210
Response 287

Letter 14, Desert Water Agency 211
Response 287

Letter 15, Devil's Den Water District 211
Response 287

Letter 16, Dudley Ridge Water District 211
Response 287

Letter 17, Kern County Water Agency 211
Response 287

Letter 18, The Metropolitan Water District
of Southern California 212
Responses 287

Letter 18B, The Metropolitan Water District
of Southern California 213
Responses 289

Letter 19, Palmdale Water District 218
Response 306

Letter 20, San Francisco Bay Conservation and
Development Commission 218
Responses 306

Letter 21, San Gabriel Valley Municipal Water District . . 218
Response 307

Letter 22, Santa Barbara County Flood Control and
Water Conservation District 219
Response 307

Letter 23, Santa Clara Valley Water District 219
Responses 307

Letter 24, Solano County Flood Control and
Water Conservation District 219
Response 308

Letter 25, Tulare Lake Basin Water Storage District . . . 219
Response 308

Page

Letter 26, State Water Contractors 220
Responses 308

Letter 27, State Water Contractors Audit Committee 223
Responses 312

Letter 28, The California Fisheries Restoration Foundation . 225
Responses 315

Letter 29, California Waterfowl Association 226
Responses 319

Letter 30, Delta Environmental Advisory Committee 227
Responses 319

Letter 31, Environmental Defense Fund 230
Responses 328

Letter 32, D. W. Kelley and Associates 233
Response 338

Letter 33, H. S. Pete Fowler, P.E. 236
Responses 338

Letter 34, National Audubon Society 236
Responses 339

Letter 35, G. Rosekilly 236
Responses 340

Letter 36, Sierra Club 237
Responses 341

Letter 37, Tehama Fly Fishers 238
Responses 343

Letter 38, United Anglers of California 239
Responses 345

Transcript of Public Hearing 240

Chapter 8. CHANGES TO THE DRAFT ENVIRONMENTAL IMPACT REPORT . . . 349

Chapter 9. LIST OF PREPARERS 353

C—105293

C-105293

Figures

		Page
1	Location Map	3
2	Corps of Engineers' Public Notice No. 5820A Amended	19
3	Relationship Between On-Peak/Off-Peak Energy Use for the State Water Project and All of California and Effects of Additional Pumping Capacity	28
4	Projected Entitlement Requests Compared to State Water Project Firm Supply	29
5	Boundaries of Delta Lowlands and Uplands	61
6	San Francisco Bay Complex	65
7	SWP Delta Export Service Areas	70
8	General Migration Patterns of Salmon, Steelhead Rainbow Trout, and American Shad in the Sacramento-San Joaquin Estuary	100
9	Operation of the Enlarged John E. Skinner Fish Protective Facility	121
10	Protest Letters Received in Response to Tom Stienstra Article	179

C—105294

C-105294

Tables

		Page
1-1	State Water Project Accomplishments Through 1983	5
1-2	Summary of Views and Comments Concerning Additional Pumps at Harvey O. Banks Delta Pumping Plant	25
3-1	Summary of Environmental Impacts	33
3-2	Alternative Operational Plans Evaluated for Banks Pumping Plant	36
3-3	Summary of Water Supply and Demand Reduction Alternatives for the Metropolitan Water District Service Area for Assumed Conditions of Significant Shortages	45
3-4	Economic Analysis of Additional Pumping Units, Purchased Capacity and Energy	49
4-1	Effects on High-High Tide of State Water Project and Central Valley Project Exports at Clifton Court Ferry	58
4-2	Rare and Endangered Fish and Wildlife in State Water Project Service Areas	71
4-3	1980 Land Use, North Bay Service Area	72
4-4	1980 Land Use, South Bay Counties	74
4-5	1980 Land Use, Central Coastal Region	75
4-6	1980 Land Use, San Joaquin Valley Counties	76
4-7	1980 Land Use, Southern California Counties	79
5-1	Summary of Environmental Impacts of Construction	83
5-2	Average Monthly and Annual Exports at Banks Pumping Plant by Year Type	89
5-3	Typical Operational Changes at Clifton Court Forebay	91
5-4	Average Monthly and Annual Delta Outflows by Year Type	93
5-5	Comparison of Average Magnitude of Delta Outflow Surges	94
5-6	Estimated Total Drawdown Effects of State and Federal Water Conditions at Clifton Court Ferry	97

C—105295

C-105295

Page

5-7 Summary of Seasonal Delta Flows Affecting Salmon and Steelhead 103

5-8 Ratio of Cross-Delta Flows to Sacramento River Flows for Months of High Salmon Abundance 104

5-9 Ratio of Old River Flows to San Joaquin River Flows for Months of High Salmon Abundance 104

5-10 Mean Monthly Salinities in the Western Delta (Antioch) During Striped Bass Spawning (April and May) 108

5-11 Exports and Outflows for Young Striped Bass Abundance During May, June, and July 108

5-12 Ratio of Cross-Delta Flows to Sacramento River Flows for Months of High American Shad Abundance 110

5-13 Historical Neomysis Abundance Indexes and Mean Environmental Variables for the Sacramento-San Joaquin Estuary, July-October 1968-1981 115

5-14 Calculated Neomysis Abundances Indices by Year Types for Alternative Operational Plans 116

5-15 Calculated Average Annual Direct Entrainment and Losses at the Delta Complex for Striped Bass and Chinook Salmon for Alternative Operational Plans 123

5-16 Calculated Direct Losses at the Delta Complex for Striped Bass and Chinook Salmon by Year Type 123

5-17 Calculated Direct Average Salvage of Screenable Size Fish Other than Striped Bass and Chinook Salmon at the Delta Complex for Alternative Operational Plans 127

5-18 Summary of General Incremental Impacts on Fish Needs for Alternative Operational Plans 131

5-19 Summary of General Qualitative Incremental Impacts on Critical Factors That Affect Striped Bass and Chinook Salmon Life Stages 132

5-20 Summary of General Incremental Impacts on Fish Salvaged at Delta Complex 133

5-21 Estimated State Water Project and Central Valley Project Export and Outflow Changes Pre-2000, Above Normal Year Type . 135

5-22 Estimated Direct Losses at the Delta Complex for Selected Fish Species, Early and Late 1990s 136

		Page
5-23	Summary of Incremental Socioeconomic Impacts of Additional Pumps on Project Service Areas for Preferred and 4-10.3 Alternatives	139
5-24	Growth-Inducing Impacts in State Water Project Service Areas for Preferred and 4-10.3 Alternatives	140
5-25	Guidelines for Determining Significant Effects	147
5-26	Effects of Clifton Court Forebay Predation Rates on Average Annual Losses of Chinook Salmon	150
5-27	Summary of Possible Striped Bass and Chinook Salmon Impact Reduction, Benefits Lost, and Unit Costs Using Operational Flexibility of the Banks Pumping Plant	151
6-1	Potential Cumulative Effects of Additional Pumps and Related Projects on Delta Flows and Fisheries (Compared to 1990-Level Conditions)	171
6-2	Summary of Cumulative Socioeconomic Impacts of State Water Project Deliveries, by Service Area	172
6-3	Summary of Cumulative Growth-Inducing Impacts, by Service Area	173
7-1	Entities Commenting on Draft Environmental Impact Report, Proposed Additional Pumping Units	178
8-1	Changes to the Draft Environmental Impact Report	349

Appendixes

A	Summary from the Final Environmental Statement for the Operation of the Delta Pumping Plant	355
B	Operation Studies and Direct Fish Impact Analysis	361
C	Benefit/Cost Analysis of Additional Pumping Units at Harvey O. Banks Delta Pumping Plant	405
D	Assessment of the Impacts of the Banks Pumping Plant in the State Water Project Service Areas	431
E	Recommended Water Management Plans	497
F	Documents Incorporated by Reference	509

C—105297

C-105297

Chapter 1. INTRODUCTION AND BACKGROUND

The California Department of Water Resources proposes to order, install, and operate four additional pumping units at the Harvey O. Banks Delta Pumping Plant (Banks Pumping Plant) of the State Water Project. Operation of the pumping plant and Clifton Court Forebay would be limited by operational constraints established by the U. S. Army Corps of Engineers. The four additional units would increase pumping capability to the full-rated design capacity of the California Aqueduct between the Banks Pumping Plant discharge outlet and Bethany Reservoir -- 10,300 cubic feet per second. The seven existing pumps have a capability of 6,400 cubic feet per second, based on recent measurements with acoustic velocity meters. The previous estimated capacity was 6,300 cubic feet per second.

Banks Pumping Plant, a key facility of the State Water Project, is located at the beginning of the California Aqueduct, about 12 miles northwest of Tracy. Together with Clifton Court Forebay and a connecting intake channel (see Figure 1), the pumping plant diverts water from the Sacramento-San Joaquin Delta for conveyance via the California and South Bay aqueducts to contracting agencies in the South San Francisco Bay area, San Joaquin Valley, and Southern California. This chapter deals primarily with the State Water Project; some background on other projects is discussed first.

The State Water Project and the Federal Central Valley Project move water from areas in Northern California to cities and farms in the Sacramento Valley, the Bay area, the San Joaquin Valley, and Southern California. Other major water transfer systems in California include:

- Los Angeles Aqueduct. The aqueduct delivers municipal and industrial water supplies from Owens River and tributaries of Mono basin to Los Angeles. The project stores the water in several reservoirs along its alignment to provide 80 percent of the water used by Los Angeles.

- All American Canal. This U. S. Bureau of Reclamation canal delivers water from Imperial Dam, on the Colorado River, to serve areas in the Imperial and Coachella valleys and the Yuma Project.

- Colorado River Aqueduct. This Metropolitan Water District aqueduct delivers water from the Colorado River at Lake Havasu to the Southern California area. The project stores the water in four reservoirs: Copper Basin, Lake Mathews, Morris, and Palo Verde.

- Hetch Hetchy Aqueduct. The aqueduct delivers municipal and industrial water to San Francisco. The facilities, owned by the city and county, store water on the Tuolumne River and Cherry Creek, both tributaries that provide natural inflow to the Bay-Delta estuary, with maximum storage capacities of 360,000 and 268,000 acre-feet, respectively. The project diverts the stored water by an aqueduct around the estuary system, thereby reducing the natural inflow to the Delta.

- Mokelumne Aqueduct. The Mokelumne River Project reduces the natural inflow to the Delta in the same manner as the Hetch Hetchy Project. This project stores and diverts water of the Mokelumne River system to supply water for East Bay Municipal Utility

C—105298

C-105298

District. The two storage reservoirs on the Mokelumne River are Pardee and Comanche reservoirs, with maximum storage capacities of 210,000 and 431,500 acre-feet, respectively.

California uses its water for a multitude of purposes. Agriculture, California's biggest industry, uses about 85 percent of the State's water, principally for irrigation. California's agricultural production leads the Nation, with $14 billion worth of crops produced in 1981. Agriculture is the largest source of employment in the State and has used irrigation projects to reclaim millions of previously non-productive acres for farming.

Management of water projects for flood control in California has prevented billions of dollars in damage and has saved many lives.

Hydroelectric power provided 27 percent of the State's energy in 1978. About 71 million barrels of oil would be needed annually to generate the 138 billion kilowatt-hours of electrical energy produced by California's hydroelectric plants.

Other benefits of water development include recreation for millions of Californians, features for fish and wildlife resources, improvement of water quality, and improvement of navigable waterways. Water projects help repel salt water intrusion into irrigable areas such as the Sacramento-San Joaquin Delta.

In the Central Valley hydrologic basin, about 500 reservoirs are owned and operated by local agencies for water supply, power generation, flood control, recreation, and other purposes. These local reservoirs have a total gross storage capacity of about 9 million acre-feet.

The Existing Central Valley Project and Related Mitigation

The Central Valley Project, operated by the U. S. Bureau of Reclamation, consists of dams, reservoirs, and conveyance facilities in Northern and Central California. Central Valley Project reservoir systems providing Delta export supplies and augmenting low summer and fall flows to the Delta are: the Shasta Division, the Trinity River Division, and the Folsom Unit of the American River Division. The project exports from the southern Delta at the Tracy Pumping Plant, at the head of the Delta-Mendota Canal, 2 miles east of the Banks Pumping Plant. About 3.4 million acre-feet of water is exported annually from the Delta by the Central Valley Project.

The Delta Cross Channel, 30 miles south of Sacramento, helps to control passage of Sacramento River water through the Delta channels to the pumping plants in the southern Delta. The Cross Channel is a facility of the Central Valley Project.

The Central Valley Project has developed facilities for mitigation of fish losses caused by the project. At Keswick Dam, downstream of Shasta Dam, salmon and steelhead are trapped and transported to Coleman Fish Hatchery. Farther downstream, at Red Bluff Diversion Dam, fish ladders on each side and in the center of the dam allow salmon and steelhead to migrate upstream. The average annual number of salmon passing the diversion dam from 1966 to 1971 was 120,000.

In the first reach of the Tehama-Colusa Canal, just upstream of the Red Bluff Diversion Dam, 1.6 million square feet of salmon spawning gravel beds have been constructed. The spawning beds have sufficient capacity for 46,000 salmon per year.

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C-105299

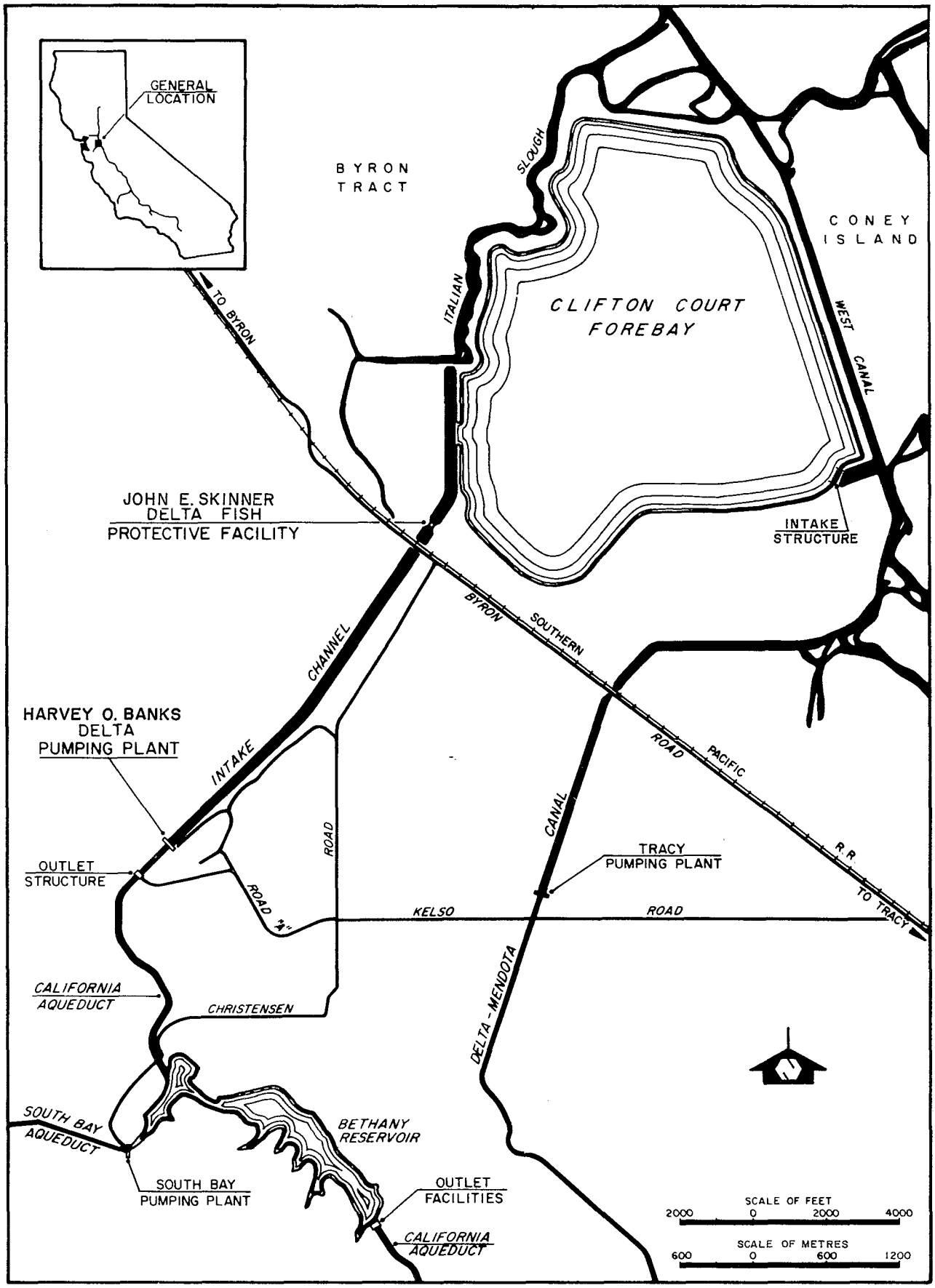


FIGURE 1. LOCATION MAP

C-105300

The Trinity River portion of the Central Valley Project has a fish hatchery below Lewiston Dam. In addition to the hatchery, the spawning beds downstream of the dam are being improved. Agreement has been reached to increase the flows in the Trinity River from 120,000 acre-feet to between 287,000 and 340,000 acre-feet per year. This increased flow is for fish habitat.

The Nimbus Fish Hatchery, downstream of Folsom Dam, was built to mitigate the spawning area loss due to the dam. In 1981-82, this hatchery provided 11,600,000 fingerling salmon and 283,000 fingerling steelhead for planting.

Another fish mitigation measure of the Central Valley Project is the Tracy Fish Collecting Facility. This facility helps prevent fish from entering the Delta-Mendota Canal. The facility has a louvered fish screen that channels the fish into holding tanks. The fish are then trucked and released to other parts of the Delta.

The San Felipe Division of the Central Valley Project is under construction. It will convey water from the Delta-Mendota Canal to San Luis Reservoir and then to portions of Santa Clara, San Benito, Santa Cruz, and Monterey counties via the Pacheco Tunnel. The project will not increase Delta exports, because water allocated to San Felipe Division is now used for irrigation in the San Joaquin Valley.

The Existing State Water Project and Related Mitigation

State Water Project facilities extend from Plumas County in Northern California to Riverside County in Southern California. The State Water Project, authorized in 1959 by the Burns-Porter Act and ratified in the November 1960 general election, was planned to deliver 4,230,000 acre-feet of water annually to service areas in Northern, Central, and Southern California. The California Aqueduct begins at the Banks Pumping Plant and extends 444 miles. It is the principal conveyance facility of the overall project, which now includes 22 dams and reservoirs, 6 power plants, and 16 pumping plants.

As required by the California Water Resources Development Bond Act, Water Code Section 12934(d)(2), the California Aqueduct system has a capacity of not less than 2,500 cubic feet per second at all points north of the northerly boundary of the County of Los Angeles in the Tehachapi Mountains in the vicinity of Quail Lake and a capacity of not less than 10,000 cubic feet per second at all points north of the initial offstream storage reservoir.

Except for the Banks and Pearblossom pumping plants, all pumping plants along the California Aqueduct have the planned units installed. Additional units at Pearblossom are scheduled for operation in 1991.

The State Water Project provides numerous benefits to the people of California, including water supply, flood control, recreation, and energy production. Table 1-1 summarizes the benefits through 1983.

Lake Oroville, the main storage facility, is situated on the Feather River in Butte County. State Water Project facilities at Oroville are operated for flood control; power generation; instream fisheries; and water supply for local areas, the Delta, and export. Three upstream reservoirs on the headwaters of the Feather River are operated for local water supply, recreation, and instream fisheries. Water released for fish and the other purposes, together with irrigation return flows, goes down the Feather and Sacramento rivers and then into the network of channels in the Delta. Releases from the Oroville facilities contribute to Delta uses, Delta salinity control, and export needs out of the Delta.

C—105301

C-105301

Table 1-1

STATE WATER PROJECT ACCOMPLISHMENTS THROUGH 1983†

Year	Water Delivered (in Acre-Feet)							Recreation Supported (Recreation Days)**	Electrical Energy Generated (Megawatt-Hours)***
	Entitlement Water			Other Deliveries					
	Municipal and Industrial Use	Agricultural Use	Total	Surplus Ag.	Surplus M&I	Other Water*	Total Delivery		
1962						18,289	18,289	30,000	
1963						22,456	22,456	105,000	
1964						32,507	32,507	331,600	
1965						44,105	44,105	499,800	
1966						67,928	67,928	482,700	
1967	5,747	5,791	11,538			53,605	65,143	455,200	
1968	46,472	125,237	171,709	111,534	10,000	14,777	308,020	931,300	628,000
1969	34,434	158,586	193,020	72,397	0	18,829	284,246	1,554,800	2,614,000
1970	47,996	185,997	233,993	133,024	0	38,080	405,097	1,804,800	2,679,000
1971	85,286	272,054	357,340	293,619	2,400	44,127	697,486	2,085,900	3,302,000
1972	181,066	430,735	611,801	401,759	22,205	73,127	1,108,892	1,971,200	1,922,000
1973	293,824	400,564	694,388	293,255	3,161	43,666	1,034,470	2,502,000	3,298,000
1974	418,521	455,556	874,077	412,923	4,753	48,342	1,340,095	4,073,600	4,672,000
1975	641,621	582,369	1,223,990	601,859	21,043	67,170	1,914,062	4,189,300	3,159,000
1976	818,588	554,414	1,373,002	547,622	32,488	116,962	2,070,074	4,239,600	2,131,000
1977	280,919	293,236	574,155	0	0	390,176	964,331	3,951,900	958,000
1978	742,385	710,314	1,452,699	13,348	3,566	122,916	1,592,529	5,773,700	2,882,000
1979	690,659	969,237	1,659,896	582,308	66,081	189,396	2,497,681	5,298,700	2,485,000
1980	730,545	799,204	1,529,749	384,835	19,722	48,590	1,982,896	5,701,900	2,988,000
1981	1,057,273	852,289	1,909,562	896,428	12,000	248,142	3,066,132	6,017,800	3,358,000
1982	928,613	820,297	1,748,910	214,570	1,303	125,484	2,090,267	6,187,700	5,097,000
1983	503,112	681,757	1,184,869	13,019	0	110,535	1,308,423	5,838,200	5,419,000
Total†	7,507,061	8,296,637	15,805,698	4,972,500	198,722	1,939,209	22,915,129	64,026,700	47,592,000

* Includes Emergency Relief Water, Kern River Intertie Water, Exchange Water, Repayment Water, Regulated Delivery of Local Supply, Conveyance of Federal Central Valley Project Water, and Recreation Water.
** A recreation day is the visit of one person to a recreation area (for recreation purposes) for any part of one day.
***Includes State's share of generation from Hyatt-Thermalito, San Luis, Castaic, and Devil Canyon powerplants.
† In addition, dams of the State Water Project have prevented millions of dollars worth of flood damage.

Additional State Water Project storage is provided by the Federal-State San Luis Reservoir in Merced County, a transportation facility reservoir in Alameda County serving the South San Francisco Bay area, and four transportation facility reservoirs in Southern California. Water diverted from the Delta at the Banks and Tracy plants is pumped into San Luis Reservoir during winter and early spring for release to the aqueducts during summer and fall.

At the northern base of the Tehachapi Mountains, the A. D. Edmonston Pumping Plant lifts California Aqueduct water nearly 2,000 feet. The water then crosses the mountains through a series of four tunnels. South of the Tehachapi Mountains, the aqueduct divides: the West Branch transports most of the water through Pyramid Lake to Castaic Lake, northwest of Los Angeles; the East Branch delivers water to the Antelope Valley and terminates at Lake Perris, in Riverside County.

Past and present fish and wildlife mitigation and enhancement for State Water Project facilities north and south of the Delta are summarized below.

The Feather River Fish Hatchery was built to mitigate the loss of salmon and steelhead spawning beds resulting from construction of Oroville Dam. The hatchery can accommodate 9,000 adult salmon and 2,000 adult steelhead. During 1981 and 1982, this hatchery provided 11,030,000 salmon and 1,203,000 steelhead for planting or transfer to other hatcheries.

C—105302

C-105302

The fall run of salmon has increased from a preproject average of about 39,000 to about 49,000. The spring run has declined from a preproject average of about 1,700 to an average of about 1,150. The steelhead run has decreased from a preproject average of 600 to about 500.

Approval and funds have been obtained to construct two additional salmon-rearing raceways to help overcome the threat of cold water virus. These raceways should double the survival rate of young salmon.

The Department of Fish and Game is using the Oroville borrow areas, sources of material for construction of Oroville Dam, to enhance fish and wildlife.

Wildlife habitat losses at San Luis Reservoir have been mitigated by purchase of an additional 900 acres. A fishery has also been established in the reservoir, which enhances this resource.

The 398-acre Kettleman City Recreation Area has been established on the California Aqueduct about 50 miles south of Fresno. Part of this area is for wildlife enhancement and a pond was built for fishery enhancement.

The fishery established along the length of the California Aqueduct and in the four Southern California reservoirs provides recreation use and associated benefits.

Wildlife habitat loss in the Southern California portion of the project is being mitigated in two parts. To mitigate for wildlife habitat loss on U. S. Forest Service land, the Department of Water Resources has agreed to purchase 1,500 acres of suitable lands for wildlife. These lands will be turned over to the Forest Service along with a specified amount of funding for habitat development and operation. The total cost is estimated to be $1.1 million. Another agreement, with Department of Fish and Game, allocates 3,033 acres of State Water Project lands for wildlife mitigation, and Metropolitan Water District of Southern California has dedicated 2,565 acres at Lake Mathews for wildlife mitigation. The Department of Water Resources will also allocate $7 million of State Water Project funds and $1 million in other funds to the Department of Fish and Game to develop, operate, and maintain the wildlife habitat. Some of these funds may be used to purchase lands in the San Jacinto Valley for this purpose.

State Water Project Supply Contracts

The Department of Water Resources has long-term water supply contracts with 30 agencies to deliver a specified annual amount of water to each contracting agency. These contractors are in the Bay area, San Joaquin Valley, central coastal area and Southern California. The maximum annual entitlements for all contractors total about 4.2 million acre-feet. This represents the maximum water that would be delivered by the State to its contractors under full contract conditions. To deliver this maximum amount of water would require a capacity of 10,300 cubic feet per second at the Banks Pumping Plant, as well as other future water development features. The reach of the aqueduct from the Banks Pumping Plant to San Luis Reservoir has been constructed to convey up to 10,000 cubic feet per second, as authorized by the Burns-Porter Act.

Water contracts establish annual entitlements and procedures for allocating deficiencies, surplus water deliveries, and payment. In general, annual entitlements follow buildup schedules, increasing each year until the maximum annual entitlement is reached. A contracting agency may request that project water be made available in annual amounts greater or less than scheduled annual entitlements, but not greater

C—105303

C-105303

than its maximum annual entitlement. Subject to approval by the State, the water delivery schedule is adjusted to the extent necessary to satisfy the request.

If during any year the supply of project water exceeds the total requested water deliveries for annual entitlements of all contractors and necessary carry-over storage for that year, the State can sell and deliver such water as surplus water. Requests for surplus water have a lower priority than entitlement requests.

A temporary shortage of water supplies can occur in any year when a drought or other temporary cause reduces project water available to less than the total requests for annual entitlements of all contractors for that year. In such an event, the State Water Project would be operated to reduce deliveries of that year's annual entitlement used for agricultural purposes by a percentage not to exceed 50 percent in any one year or a total of 100 percent of yearly annual entitlements in any seven consecutive years. If necessary, further reductions will be made to all deliveries, regardless of use, and the reduction will be in proportion to the entitlement.

The annual entitlements and the maximum annual entitlements of all contractors will be reduced proportionately under the following specific conditions:

- The State is unable to build enough additional conservation facilities to prevent a reduction in minimum yield.

- There is a reduction in the minimum project yield for any other reason.

In both cases, preventive or remedial measures by the Department will be considered before the shortage is applied. If a shortage is applied, the sum of the revised maximum annual entitlements of all contractors will equal the reduced minimum project yield.

Statutes Affecting State Water Project Development

The Department of Water Resources is obligated to preserve and, where possible, enhance fish and wildlife while operating the State Water Project, as declared by the California Legislature in Water Code Sections 11900 through 11925, commonly referred to as the Davis-Dolwig Act.

The Delta Protection Act, Water Code Sections 12200 et seq., has placed certain obligations on the State with respect to the Delta. The Act requires that the State, in cooperation with the United States, provide salinity control and an adequate water supply for reasonable uses of water in the Delta. Substitute facilities may be provided in the Delta in lieu of salinity control if it is in the public interest and if there is no increased financial burden on the Delta water users solely because of such substitution. The Act gives the Delta users a priority to purchase State Water Project water when reasonable needs exceed vested rights. The Act states that if these water users desire additional benefits in excess of their vested rights, such benefits can be obtained from the project operators through contracts providing for payment for the benefits received.

The Area of Origin laws, Water Code Sections 10505 and 11460 to 11463, provide restrictions and limitations to protect the water requirements of the county of origin or the watershed in which water originates. This protection grants the areas of origin the right to construct projects or make diversions without being subject to the prior rights acquired under State applications for the State Water Project. It also grants areas of origin preferential rights to contract for project water within the general framework established in the State water supply contracts.

C—105304

C-105304

The Burns-Porter Act, Water Code Section 12931, declares the Delta to be part of the Sacramento River watershed and, thus, includes the Delta in the area of origin protection.

Public Resources Code Section 5093.50 et seq. provides that "certain rivers which possess extraordinary scenic, recreational, fishery or wildlife values, shall be preserved in their free-flowing state, together with their immediate environments, for the benefit and enjoyment of the people of the State."

The act commonly referred to as the Wild and Scenic Rivers Act forbids the construction of dams, reservoirs, or other water impoundment facilities or any water diversion facility on any river in the system until a determination is made that such a facility is needed to supply domestic water to the residents of the county or counties through which the river flows, and any such approved facility must not adversely affect the river's free-flowing condition. Rivers in the system are: Smith, Klamath, Scott, Salmon, Trinity, Eel, Van Duzen, and specific reaches of the American. The Federal Wild Rivers Act also provides further protection to these and other river systems such as the Middle Fork Feather River.

The California Environmental Quality Act, Public Resources Code Section 21000 et seq., establishes a strong public policy for preservation and enhancement of the State's environment. It also provides that environmental factors should be considered in planning and feasibility studies. Any facility to be constructed by or under the authority of the State requires an environmental impact report if the facility may have a significant effect on the environment.

The National Environmental Policy Act, 42 U.S.C. Section 4321 et seq., contains a strong Federal commitment to preserve and enhance the human environment. It provides for preparation of an environmental impact statement for facilities constructed by the Federal Government or its licensees or for facilities funded by the Federal Government or subject to Federal Government approval where there would be an impact on the environment.

State Water Project Operation

Physical and institutional constraints govern operation of the State Water Project. Principal factors that affect the State's ability to meet gradually increasing contractual obligations for water deliveries are:

- Available water supply, State Water Project demands, and delivery capabilities
- Decision 1485
- Coordinated Operation Agreement
- Power operations
- Regulatory permits
- Hydraulic constraints and Banks Pumping Plant capacity

These governing factors are discussed in the following sections.

Available Water Supply, State Water Project Demands, and Delivery Capabilities

Availability of water supplies at the Delta varies with natural conditions and upstream development. Natural hydrologic variations cause extreme fluctuations in monthly and yearly inflows. Winter floods produce Delta flow rates of several hundred thousand cubic feet per second, while summer conditions can decrease rates to a few thousand cubic feet per second. The total annual volume of inflow can also vary substantially. Unimpaired annual volumes range from less than 10 million acre-feet in critical years to more than 50 million in wet years.

Upstream development has occurred from both local and project facilities. Use within the local area has priority over

C—105305

C-105305

project use through area of origin laws; therefore, local development will directly decrease project supplies as it occurs. By the year 2000, existing project firm yield supplies are projected to decrease by 300,000 acre-feet. Supplies from the additional pumps can offset a portion of this loss.

Upstream development will contribute to future shortages if proper solutions are not found. However, other factors in the service area will also add to the frequency and severity of such shortages. Even with extensive planned conservation efforts, urban water demands will increase. This is further complicated by the fact that a portion of Colorado River supplies used by Southern California for many years will be diverted to Arizona. The additional pumps would help reduce the frequency and severity of these shortages.

State Water Project contractors regularly make short-term and long-term projections for entitlement water use. These requested entitlement supplies are delivered in accordance with State Water Project contracts, discussed earlier in this chapter. Annual requested entitlement deliveries are currently less than the annual contracted entitlement amounts.

Contractor requests are below contracted entitlements principally because population growth rates have slowed; another contributing factor has been conservation and waste water reclamation efforts to reduce demands. In determining requests, contractors balance all supplies with demands to determine what contribution project deliveries will provide as one supply source. Supply sources in addition to the State Water Project include local ground water, local surface water, and other import sources. As demands are reduced, the contractor requests for State Water Project supplies are also reduced. For conditions of the early 1990s, contractor demands reflect reductions for conservation, waste water reclamation, conjunctive use of surface and ground water, and water exchanges and transfers. Urban water conservation will account for 250,000 acre-feet per year reductions.

The demand reductions included in the contractor requests are consistent with:

- Demand levels used in the operation studies to evaluate impacts of the pumps in Chapter 5 (Operation Impacts, Conditions During the Early 1990s).
- Recommended conservation measures in water management plans for State Water Project contractors discussed later in this chapter and in Appendix E.
- Department of Water Resources Bulletin 160-83 on the California Water Plan.

It is important to note that the agricultural water conservation values in Bulletin 160-83 are expected values and occur mostly in the Colorado River hydrologic study area, which includes Imperial Irrigation District. Water savings from water management measures associated with Imperial Irrigation District are included in the discussion of water supply and demand reduction alternatives.

Even though entitlement requests are less than contracted entitlements, they are advancing beyond State Water Project dependable yield. The entitlement requests are estimated to be 3.1 million acre-feet in 1990, increasing to 3.6 million in 2000. Starting in the mid-1980s, State Water Project dependable yield will not be sufficient to meet the contractors' entitlement requests.

There are two approaches for presenting supplies and delivery capabilities of the State Water Project: firm yield and probability.

Based on the drought years of 1928 to 1934 water supply conditions, the dependable yield of the State Water

C—105306

C-105306

Project is about 2.3 million acre-feet annually with existing facilities and water quality standards. The dependable yield will decrease by about 0.3 million acre-feet by year 2000 as a result of increased use in areas of origin, maturity of contractual obligations of the Central Valley Project, and other prior rights. This firm yield approach was the foundation of planning for the State Water Project and is embodied in the water supply contracts. It is valid for comparative purposes, but it shows only part of the picture. A probability approach can provide added information for a more complete picture.

The probability concept shows that for year 2000 with existing facilities and standards, in more than 90 percent of years the project can deliver at least 2.1 million acre-feet; in 50 percent of years it can deliver 2.5 million acre-feet; and in 25 percent of years it can deliver 3.6 million acre-feet.

Water Availability Studies

Since 1914, water users seeking to appropriate water have been required to obtain a permit from the State. Before granting a permit, the State must determine if water is available for the proposed diversion. This procedure has become increasingly complicated. The Sacramento-San Joaquin watershed is particularly complicated because of its size, the number of water rights holders, and the projects that export water from the basin.

The State Water Resources Control Board hearings on the availability of water, held in April and May 1983, led to Water Right Decision 1594 in November 1983. That decision affects new water right permits and over 400 existing water right permits that contain Standard Water Right Term 80 or 91. Term 80 provides for Board reservation of jurisdiction to change the season of diversion. Term 91 prohibits diversion when releases of Central Valley Project and State Water Project stored water are flowing out of the Delta to meet water quality standards. The Control Board's Order WR 84-2, February 1984, amended and affirmed Decision 1594 and denied several petitions for reconsideration.

Water Conservation and Water Management Plans

Article X, Section 2, of the California Constitution states that "water resources of the State shall be put to beneficial use to the fullest extent to which they are capable and that the conservation of the State's water is to be exercised with a view to their reasonable and beneficial use."

Since the early 1970s, the Department of Water Resources has studied possibilities for reducing water use throughout the State by water conservation and waste water reclamation. Particular effort has gone into investigations within the service areas of the State Water Project.

The Department continuously evaluates the potential for water savings and reclamation and incorporates the estimates in statewide reports such as Bulletin 160-83 on the California Water Plan and Bulletin 198-84 on water conservation. These reports contain information on projected population growth and water needs for the next 30 years and the steps that are being and can be taken to make more efficient use of California's water.

Bulletin 160-83 has projected statewide net water supply savings of 1.6 million acre-feet in year 2010 resulting from expected water conservation. About 60 percent of these projected savings would be from the urban sector and 40 percent from the agricultural sector. Over 75 percent, or 490,000 acre-feet, of agricultural savings is from savings in the Imperial Irrigation District. Expected savings of about 150,000 acre-feet was identified for the rest of the

C—105307

C-105307

State. Use of reclaimed water is also projected to increase.

Major elements of water conservation programs by the Department include:

- Making water saving devices available to all households in the State. These devices have been distributed to over 3.3 million households.

- A landscape water conservation program, which emphasizes implementation programs, such as lawn watering guides and water audits for large turf.

- A leak detection and repair program with an expanded grant program and local agency assistance program to help agencies prevent the loss of water supply.

- Developing public education programs aimed at both children and adults. This program has reached 10 percent of California's elementary school children.

- Developing water pricing methods that would encourage water conservation without adversely affecting revenues.

- Developing a program for reducing agricultural water use in a way that is relevant to the specific area.

- Documenting conservation potential in the urban sector for use in outreach programs to effect water savings.

- An agricultural water conservation program that has gone beyond research and demonstration projects to implementation of a mobile laboratory program and the California Irrigation Management Information System program.

These water conservation programs are integrated with other programs such as water reclamation and improved water management practices, conjunctive use of ground water and surface water, watershed management, banking of water supplies for use in water-deficient years, interbasin and intrabasin transfers of developed water supplies, and development of conventional in-basin water supplies.

Governor's Executive Order B 68-80, issued in 1980, directed the Department of Water Resources to prepare a plan of water conservation, reclamation, and management for the State Water Project, and to implement a program of recycling agricultural drainage and other brackish water to augment project supplies.

Separate draft reports on recommended water management plans have been completed for State Water Project contractors. Each contractor was involved as much as possible in the preparation of its plan. The plans recognize existing programs within each service area.

The components of each water management plan are directed toward coordinating and maximizing the use of existing water supplies and facilities in the State Water Project service areas. The plans were developed in a consistent manner, while allowing flexibility to consider the uniqueness and individual constraints within each water contractor's service area. The common objective was to develop plans that:

- Recommend actions to reduce demand, reclaim waste water, use ground water conjunctively with surface supplies, and facilitate water exchanges, and undertake other measures that will reduce or delay the need for new surface water facilities.

- Are feasible and implementable.

- Are flexible and can be implemented in stages, allowing some actions to be implemented as soon as possible and other actions that are subject to institutional, economic, or technologic constraints to be implemented as the constraints are resolved.

C—105308

C-105308

Examples of recommended water management measures in the plans are presented in Appendix E. They include such things as:

- Urban and agricultural water conservation.
- Conjunctive use of surface and ground water.
- Waste water reclamation.
- Water exchanges and transfers.

More specifically conservation measures include: education and public information, leak detection programs, meter calibration and replacement programs, device distribution programs to reduce water use, pricing, measures to reduce evapotranspiration, and measures to reduce percolation to perched water tables.

Estimated savings for the State Water Project service area would be over 300,000 acre-feet for early 1990s, mostly from Metropolitan Water District.

Demand reductions for conservation and waste water reclamation used in determining the project needs identified in the section "Available Water Supply, State Water Project Demands and Delivery Capabilities" are based on the savings potential identified in these plans.

These savings are consistent with savings projected in Bulletin 160-83, if the State Water Project service area is considered separately (although based on a different methodology because the bulletin covered the whole State).

The recently enacted Urban Water Management Planning Act, Water Code Section 10610 et. seq., applies to every supplier providing water for municipal purposes to over 3,000 customers or supplying over 3,000 acre-feet of water annually. The Act requires that:

- Such suppliers adopt an urban water management plan containing prescribed elements by the end of 1985.
- The plan be filed with the Department of Water Resources.
- The Department submit annual reports to the Legislature on the status of the plans.
- Each supplier periodically review its plan.

Prescribed elements of the water management plans are:

- Estimated past, present, and projected water use.
- Conservation measures now practiced.
- Alternative measures to improve water use efficiency, considering economic, environmental, and other factors.
- A schedule of implementation.
- Frequency and magnitude of supply deficiencies.
- Ability to meet short-term deficiencies.

A plan under this Act that indicates a need for additional water supplies shall contain evaluations of:

- Waste water reclamation.
- Short-term or long-term exchanges or transfers.
- Management of peak demands.
- Incentives to alter water use practices, including fixture and appliance retrofit programs.
- Public information and educational programs.
- Changes in pricing, rate structures, and regulations.

C—105309

C-105309

Many of the items that require evaluation under the Urban Water Management Planning Act have been considered in the Department's draft reports on recommended water management plans. The contractors are using information from the Department's reports in complying with the Act and other measures.

The Department is continuing with studies of water conservation potential in the State Water Project service areas and statewide.

Decision 1485

Operation of Banks Pumping Plant and Clifton Court Forebay is coordinated with that of the upstream State Water Project and Central Valley Project reservoirs and Federal diversion facilities in the Delta to meet applicable Federal and State water quality standards for the Delta and Suisun Marsh.

The present standards are set forth in Water Right Decision 1485 of the State Water Resources Control Board. These standards are for protection of beneficial uses of water in the Sacramento-San Joaquin estuary, including municipal and industrial, agricultural, and fish and wildlife uses. The underlying principle of these standards is that water quality in the Delta should be at least as good as it would have been had the State and Federal projects not been constructed, as limited by the constitutional mandate of reasonable use. The State Board recognized that the standards would not achieve without-project levels of protection for some fish species, but deemed the level of protection under the decision reasonable until final decisions concerning means to mitigate project impacts were made. The standards include adjustments in the levels of protection to reflect changes in hydrologic conditions.

In addition to minimum flow and water quality requirements, project diversions are limited in May, June, and July to protect striped bass. Before adopting Decision 1485, the State Water Resources Control Board held hearings and prepared draft and final environmental impact reports. These reports are incorporated into this report by reference.

Decision 1485 applies the same water quality protection terms and conditions to both the Central Valley Project and the State Water Project by amending the permits for both projects. The State Water Resources Control Board did this because it determined that it was impossible to separate the effects of the two projects on the Delta.

The U. S. Bureau of Reclamation has traditionally declared that it is not legally bound by any standards set by the State. However, with some exceptions during the 1976-1977 drought, the Bureau of Reclamation has voluntarily met the standards under an annual agreement with the Department of Water Resources.

A trial court decision by Judge Figone on April 13, 1984, on the Decision 1485 cases (Judicial Council Coordination Proceeding No. 548) concluded that the State Water Resources Control Board, in many instances, did not proceed in the manner required by law, and failed to support Decision 1485 with adequate findings. Figone's judgment remanded the proceedings to the Board and commanded the Board to set aside Decision 1485 and to reconsider it in light of his decision. Most parties involved have appealed. The appellate court stayed the judgment, leaving Decision 1485 in effect.

Coordinated Operation Agreement

Central Valley Project and State Water Project operations have been coordinated under terms of an agreement signed in 1960 and supplemented in 1971. The 1971 supplement was not signed, but it has been adopted by the operators on a year-by-year basis.

C—105310

C-105310

The Department of Water Resources and the Bureau of Reclamation propose to enter into a new Coordinated Operation Agreement for the State Water Project and Federal Central Valley Project. The two agencies released a joint environmental document on September 18, 1985, to comply with State and Federal environmental protection laws.

The purpose of the proposed agreement is to assure that each project obtains its share of water from the Delta and bears its share of obligations to protect other beneficial uses of water in the Delta and the Sacramento Valley. Coordinated operation by agreed-upon criteria can increase the efficiency of both projects.

The report evaluates the environmental consequences of the proposed action of signing and implementing the draft Coordinated Operation Agreement of May 20, 1985, as compared to the consequences of no action; i.e., not signing and implementing the proposed agreement.

The agreement requires negotiations toward another contract for:

- Additional conveyance for the Central Valley Project by the State Water Project (conveyance under the proposed agreement is provided for Decision 1485, Cross Valley Canal deliveries, and existing wheeling contracts).

- State Water Project purchase of Central Valley Project interim supplies.

The agreement also addresses the Federal Government's method of responding to changes in the State Water Resources Control Board's standards.

Required congressional authorization is being sought.

State Water Project Power Operations

The Department of Water Resources is one of the largest publicly-owned electric systems in the United States. As of April 1983, the Department became a fully interconnected bulk power agency and assumed all the rights and responsibilities of such an agency in the western electric grid. This requires that the Department maintain a reliable electric system. Due to the Department's unique ability to control its pumping loads, the Department will always be a major purchaser or seller of power in the west. Managing its water and power resources will result in lowering the cost of delivered water to the water contractors.

Operations with the additional pumping units will add to the Department's ability to control its pumping loads and advance its long-range energy program. This long-range program is aimed at elimination of wasteful, inefficient, and unnecessary consumption of energy. Its objective is providing energy and transmission resources in a manner that is economically sound, has the highest regard for the environmental concern, and best uses existing power generating facilities. Along with the added capability of the additional pumps, this program includes measures such as water conservation, energy recovery along the aqueduct system, use of renewable energy sources, and minimization of all on-peak energy use.

Details on the long-range energy program are available in Department of Water Resources Long-Range Energy Program Environmental Impact Report and annual reports on the State Water Project, Bulletin 132. Each year, when preparing statements of charges to water contractors, the Department develops and assesses short-range and long-range

C—105311

C-105311

aqueduct operation studies. These studies are needed to project the amount of electrical capacity and energy required to deliver the contractors' requested entitlement water in future years. The projected power requirements also include pumping for recreation water, reservoir and aqueduct losses, and storage changes south of the Delta.

The State Water Project aqueduct operation studies are based on median-year water supply conditions. The energy requirements for each pumping plant include appropriate allowances for transmission losses. In addition to energy requirements, the Department must consider electrical capacity requirements -- the maximum demands for electrical power during given periods of time. Since the Department has flexibility in regulating the State Water Project electrical power load, the project is operated to minimize pumping requirements during on-peak periods, when capacity and energy costs are greatest. Thus, State Water Project maximum electrical capacity requirements occur during off-peak periods (nights, weekends, and holidays).

State Water Project power requirements can vary significantly, depending on the balance of water supply and water demand in a given year. Dry conditions in Northern California reduce the supply of water available for delivery and decrease power requirements if the State Water Project cannot deliver full entitlement requests. Power requirements also decrease if hydrologic conditions or actions by local water agencies reduce demands in the San Joaquin Valley or Southern California. In general, power requirements would be larger than projected only if water demands increased in Southern California and there were sufficient water supplies in Northern California available for delivery.

In Bulletin 132-84 (Table 18) State Water Project requirements were projected to increase from 5.3 billion kilowatt-hours in 1985 to 10.8 billion kilowatt-hours in 2000. The resources to meet these projected requirements are approximately as shown below.

Resource	% of Total	
	1985	2000
Hydroelectric		
Hyatt-Thermalito	27.3	20.7
Aqueduct Recovery Plants	16.8	27.3
Other	7.5	6.1
Geothermal	3.7	6.2
Edison Exchange	12.5	9.3
Coal	14.0	7.3
Wind	0.2	0.2
Potential Pacific Northwest Purchase	18.0	22.9

Regulatory Permits for Banks Pumping Plant, and Related Environmental Documentation

In 1975, the Department of Water Resources applied for additional Department of the Army permits (under Section 10 of the Rivers and Harbors Act of 1899) for operation of the existing pumping plant and for installation and operation of four additional pumps. These permit applications were filed following an order of the U. S. District Court in a suit brought by the Sierra Club, which challenged the application of existing permits for operation of the Banks Pumping Plant.

In September 1980, the U. S. Army Engineer District filed a final environmental statement with the Environmental Protection Agency on operation of the existing Banks (then Delta) Pumping Plant, intake channel, and Clifton Court Forebay. This environmental statement is incorporated by reference, and the executive summary from that statement is reproduced in Appendix A. The statement discussed the beneficial and adverse effects of water development in general (and State Water Project diversions in particular) on fish and wildlife in the Sacramento-San Joaquin estuary. It also

C—105312

C-105312

discussed the fish and wildlife mitigation measures incorporated in Decision 1485 and enlargement of the John E. Skinner Delta Fish Protective Facility* to improve the fish salvage system.

By letter dated March 30, 1981, the National Marine Fisheries Service stated to the U. S. Army Corps of Engineers that it found the final environmental statement on operation of the Banks Pumping Plant to be inadequate in several areas of impact analysis and mitigation measures. In addition, the Marine Fisheries Service requested that various conditions be included in connection with issuance of a Corps of Engineers permit for continued operation of the Banks Pumping Plant. These proposed conditions were:

- The volume of water to be pumped annually be limited to 1980 State Water Project entitlements.
- Pumping be scheduled to minimize impacts on fish.
- The Corps of Engineers retain jurisdiction over operation of the plant until various Bay-Delta fish and wildlife studies are completed.
- The Department of Water Resources install and maintain fish screens on Delta agricultural diversions.
- If losses have not been mitigated after 5 years of monitoring impacts of the foregoing conditions, the Department of Water Resources provide fish hatcheries or other habitat improvement measures to replace losses of fish.
- If a Peripheral Canal or other facilities are built that lessen the impacts of the banks Pumping Plant, conditions may be reassessed and changed accordingly.

The objective of the conditions proposed by the National Marine Fisheries Service is to protect the fish and wildlife of the Bay and Delta, an objective shared by the Department of Water Resources and the Department of Fish and Game. The two departments have proposed protective measures for mitigation of the Banks Pumping Plant. This proposal, in the form of an agreement between the two departments, is discussed in Chapter 5, in the Mitigation Section.

Operation pursuant to the proposed National Marine Fisheries Service conditions would reduce pumping levels to below those allowed under existing conditions. The proposed conditions were not acted on because of the April 28, 1981, U. S. Supreme Court opinion on the suit brought by the Sierra Club. The Supreme Court decision was that the Sierra Club could not bring a suit under the Rivers and Harbors Act. The Court did not determine whether permits were required for the existing plant and for the additional pumps. The case was sent back to the District Court for a decision consistent with the Supreme Court opinion.

On May 19, 1981, the Department of Water Resources asked the Corps of Engineers to suspend proceedings on Permit Application 5820 for the existing plant and to withdraw Permit Application 5820A for the four additional pumps. The Department of Water Resources and the Corps of Engineers then held a series of meetings to determine:

- Whether operation of the four additional pumps would affect the course, location, or condition of

*The Skinner Fish Facility is on the intake channel between Clifton Court Forebay and Banks Pumping Plant. In June 1980, the Department of Water Resources filed a Notice of Determination (under California Environmental Quality Act) for enlarging the fish facility. The enlarged facility is now being tested.

C—105313

C-105313

Delta waters and thus require a Section 10 permit.

° Under what operational constraints a permit would not be required.

As a result of these meetings, agreement was reached on appropriate operational constraints not requiring a permit. These constraints are set forth in Corps of Engineers Public Notice 5820A, Amended (October 13, 1981), included here as Figure 2, which is the basis for preferred operation of the additional pumps.

The Sierra Club subsequently asked the District Court to require a permit for the existing and enlarged pumping plant based on three issues: civil rights violations, compliance with the National Environmental Policy Act and California Environmental Quality Act, and abuse of discretion by the Corps of Engineers under the Federal Administrative Procedures Act. The first two issues were dismissed by the District Court in July 1982.

With respect to the Administrative Procedures Act, the Court agreed with the determination that no additional Corps of Engineers permit is necessary for the existing pumps and has made a decision regarding a permit for operation of the additional pumps. This decision, filed on December 30, 1982, was as follows:

° The Corps of Engineers should retain jurisdiction to evaluate effects on the course, location, condition, and capacity of Delta waters after the four additional pumps are installed.

° The Corps of Engineers will monitor the operations and enable public access to results of such monitoring.

° Evidence of significant effects on the course, location, condition, or capacity of Delta waters from operation of the enlarged plant will be grounds for requiring the State to apply for a Corps permit.

Hydraulic Constraints and Banks Pumping Plant Capacity

Hydraulic constraints can limit monthly maximum exports of the State Water Project. The constraints are related to:

° Volume of Clifton Court Forebay
° Forebay inlet gate size and placement
° Tidal fluctuations at the inlet gate
° Capacity of southern Delta channels
° Flows in the San Joaquin River

Clifton Court Forebay storage enables a high use of off-peak power at the Banks Pumping Plant. Inflows to the forebay are governed by tidal fluctuations, which average 3.7 feet daily. Five radial gates at the southeast corner of the forebay are open during high tides and closed during low tides. Operational procedures for the inlet gates consist of minimizing the drawdown effects of the diversions at all tide levels.

Southern Delta channels were not designed for project operations and, therefore, limit the amount of water that can be pumped from the southern Delta without eroding the channels and levees.

Water levels in southern Delta channels are sensitive to State Water Project and Central Valley Project diversions. The drawdown effects are of concern to local agricultural diverters and have been studied as part of the discussions and negotiations between the South Delta Water Agency, the Bureau of Reclamation, and the Department of Water Resources. Water supply and quality issues in the southern Delta are discussed in Chapter 4.

Banks Pumping Plant and Clifton Court Forebay play a key operational role, because they are at the head of the aqueduct system.

The physical capability of the Banks Pumping Plant would increase from 6,400 to 10,300 cubic feet per second with the

C—105314

C-105314

four additional pumps. However, the maximum monthly export rate probably would be less than 10,300 cubic feet per second because of hydraulic constraints. The Department of Water Resources estimates the maximum average monthly rate to be about 7,300 cubic feet per second because of these constraints. The estimated yield increase from these calculations with the 7,300 cubic foot per second maximum is 57,000 acre-feet per year. This is an increase in yield of less than 3 percent over the existing project capability.

Because of the uncertainty of determining the maximum monthly rate, the impact was analyzed for two or four additional pumps considering the range from 7,300 to 10,300 cubic feet per second of maximum proposed plant capacity. The two additional pumps would have a capacity of 8,500 cubic feet per second, while four additional pumps would have a capacity of 10,300 cubic feet per second. The lower rate produces slightly less yield and, therefore, less benefits. The higher rate in both cases produces 7,000 acre-feet per year increased firm yield, with increased exports during winter when fish abundance and resulting impacts are low. (See Chapter 3 and the response to General Issue 10, in Chapter 7, for more discussion on this subject.)

Other Litigation

The lawsuit, South Delta Water Agency et al. versus United States et al. was filed on July 22, 1982, in the Federal District Court in Sacramento against the Bureau of Reclamation and the Department of Water Resources over the effect of operation of the Central Valley Project and State Water Project on the southern Delta. The suit seeks 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.

The complaint by the South Delta Water Agency alleges that:

- Central Valley Project operations on the San Joaquin River, primarily Friant Dam, unlawfully reduce the quantity and degrade the quality of water flowing in the San Joaquin River to the southern Delta.

- Operation of State Water Project and Central Valley Project pumps violates southern Delta rights by lowering water levels, reversing flows, and diminishing the influence of the tides.

- The Secretary of the Interior's designation of the Stanislaus River basin for allocating water from New Melones Reservoir violates southern Delta rights by not including the southern Delta in the basin.

Direct involvement of the Department of Water Resources in the suit is due to the effect of operation of its pumps on the southern Delta. The other issues involve only the Bureau of Reclamation.

In February 1984, the Department filed its answer. On July 26, 1985, the Ninth Circuit Court of Appeals affirmed the District Court's denial of the United States' Motion to Dismiss on sovereign immunity grounds.

Ecological Studies

The Interagency Ecological Study Program in the Sacramento-San Joaquin Estuary is being conducted by the Department of Fish and Game, the Department of Water Resources, the U. S. Fish and Wildlife Service, the U. S. Bureau of Reclamation, the U. S. Geological Survey, and the State Water Resources Control Board. This program is being conducted under terms of an Interagency Memorandum of Agreement executed on July 13, 1970. The purpose of that agreement is to

C—105315

C-105315

Public Notice

US Army Corps
of Engineers
Sacramento District
650 Capitol Mall
Sacramento, CA 95814

Public Notice No. 5820A Amended

Date: 13 October 1981

In Reply Refer to: SPKCO-O

Comments Due by:

TO WHOM IT MAY CONCERN:

Subject: Suspension of EIS preparation and permit processing for the application (No. 5820A) to operate four additional pumps at the Delta Pumping Plant.

Applicant: State of California, Department of Water Resources (DWR), P.O. Box 388, Sacramento, California 95802.

The California Department of Water Resources (DWR) plans to limit the operation of the expanded pumping plant such that daily diversions into Clifton Court Forebay would not exceed 13,870 acre-feet and three day average diversions would not exceed 13,250 acre-feet. These amounts are based on the historical maximum diversions for the existing Delta Pumping Plant complex.

The existing Delta Pumping Plant, including its maximum operation, is covered by the nationwide permit for work completed before December 1968. Operation of the expanded facility such that future diversions into the forebay do not exceed the historical maximum one-day and three-day diversion rates would have no increased effect on navigable capacity of the Delta waterways. Therefore no additional permit will be required under Section 10 of the River and Harbor Act of 1899 provided that the historical maximum diversion rates are not exceeded.

In addition to the operational limits described above, DWR plans to increase diversions by one-third of the San Joaquin River flow at Vernalis during the period from mid-December to mid-March when the flow exceeds 1000 cubic feet per second. Analysis of this proposed operation, using mathematical models of the Delta, shows that there would be no additional reduction in water levels at Clifton Court Ferry because any increased drawdown would be off-set by higher stages caused by increased San Joaquin River flows. Also, analysis shows that the flow direction in the channels near the forebay will not be substantially affected by this operation.

We have concluded, therefore, that diverting one-third of the flow at Vernalis between mid-December and mid-March when flows exceed 1000 cfs would have no effect on navigable capacity, and no Section 10 permit is required for this operation.

Because the proposed operation does not require a Department of Army permit, no EIS will be prepared and the Corps will not participate in a joint EIS/EIR process with the California DWR. DWR, however, is continuing to prepare an EIR under the California Environmental Quality Act (CEQA). Permit processing and EIS preparation may be resumed if DWR decides to operate the Delta pumping plant differently from the operation described in this notice.

If you have any questions concerning this notice please call Mr. Tom Coe of our Regulatory Section (916) 440-2541, FTS 448-2541.

Paul F. Kavanaugh

PAUL F. KAVANAUGH
Colonel, CE
Commander and District Engineer

FIGURE 2. CORPS OF ENGINEERS' PUBLIC NOTICE NO. 5820A AMENDED

provide for ecological studies necessary for a thorough understanding of the San Francisco Bay-Delta estuary. The objectives of these studies are:

- To improve understanding of the requirements of fish and wildlife in the Bay-Delta system.
- To develop design and operating criteria for the State Water Project and Central Valley Project for protection and enhancement of Bay-Delta fish and wildlife.
- To monitor project operations and to evaluate and modify operating criteria as necessary.

During fiscal year 1984-85 the studies covered fish, fish facilities, water quality, Suisun Marsh, and outflow requirements for San Francisco Bay. Total funding under the program has been about $40,000,000. Of this amount, about $20,000,000 has been funded by the Department of Water Resources.

Fish Studies

These studies provide information on resident and anadromous fish, including striped bass, chinook salmon, and American shad. The information can be used to help determine the impact of the State Water Project and Central Valley Project on fish distribution and abundance. Activities consist of:

- A summer program to estimate the number of young striped bass reaching 1.5 inches. These estimates are used to determine annual variations in year-class strength and survival through the larval stages.
- A program to tag adult striped bass during the spring. The tagging program, with subsequent recapture of tagged fish, is used to develop annual estimates of the number of adult striped bass by sex and age. The population estimates also can be used to estimate the number of eggs released during the spawning runs.
- Studies to determine the relationship between river flow conditions and young salmon and striped bass survival.
- A program of tagging young salmon to determine survival rate in the Delta and the Pacific Ocean.
- A program to evaluate resident fish to assess their abundance, distribution, and migration patterns.

Fish Facilities and Related Studies

These studies are being conducted to provide information to Department of Water Resources engineers for the design and evaluation of fish protective facilities. The Department has recently spent $4.5 million to improve and enlarge the John E. Skinner Fish Facility, plus expenditures to construct fish screens for Roaring River (Suisun Marsh). The Department is also designing screens for the North Bay Aqueduct. With respect to Skinner Fish Facility, the Department is studying:

- Efficiency of new secondary screens.
- Effectiveness of new screen material on holding tanks for reducing losses.
- Effectiveness of a new cleaning system on the secondary screens; in particular, the buildup and removal of peat fibers from the perforated plate.

Related studies involve:

- Improvements in the system for hauling salvaged fish to the Sacramento River for release.
- Predation losses in Clifton Court Forebay and whether predator control would be effective and practical.

C—105317

C-105317

- Other potential losses of striped bass and other fish in the system and assessing the magnitude of these losses in relation to those associated with the State Water Project. Examples of facilities where significant losses may occur include Delta agricultural diversions, Tracy Pumping Plant, Contra Costa Canal, and Pacific Gas and Electric Company intakes.

Water Quality Studies

These studies include water quality monitoring and mathematical modeling to predict the effect of project operation on the Bay-Delta system. Activities consist of:

- Analyzing factors that stimulate or inhibit algal growth in this estuarine environment.
- Working with a private consulting firm on improvement of the multilayered, steady-state model for the Delta and Suisun Bay area that will reproduce stratified flow conditions and will better represent the prototype. The model will be used to investigate conditions that caused extremely low productivity in the estuary during the 1976-1977 drought and to establish flow distribution and salinity relationships.
- Analyzing phytoplankton and zooplankton populations.
- Investigating food chain relationships in the central Delta, especially the post-drought decline in primary productivity and the continuing development of a time-variable phytoplankton model.

Suisun Marsh Study

Activities of the Suisun Marsh Study consist of:

- Coordinating operation and maintenance of the Initial Facilities: Roaring River distribution system, Morrow Island distribution system, and Goodyear Slough outfall.
- Monitoring the fish screens at the Roaring River diversion.
- Cooperating in the interagency studies to determine requirements for maintaining Suisun Marsh as a brackish water marsh. Facilities being considered are: Montezuma Slough control structure, Grizzly Island distribution system, Potrero Hills ditch, Boynton-Cordelia distribution system, Cordelia-Goodyear ditch, and Goodyear Slough control structure.
- Continuing to monitor marsh habitat.
- Providing funds to the Department of Fish and Game for marsh planning.

San Francisco Bay Outflow Study

Activities of the San Francisco Bay Outflow Study consist of:

- Monthly tow net sampling at 35 stations in the bay system to determine marine species distribution and to provide information on the relationship between the shrimp population and Delta outflow.
- Compiling and plotting historical Delta outflow, gaged inflows from other streams tributary to the bay, and inflow from treated waste water.
- Maintaining 2 electrical conductivity recorders in San Francisco Bay to document salinity changes resulting from changes in Delta outflow.
- Analyzing correlations between fresh water inflows and salinity.
- Collecting information on salinity in the bay during periods of high Delta

C—105318

C-105318

outflow to document effects of high flows.

- Working with the U. S. Geological Survey, Sacramento District, as part of a study on hydrodynamic circulation in the San Francisco Bay system downstream of Benicia.

A recent report from this study is Effects of Freshwater Outflow on San Francisco Bay Biological Resources, July 1983. This report is basically a literature review, with some tentative conclusions, discussed in Chapter 6, under Cumulative Impacts.

Related Studies

Studies other than those under the direction of the Interagency Ecological Study Program include:

Cooperative Striped Bass Study. This study, funded by the State Water Resources Control Board, has investigated relationships between toxic materials in Bay and Delta waters and problems with the striped bass population. The study, in cooperation with the National Marine Fisheries Service and the Department of Fish and Game, has found that chronic toxic chemical exposure seriously affects every stage of the striped bass life cycle, from eggs to adults. Findings are discussed in Chapter 5, under General Impacts on Striped Bass.

The study is now finished and the Department of Fish and Game prepares an annual health index for striped bass.

Striped Bass Working Group. This study by a group of scientists, working at the request of the State Water Resources Control Board, was to investigate causes of the striped bass decline and identify corrective action. Findings are discussed in Chapter 5, under General Impacts on Striped Bass. The group's recommendations have resulted in two programs:

- Phytoplankton Work Group to compile and analyze existing data on Delta hydrodynamics and productivity, especially as they relate to phytoplankton.

- Controlled Flow Experiment to determine (1) the effects of State Water Project and Central Valley Project water exports on food chain (phytoplankton and zooplankton) development and abundance during the larval stages of young striped bass in the Bay-Delta estuary and (2) the relative importance of these effects in comparison to other factors affecting the food chain.

Interagency Delta Health Aspects Monitoring Program. This data collection program is designated to evaluate health aspects of Delta water supplies and water quality changes that might result from water transfers through the Delta. Participating agencies have included the Bureau of Reclamation, City of Stockton, East Bay Municipal Utility District, and the water contractors of the State Water Project. The program is designed to identify sources of contaminants to Delta water and determine how they are transported through the system and how this affects the concentration at points of withdrawal.

Biological agents such as viruses, bacteria, and others that can be effectively removed or rendered harmless in the water treatment process are not evaluated. The constituents that are not removed or are extremely difficult to remove using standard processes are being addressed in this study. Some of the constituents of concern to public health that are being monitored are asbestos, sodium, selenium, pesticides, and organic trihalomethane precursors.

Planning Perspective

The proposed action to install the additional pumps is being closely coordinated with the Department's

C—105319

C-105319

statewide water program and with other specific planning programs for the State Water Project and Delta. Chapter 6 discusses these planning programs in the Governor's Water Legislation Package of 1984 and Cumulative Impacts sections.

The Department's statewide planning activities are based on language contained in the Water Code and on recent guidance provided by Governor Deukmejian. Section 12581 of the Water Code states:

> "In studying water development projects, full consideration shall be given to all beneficial uses of the State's water resources including irrigation, generation of electric energy, municipal and industrial consumption of water and power, repulsion of salt water, preservation and development of fish and wildlife resources, and recreational facilities, but not excluding other beneficial uses of water, in order that recommendations may be made as to the feasibility of such projects and for the method of financing feasible projects."

Governor Deukmejian has outlined specific statewide planning direction to guide water programs. In January 1984 the Governor outlined seven key points in his State of the State message to underlie a policy for a water program. The Governor's specific statement was as follows:

> "California has enough water to meet our growing needs and protect our environment, if we use it wisely and if we take the needed actions now. To ensure water for all Californians, we should emphasize the following seven points: first, water conservation and salvage of wasted water are some of the most economical ways to meet our needs; second, the quality of water supplies must be protected; third, we should build additional facilities to store surplus water underground and in offstream reservoirs; fourth, where feasible our water systems should be interconnected to improve their utility during drought; fifth, fish and wildlife must be protected; sixth, the water rights of the areas where water originates must be fully respected; and seventh, technology such as drip irrigation, waste water reclamation and desalination represent important elements in our program."

Under the Burns-Porter Act, the Department has specific planning responsibilities for the State Water Project. These planning activities are being guided by specific management objectives, which are:

- To protect the environment and economy of the Delta.
- To provide dependable water supplies to Delta users and to State Water Project and Central Valley Project users that divert from the Delta.
- To protect the financial integrity of the State Water Project and Central Valley Project.

Planning for and purposes of installation and operation of the additional pumps are consistent with the Department's statewide, project, and Delta planning. The increased reliability for water supply delivery, power cost savings, and standby pumping capacity provided by the pumps will aid the Department in meeting future economically sound and environmentally sensitive water development.

The proposed additional pumping units have a favorable benefit/cost ratio. Mitigation for the additional pumps and the diversion constraints included are consistent with Delta protection planning, an important objective of the Department. Mitigation includes measures for the incremental effects of the pumps and extended measures to mitigate the direct impacts of the existing pumps. In addition to this mitigation, operation under the

C—105320

C-105320

preferred alternative will shift exports toward winter months of low fish abundance and away from summer months of high abundance, with resulting reduction in fish entrainment losses for many species, including striped bass.

Planning activities related to the Delta are complex; therefore the timing of specific long-range planning measures is difficult to predict. The decision on proceeding with the additional pumps recognizes these planning difficulties by considering economic justification and environmental impacts of the pumps independent of future water resources measures. Evaluation of the preferred alternative showed that the pumps, without future Delta planning measures and with limitations imposed by natural factors, the State Water Resources Control Board, the Corps of Engineers, and existing contracts, represent a sound economic and environmental step toward water resource development without reliance on any particular future facility.

Action taken in connection with this environmental document to install and operate the additional pumps according to the Corps constraints should not be interpreted as precluding the Department of Water Resources from future planning to operate the plant at its full capacity as part of its efforts to meet contractual commitments. It is expected that future statewide water resources programs will introduce planning for new agreements, water facilities, levee construction, water management programs, and project operations without the diversion constraints for navigable capacity. Implementation would require additional consideration of the Federal regulatory permit process and the need for added environmental documentation.

Public Participation

In 1975, the Department of Water Resources applied for additional Department of the Army permits for operation of the existing pumping plant and for installation and operation of four additional pumps. On July 7, 1980, the Corps of Engineers, Sacramento District, issued Public Notice 5820A on the application by the Department of Water Resources for a permit to install and operate four additional pumping units. This notice informed interested parties of the preparation of a joint environmental impact statement/report related to construction and operation of the four additional units. The notice invited comments on the scope, alternatives, major issues, and mitigation to be discussed in the report.

In addition, the Sacramento District published in the Federal Register a Notice of Intent to prepare the draft environmental impact statement/report. Concurrently with the Corps of Engineers Public Notice 5820A in July 1980, the Department of Water Resources issued a combined "Notice of Preparation" and "Notice of Solicitation of Views During Predraft Environmental Impact Statement and Environmental Impact Report Consultation Process". The combined notice had two purposes:

- To inform responsible and trustee agencies of the preparation of a draft environmental impact statement/report.
- To solicit other views.

The State and Federal notices were sent together to Federal, State, and local agencies; environmental organizations; and interested individuals. Both notices briefly described the purposes, alternatives, and probable effects of the additional pumps. A scoping meeting held on February 5, 1981, in Sacramento was attended by 30 people. The notice for this meeting had essentially the same distribution as the notices of July 1980, and included a summary of comments already received. Table 1-2 summarizes views expressed and comments received as a result of these notices and the scoping meeting.

C—105321

C-105321

Table 1-2

SUMMARY OF VIEWS AND COMMENTS CONCERNING ADDITIONAL PUMPS AT HARVEY O. BANKS DELTA PUMPING PLANT
(Received through February 1981)

Expressions of Support

Assemblyman Richard Lehman
Metropolitan Water District of Southern California
Kern County Water Agency
California Farm Bureau Federation

Expressions of Opposition

Agency or Entity	Reasons
Association of Bay Area Governments	Opposed to Peripheral Canal and related facilities until outflow standards are established for San Francisco Bay.
South Delta Water Agency San Joaquin Farm Bureau Federation	Opposed to new pumps without full mitigation by the State Water Project for impacts on southern Delta water supply.
Three Local Property Owners Water Ski Club	Erosion, siltation, drawdowns, reverse flows, dirt and trash, water quality.
Various Other Interests	Adverse effects on reservoir storage, recreation, and upstream flows.

Subjects That Should be Addressed in the Environmental Impact Report

Commenting Agency	Area of Concern
National Marine Fisheries Service Central Delta Water Agency	Alternatives (conservation, ground water management, pricing policies, relocation of service areas).
National Marine Fisheries Service U. S. Fish and Wildlife Service U. S. Bureau of Reclamation	Areas of Impact (upstream, Delta, Bay, service areas).
National Marine Fisheries Service	Cumulative Impacts (Senate Bill 200 implementation, Central Valley Project, etc)
Counsel of San Joaquin County	Growth in State Water Project service areas.
Counsel of San Joaquin County	Water Levels in Southern Delta
California Department of Fish and Game U. S. Fish and Wildlife Service National Marine Fisheries Service U. S. Bureau of Reclamation Counsel of San Joaquin County	Fishery Impacts
Central Delta Water Agency	Navigation Impairments
California Department of Fish and Game California Resources Agency North Delta Water Agency	Peripheral Canal (analysis with and without).
Counsel of San Joaquin County U. S. Bureau of Reclamation Central Delta Water Agency	Scour
Central Delta Water Agency U. S. Bureau of Reclamation	Water Hyacinths

C—105322

C-105322

The Draft Environmental Impact Report on the Proposed Additional Pumping Units was distributed on November 30, 1982, with a 45-day comment period ending January 15, 1983. (Action on the Federal environmental statement was suspended in October 1981 when the Corps determined that no Federal permit was required.) In response to several requests, the comment period was extended to February 15. A public hearing was held on February 4 in Sacramento.

Comment letters were received from 30 Federal, State, and local agencies, 8 environmental groups, and 3 individuals. At the February 4 hearing, 11 individuals testified, representing the same or similar groups. In addition, 75 letters from individuals and 81 signed form statements from members of two fishing clubs were received, all protesting the additional pumps. Most of these letters and forms were apparently generated by a request to write the Department, made by outdoor columnist Tom Stienstra in the January 30, 1983, issue of the San Francisco Examiner and Chronicle.

The comment letters, the transcript of the public hearing, the Stienstra article, and a representative protest letter are reproduced in Chapter 7. All comments received have been considered in preparing this final environmental impact report. The report has been expanded or modified, where deemed appropriate, in response to the comments.

C—105323

C-105323

Chapter 2. PROJECT DESCRIPTION

This chapter describes the purposes, physical features, and construction activities in connection with the proposed additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Purposes

The purposes of additional pumping units at the Banks Pumping Plant are to:

- Minimize on-peak power requirements to improve the efficient use of existing power generating facilities and reduce costs for the State Water Project.
- Provide standby pumping capacity to compensate for outages of the existing units.
- Increase reliability of State Water Project supply deliveries.

These three purposes are discussed in the following sections.

In addition, an important advantage of the additional pumps with the existing project storage and facilities would be to allow more efficient operations by shifting some exports away from summer months of high fish abundance to winter months of low abundance.

Power Savings

The increased capacity of the additional pumps would allow shifting power use from periods of high demand to periods of low demand to more effectively use existing generating capacity. This helps the Department meet its long-range energy program, which includes measures to help protect the environment. Specifically, the additional pumps would delay State Water Project needs for additional power generating capacity and any associated power plant construction needed to provide such capacity. This would increase efficiency in electrical load management and reduce project power costs by more use of lower cost off-peak rates and by reducing project costs for capacity.

Figure 3 shows the relationship between on-peak and off-peak energy use for the State Water Project in comparison with all of California. The figure also shows the effects of additional pumping capacity at Banks Pumping Plant.

Outages

Maintenance work on the existing units may be required any time of the year. Scheduling preventive maintenance has become difficult in recent years and will become more so because of the increasing continuous use of all the pumps.

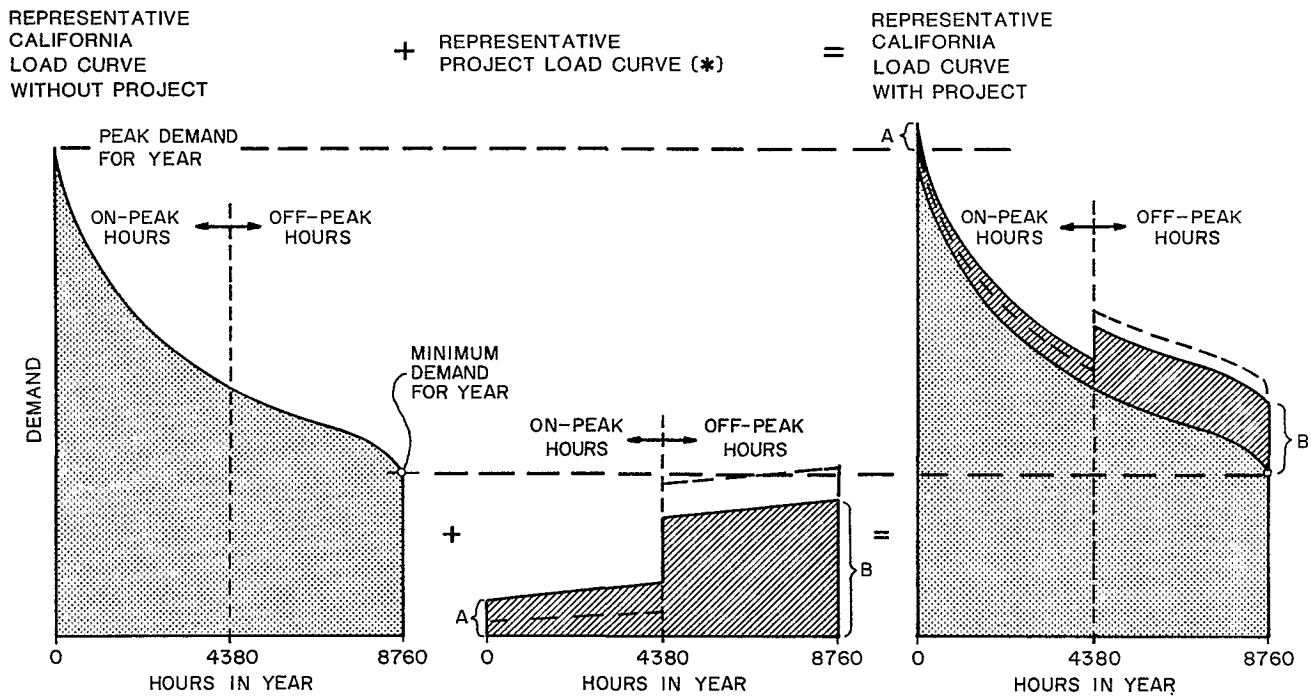
Cavitation of the pump impellers, a major maintenance problem, requires about a 6-week outage per unit to repair. In 1981, the average down time was 28.7 days per unit. From 1975 to 1981, the plant has had an overall annual operating availability of about 85 percent, which means an annual outage of 15 percent. This outage includes scheduled maintenance of about 9 percent and unscheduled (forced) outages of about 6 percent. The unscheduled outages can be critical to project operation.

C—105324

C-105324

FIGURE 3

RELATIONSHIP BETWEEN ON-PEAK/OFF-PEAK ENERGY USE FOR THE STATE WATER PROJECT AND ALL OF CALIFORNIA AND EFFECTS OF ADDITIONAL PUMPING CAPACITY (DASHED LINES)



(*) MAGNITUDE OF PROJECT LOAD OVEREMPHASIZED IN RELATION TO TOTAL CALIFORNIA LOAD FOR PURPOSE OF CLARITY

Forced outages represent unavailable capacity and a potential for lost water supplies if they occur during unregulated flow conditions when the pumping plant would otherwise operate at capacity. Water supplies lost due to forced outages cannot be recovered. The loss of water supplies attributable to one large unit continuously out of service during a critical time of need is about 15,000 acre-feet per week -- enough to meet the annual needs of about 15,000 families. Additional pumping units would provide standby capacity and compensate for this potential loss.

In addition, the State Water Project and Central Valley Project are subject to outages from canal lining failures. The additional pumps would provide flexibility to minimize project yield losses by enabling additional pumping after repair of canal lining.

Increased Reliability of Water Supply Deliveries

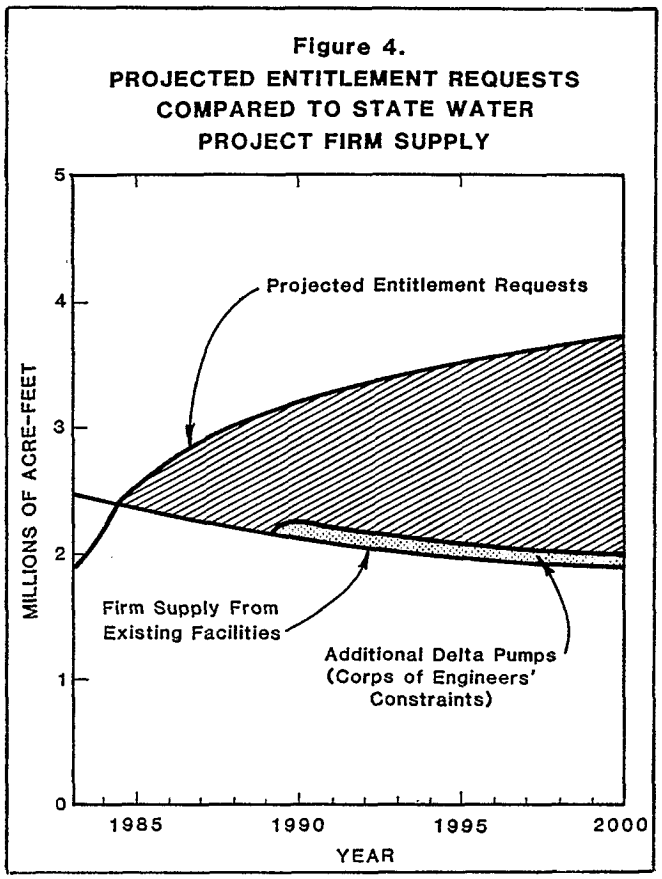
Additional pumping units would provide increased reliability of State Water Project deliveries by improving export operations in two areas:

- Compensation for outages of existing pumps, as previously described; and

- Increased winter diversions of some unregulated flows to provide yield during critical year operations to reduce a portion of the decline of existing project yield due to upstream area of origin use (see Figure 4). Also, the additional pumps would increase average annual exports to increase the percentage of time that project demands can be met in noncritical periods and provide additional supplies for development of locally managed ground water supplies.

C-105325

C-105325



Physical Features

Actions involved in manufacturing and installing additional units and modifications in the southern Delta are discussed below. Modification of Clifton Court Forebay is not required for operations under criteria developed by the Corps of Engineers to ensure that adverse effects on navigable capacity are not increased by the additional pumps. Modification of the forebay would probably be needed, however, to achieve the pumping levels used in alternatives that exceed the Corps of Engineers criteria.

Pumping Units

The additional pumps could each discharge 1,067 cubic feet per second, and each would be driven by a 34,500-horsepower electric motor. The units would be installed in the existing plant building, in space provided during original construction. No new buildings or enlargements would be needed. These pumps would be paired to discharge through existing manifolds into two existing 15-foot-diameter discharge lines and then into the California Aqueduct.

Procurement and installation of the units and auxiliary equipment would involve at least eight contracts to cover the necessary components: pumps, motors, valves, transformers, switchgear assemblies, distribution centers, control boards, and a completion contract. The time from initial advertisement for bids to operational status would be about 5 years.

Construction Activities

Major construction activities involved with installation of the units in the plant consist of:

- Shipping the mechanical and electrical equipment to the site.
- Erecting a temporary concrete batch plant nearby.
- Hauling in cement and aggregate.
- Placing forms, reinforcement, concrete, and equipment in the plant.

Activities and associated impacts during fabrication, shipment, and installation are discussed in Chapter 5 (Impacts of Construction).

Southern Delta Modifications

The Department has studied options for modifying the southern Delta; for this report modifications were assumed to consist of any of the following:

- A second intake at the northeast corner of Clifton Court Forebay.

C—105326

C-105326

- Dredging and other improvements in three southern Delta channels: Victoria Canal, Middle River, and Old River.

The forebay modifications and dredging of southern Delta channels are discussed in Chapter 3 (Alternative Operational Plans 2-8.5 and 4-8.5, and Alternative Operational Plan 4-10.3) and Chapter 5 (Second Clifton Court Forebay Intake). These plans for the southern Delta are not complete water transfer plans, because reverse flows in the lower San Joaquin River would not be eliminated and northern Delta modifications would also be required. These modifications are only for alternative operational plans that go beyond Corps of Engineers Public Notice 5820A, Amended, constrained operating criteria. The high export alternatives are for the purpose of computing the impacts associated with using maximum capacity with the additional pumps and existing facilities.

Delta hydraulic improvements are needed, but they have not been formulated. These improvements would be more comprehensive than those discussed here and would fall into the classification of a Delta water transfer plan. The Department of Water Resources is studying alternative plans for water transfer in both the northern and southern Delta. These alternatives are described in Chapter 6, under Alternatives for Delta Water Transfer.

C—105327

C-105327

Chapter 3. DESCRIPTION AND COMPARISON OF ALTERNATIVES

Two types of alternatives were evaluated:

- Alternative operational plans.
- Water supply and demand reduction alternatives in project service areas.

Table 3-1 is an environmental checklist summary for the preferred, other operational, and water supply and demand reduction alternatives.

Ten alternative operational plans were evaluated for operation of Banks Pumping Plant and Clifton Court Forebay, based on overall operation of the State Water Project and Central Valley Project in compliance with Decision 1485. Environmental effects of these alternatives were evaluated in two categories. Conditions before year 2000 are discussed in detail in Chapter 5, using comprehensive water supply and power studies. Beyond the year 2000, future related projects such as reservoirs or other facilities can affect the operations. The additional pumps can increase exports with future projects. Conditions after are discussed in Chapter 6 considering potential cumulative impacts of related water resources projects.

The no-project alternative represents State Water Project operations with existing Banks Pumping Plant capacity. The preferred alternative is to install four additional units and operate the plant and forebay according to U. S. Army Corps of Engineers constraints established in Public Notice 5820A, Amended*, and Decision 1485 or any other valid water right standards.

Alternatives considered in the draft environmental impact report are also considered in this final, with added alternatives to accommodate updated operation studies and to clarify questions on the draft.

The 10 alternative operational plans are identified by two numbers, the first indicating the additional units and the second indicating the maximum monthly pumping plant export rate, in thousand cubic feet per second. For example, the no-project alternative is designated 0-6.4 because no new units would be installed and the present maximum monthly diversion rate is about 6,400 cubic feet per second. Similarly, the plan designated 4-10.3 represents four new units with a maximum monthly export rate of 10,300 cubic feet per second.

Special designations used for the four alternative operational plans that meet Corps constraints include the word "Corps". These alternatives are explained later in this chapter.

Alternative operational plans with an odd number of additional units were not evaluated because of Banks Pumping Plant design. The plant was designed and constructed for installing additional units in pairs. One or three additional units could be installed, but that would virtually preclude future installation of the unit sealed off.

Several alternatives involving operation of Banks Pumping Plant at export levels below present levels were discussed in the Federal environmental impact statement on the existing pumping plant, published in September 1980. These alternatives, evaluated as limitations

*In this report these constraints are referred to as "Corps constraints".

C—105328

C-105328

on use of the existing pumping plant capacity with no change in operation of upstream reservoirs, were:

- Moderate reduction of pumping (70 percent limit).
- Severe reduction of pumping (30 percent limit).
- Cease pumping.

In general, environmental and financial impacts of these alternatives were increasingly severe south and west of the Delta; environmental impacts in the Delta were increasingly beneficial. Moderate reduction of pumping would have frozen water deliveries at about the 1980 entitlement level.

Operational Considerations

Operational considerations for Banks Pumping Plant and Clifton Court Forebay include:

- Available water supply.
- Decision 1485.
- Coordinated Operation Agreement.
- Power operations.
- Regulatory permits.
- Hydraulic constraints and Banks Pumping Plant capacity.
- Project demands, capability, and efficient operations.

These operational considerations were discussed in Chapter 1, under "State Water Project Operation"; more detailed information on hydraulic constraints, pumping plant capacity, and efficient operations is presented here.

Hydraulic Constraints and Banks Pumping Plant Capacity

The gated control structure for Clifton Court Forebay was designed for a continuous inflow of 12,000 cubic feet per second, but can pass flows up to 16,000 cubic feet per second when a very high tide coincides with minimum water levels in the forebay. Design flow has occasionally been exceeded under conditions of very high flows in the San Joaquin River. During tests in 1974, the peak inflow was about 14,000 cubic feet per second. However, under conditions of low San Joaquin River flows, the combined export capacity of the Central Valley Project and the State Water Project is restricted by southern Delta channel capacity, and is about 11,000 cubic feet per second.

Constantly changing head differential between exterior tides and interior water levels causes a significant diversion constraint when the differences converge during hourly operations. Other operational constraints are imposed by minimizing drawdowns and controlling tidal currents and velocities in nearby channels to prevent erosion. These constraints restrict gate opening periods to appropriate high tide conditions.

With such constraints, it is difficult to define a maximum pumping rate at Banks Pumping Plant that could be sustained on a monthly basis under high flow and tide conditions because of the many and complex hydraulic variables involved. A maximum monthly export rate was estimated for the Corps constraints that could occur from mid-December to mid-March with high San Joaquin River flows and additional pumping units. This estimate was based on calculations of a representative distribution of hourly forebay inflows during a 31-day month (744 hours), as shown below.

Forebay Inflow Rate in Cubic Feet per Second	Hours per Month	Average Hours per Day
Zero (Gates Closed)	124	4.0
0 to 3,000	3	0.1
3,000 to 5,000	22	0.7
5,000 to 7,000	85	2.7
7,000 to 10,000	210	6.8
12,000 (Design Inflow)	300	9.7
Total	744	24.0

C—105329

C-105329

Table 3-1

SUMMARY OF ENVIRONMENTAL IMPACTS

	IMPERIAL VALLEY CONSERVATION EXTRAORDINARY WATER CONSERVATION MEASURES ALTERNATIVES 4-8.5, 4-10.3 ALTERNATIVES 4-6.3*				DESALINIZATION TRANSFER
1. Earth. Will the proposal result in.					
a. Unstable earth conditions or in changes in geologic substructures?	N	N	N	N	N
b. Disruptions, displacements, compaction or overcovering of the soil?	N	N	N	N	M
c. Change in topography or ground surface relief features?	N	N	N	N	N
d. The destruction, covering or modification of any unique geologic or physical features?	N	N	N	N	M
e. Any increase in wind or water erosion of soils, either on or off the site?	N	N	N	N	N
f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake?	N	N	N	N	N
g. Exposure of people or property to geologic hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards?	N	N	N	N	N
2. Air. Will the proposal result in:					
a. Substantial air emissions or deterioration of ambient air quality?	N	N	N	N	N
b. The creation of objectionable odors?	N	N	N	N	N
c. Alteration of air movement, moisture or temperature, or any change in climate, either locally or regionally?	N	N	N	N	N
3. Water. Will the proposal result in					
a. Changes in currents, or the course or direction of water movements, in either marine or fresh waters?	N	Y	N	M	N
b. Changes in absorption rates, drainage patterns or the rate and amount of surface water runoff?	N	N	N	Y	N
c. Alterations to the course or flow of flood waters?	N	N	N	N	N
d. Change in the amount of surface water in any water body?	N	N	N	M	N
e. Discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen or turbidity?	N	N	N	M	M
f. Alteration of the direction or rate of flow of ground waters?	N	N	N	N	N
g. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations?	Y	Y	M	M	M
h. Substantial reduction in the amount of water otherwise available for public water supplies?	N	N	N	N	N
i. Exposure of people or property to water related hazards such as flooding or tidal waves?	N	N	N	N	N
4. Plant Life. Will the proposal result in:					
a. Change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, and aquatic plants)?	N	N	N	N	N
b. Reduction of the numbers of any unique, rare or endangered species of plants?	N	N	N	N	N
c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species?	N	N	N	N	N
d. Reduction in acreage of any agricultural crop?	N	N	N	N	N
5. Animal Life. Will the proposal result in:					
a. Change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms or insects)?	N	N	N	N	N
b. Reduction of the numbers of any unique, rare or endangered species of animals?	M	M	N	N	N
c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals?	N	N	N	N	N
d. Deterioration to existing fish or wildlife habitat?	Y	Y	N	M	M
6. Noise. Will the proposal result in.					
a. Increases in existing noise levels?	N	N	N	N	N
b. Exposure of people to severe noise levels?	N	N	N	N	N
7. Light and Glare. Will the proposal produce new light or glare?	N	N	N	N	N
8. Land Use. Will the proposal result in a substantial alteration of the present or planned land use of an area?	N	N	N	N	N
9. Natural Resources. Will the proposal result in:					
a. Increase in the rate of use of any natural resources?	Y	Y	N	Y	Y
b. Substantial depletion of any nonrenewable natural resource?	N	N	N	N	N
10. Risk of Upset. Will the proposal involve.					
a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?	N	N	N	N	N
b. Possible interference with an emergency response plan or an emergency evacuation plan?	N	N	N	N	N

	IMPERIAL VALLEY CONSERVATION EXTRAORDINARY WATER CONSERVATION MEASURES ALTERNATIVES 4-8.5, 4-10.3 ALTERNATIVES 4-6.3*				DESALINIZATION TRANSFER
11. Population. Will the proposal alter the location, distribution, density, or growth rate of the human population of an area?	Y	Y	Y	Y	Y
12. Housing. Will the proposal affect existing housing, or create a demand for additional housing?	Y	Y	Y	Y	Y
13. Transportation/Circulation. Will the proposal result in:					
a. Generation of substantial additional vehicular movement?	M	M	M	M	M
b. Effects on existing parking facilities, or demand for new parking?	M	M	M	M	M
c. Substantial impact upon existing transportation systems?	N	N	N	N	N
d. Alterations to present patterns of circulation or movement of people and/or goods?	M	M	M	M	M
e. Alterations to waterborne, rail or air traffic?	M	M	M	M	M
f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians?	N	N	N	N	N
14. Public Services. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas					
a. Fire protection?	M	M	M	M	M
b. Police protection?	M	M	M	M	M
c. Schools?	M	M	M	M	M
d. Parks or other recreational facilities?	M	M	M	M	M
e. Maintenance of public facilities, including roads?	M	M	M	M	M
f. Other governmental services?	M	M	M	M	M
15. Energy. Will the proposal result in					
a. Use of substantial amounts of fuel or energy?	Y	Y	N	Y	Y
b. Substantial increase in demand upon existing sources of energy, or require the development of new sources of energy?	Y	Y	N	Y	Y
16. Utilities. Will the proposal result in a need for new systems, or substantial alterations to the following utilities:					
a. Power or natural gas?	M	M	M	M	M
b. Communications systems?	M	M	M	M	M
c. Water?	M	M	M	M	M
d. Sewer or septic tanks?	M	M	M	M	M
e. Storm water drainage?	M	M	M	M	M
f. Solid waste and disposal?	M	M	M	M	M
17. Human Health. Will the proposal result in					
a. Creation of any health hazard or potential health hazard (excluding mental health)?	N	N	N	N	N
b. Exposure of people to potential health hazards?	N	N	N	N	N
18. Aesthetics. Will the proposal result in the obstruction of any scenic vista or view open to the public, or will the proposal result in the creation of an aesthetically offensive site open to public view?	N	N	N	N	M
19. Recreation. Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?	N	N	N	N	N
20. Cultural Resources.					
a. Will the proposal result in the alteration of or the destruction of a prehistoric or historic archeological site?	N	N	N	N	N
b. Will the proposal result in adverse physical or aesthetic effects to a prehistoric or historic building, structure, or object?	N	N	N	N	M
c. Does the proposal have the potential to cause a physical change which would affect unique ethnic cultural values?	N	N	N	N	N
d. Will the proposal restrict existing religious or sacred uses within the potential impact area?	N	N	N	N	N
21. Mandatory Findings of Significance.					
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	M	M	M	M	M
b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time while long-term impacts will endure well into the future.)	M	M	M	M	M
c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of those impacts on the environment is significant.)	M	M	M	M	M
d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	N	N	N	N	N

Y = YES, N = NO, M = MAYBE

* Preferred alternatives for 4-7.3 (Corps) and 4-10.3 (Corps). This rating also applies to 2-7.3 (Corps) and 2-8.5 (Corps).

C—105330

C-105330

The hours for the various forebay inflow rates were projected from hourly operation studies of Clifton Court Forebay. The resulting maximum monthly diversion rate into the forebay was about 7,300 cubic feet per second with the present inlet gates. This evaluation accounted for the hourly changes in hydraulic conditions that affect Clifton Court Forebay inflow rates. The studies for this estimate considered:

- Clifton Court Forebay volume.
- Clifton Court Forebay inlet gate capacity.
- Historical tidal fluctuations.
- Historical San Joaquin River inflows at Clifton Court Forebay.

Because of the complexity of this evaluation, calculations were limited to three years of record, representing a range of hydrologic conditions. The 7,300 cubic foot per second maximum monthly forebay diversion estimate was considered in the alternative operational plans to represent a conservative, or lower limit, analysis for additional pumps operated under Corps constraints. This estimate limited the ability of the additional pumps to increase the reliability of project water supply deliveries and, therefore, limited net benefits attributable to the pumps.

Because of complicated Delta hydraulics, a second method of evaluating maximum exports under Corps constraints was also considered, assuming no southern Delta channel hydraulic constraints. This method for the upper limit analysis and maximum monthly exports was based on pumping plant capacity, aqueduct capacity, and San Joaquin River inflows. Maximum pumping plant export capacity for this upper limit then equaled 8,500 cubic feet per second for two pumps and 10,300 for four pumps. These potential maximum export conditions only apply from mid-December to mid-March because of the Corps constraints. Even with no hydraulic constraints, the Corps constraints limited maximum monthly exports according to the San Joaquin River inflows. Assuming conditions expected during the 1990s, Corps constraints, and no channel or forebay hydraulic limitations, the relationships between maximum monthly Banks Pumping Plant exports, San Joaquin River inflows, and percent occurrence based on 57 years of hydrologic conditions are summarized below for the December 15 to March 15 period.

Export (cfs)	San Joaquin River Inflow (cfs)	Percent Occurrence
7,300	1,800	82
8,500	5,500	10
10,300	11,500	4

With present facilities, San Joaquin River inflows become a limiting factor and the incremental yield attributed to two additional pumps equaled that of four additional pumps with Corps constraints for the upper limit analysis.

Evaluation under Corps constraints showed about 10 percent more yield available with additional pumps operated for the upper limit condition of no southern Delta hydraulic constraint as compared to the 7,300 cubic feet per second lower limit value that reflects the hydraulic constraints. In addition to the yield increase, this upper limit method of operation would further reduce fish impacts by shifting exports away from summer months of high fish abundance toward winter months of low abundance. Both methods of evaluation are included in the alternative operational plans and are discussed in more detail later in this chapter.

Efficient Operation of the State Water Project

With or without additional pumps, efficient operation of the State Water Project would optimize operations to best use unregulated Delta flows that are surplus to Decision 1485 requirements. This would minimize diversions during regulated flow periods, minimize

C—105331

C-105331

carriage water releases from Lake Oroville, and conserve water in storage for release during dry and critical years. Optimal use of unregulated winter and spring flows to increase storage in San Luis Reservoir would enable a reduction of summer exports to conserve upstream storage and reduce fish entrainment during periods of high abundance.

Occurrence of unregulated Delta outflows is generally highest from December through March. Unregulated flows seldom occur from July through September.

Operations under the various operational alternatives for additional pumps were evaluated for yearly, monthly, and daily changes. Two types of operation studies were used to evaluate yearly and monthly studies: (1) water supply studies for conditions during the early 1990s, considering hydrological conditions over a 57-year historical period, and (2) long-range median year studies for power assessments. The first study enabled evaluation of incremental firm yield capabilities for the proposed additional pumps that will increase the reliability of project water supply deliveries. In addition to the power assessments, the second study provided information about conditions beyond the early 1990s for project operational changes during above-normal water supply years. These studies are summarized in Appendix B.

Daily operations were evaluated because operation with additional units may at times involve increased off-peak pumping and diversions on weekends and decreased on-peak pumping and diversions during the week. The period from Saturday night to Monday morning represents about 40 percent of off-peak hours during a week. In addition to the operational studies, an analysis was made to evaluate daily changes. Daily pumping rates at Banks Pumping Plant may be more or less than the corresponding diversion into Clifton Court Forebay because of use of forebay storage. However, this storage is not large, so monthly average diversions will be about the same as monthly average pumping. Details are presented in Chapter 5 (Daily Operational Changes at Clifton Court Forebay).

With or without additional pumps, an important objective of the State Water Project will be to deliver entitlement water and maintain highest possible storage levels at San Luis Reservoir after protective water right standards are met. When San Luis storage is at or above its rule curve*, there is a potential for intermittent export deliveries for locally managed ground water programs. This potential increases with increased diversion capability at Clifton Court Forebay.

Intermittent export deliveries could be stored in ground water basins to enable further increase in dependable yield. Ground water storage programs are being studied, but no decisions to proceed have yet been made. The ground water basins would be managed by local agencies. Local costs of regulating, storing, and recovering intermittent supplies from ground water basins are estimated at up to $102 per acre-foot in Southern California, not including surface storage costs or costs for delivering water from the Delta to the California Aqueduct turnout.

In April 1984, the Department of Water Resources published a final environmental impact report on plans to enlarge the capacity of the East Branch of the California Aqueduct by 600 cubic feet per second from Alamo Powerplant through Devil Canyon Powerplant Afterbay. Certain features of the plan would be designed to accommodate later enlargement to a total capacity of 1,200 cubic feet per second, if needed. First-stage

*The San Luis rule curve sets minimum monthly storage levels to enable scheduled deliveries the following year if it is a critical year.

C—105332

C-105332

enlargement would provide sufficient capacity to convey present State Water Project supplies to meet increasing demands on the eastern side of the Metropolitan Water District service area. The second stage would allow for increased intermittent ground water deliveries.

In April 1985, Metropolitan Water District's board voted in favor of the East Branch enlargement. Metropolitan Water District will prepare an environmental impact report for participation.

With first-stage enlargement, potential for a ground water storage program in Southern California is limited, but analyses in this report assume the full East Branch enlargement and ground water storage, with and without the new pumps. Effects of this assumption are:

- Maximum Delta impacts.
- Maximum ground water yield potential.
- Maximum electrical power costs and costs for ground water operations.

If second-stage enlargement does not occur, impacts would be somewhat less.

Physical and Operational Comparison of Alternative Operational Plans

The 10 alternative operational plans, summarized in Table 3-2, are discussed with existing State Water Project facilities, an enlarged East Branch, and increased ground water storage.

Table 3-2

ALTERNATIVE OPERATIONAL PLANS EVALUATED FOR BANKS PUMPING PLANT

Plan Designation	Additional Units	Maximum Monthly Export (cfs)	Hydraulic Improvements to Southern Delta	Conditions of Maximum Monthly Export	Comments	Estimated Incremental Firm Yield (1000 AF/Yr)	Estimated Incremental Ground Water Firm Yield Increase † (1000 AF/Yr)	Estimated Average Annual On-Peak Power Savings (Pre-2000) Capacity (MW)	Energy (Million kWh)
0-6.4	0	6,400	None	When water supplies available	No-Project Alternative	--	--	--	--
2-6.4	2	6,400	None			--	--	46	146
4-6.4	4	6,400	None			--	--	77	259
2-7.3 (Corps)*	2	7,300	None	When water supplies and San Joaquin River flows available between mid-December and mid-March		57	9	0	140
2-8.5 (Corps)*	2	8,500	None			64	9	Not Evaluated	
4-7.3 (Corps)*	4	7,300	None		Preferred Alternative Lower Limit	57	9	28	220
4-10.3 (Corps)*	4	10,300**	None		Preferred Alternative Upper Limit	64	9	Not Evaluated	
2-8.5	2	8,500	Yes	When water supplies available		178	43	Not Evaluated	
4-8.5	4	8,500	Yes			178	43	Not Evaluated	
4-10.3	4	10,300***	Yes			188	43	Not Evaluated	

† Could be higher depending on occurrence of outages that would be compensated for by the additional pumps.
* Constrained by Public Notice 5820A-Amended, U. S. Army Corps of Engineers. Daily diversions would not exceed 13,870 acre-feet; 3-day average diversions would not exceed 13,250 acre-feet. Increase diversions equal to one-third the San Joaquin River at Vernalis are permitted from mid-December to mid-March when the San Joaquin River flow exceeds 1,000 cubic feet per second.
** In a 57-year operation study, early 1990s, 10,000 cfs achieved in only 4 months, or 0.6 percent of the time.
***In a 57-year operation study, early 1990s, 10,000 cfs achieved in 87 months, or 12.7 percent of the time.

C—105333

C-105333

Alternative Operational Plan 0-6.4

Under Alternative 0-6.4 (no project) there would be no additional pumps installed, no modifications to southern Delta channels, no on-peak power or energy savings, and no increased reliability of State Water Project water supply deliveries. As discussed in Chapter 2, exports could be reduced by forced outages. Daily diversion rates into the forebay would vary and would peak on weekends, with a maximum of about 7,000 cubic feet per second (the historical record). The maximum monthly pumping plant export rate would be constrained to about 6,400 cubic feet per second.

With present upstream development, State Water Project firm yield would continue to decrease from 2.3 million acre-feet to about 2.0 million acre-feet in the year 2000. This would cause a decrease in annual export volumes for drier water supply years. In wetter years, future entitlement buildup schedules would increase annual export volumes. The rate of these buildup schedules is expected to be slowed by planned conservation measures.

San Luis Reservoir would fill in about 20 percent of all years for conditions during the early 1990s. Increased exports during wetter years to meet increasing contractors' requests would include water for development of locally managed ground water supplies south of the Delta. Estimated average annual potential yield capabilities from ground water storage basins would be 182,000 acre-feet per year for conditions during the early 1990s.

Alternative Operational Plan 2-6.4

Alternative 2-6.4 (two new pumps but no increase in maximum monthly diversion rate) would compensate for forced outages, but would not increase the maximum monthly diversion rate into the forebay above the present pumping capacity.

This alternative would have power cost savings compared to the no-project alternative. Estimated annual pre-2000 on-peak power savings would be 46 megawatts capacity and 146 million kilowatt-hours when shifting from on-peak to off-peak pumping rates.

There would be no modifications in the southern Delta. Daily rates of diversion into the forebay would fluctuate more than under the no-project alternative, increasing on weekends (Saturday, Sunday, and Monday) and decreasing during the week. Maximum daily diversion rates from October through April might reach about 8,000 cubic feet per second, depending on water supply conditions, tides, and storage levels in Clifton Court Forebay.

San Luis Reservoir storage, export increases during normal and above normal years to meet increasing contractor requests, and local ground water would be about the same as for the no-project alternative. Protection against forced outage situations would be provided by the increased reliability of project water supply deliveries.

Alternative Operational Plan 4-6.4

Alternative 4-6.4 (four new pumps but no increase in maximum monthly diversion rates into the forebay) would require no modifications in the southern Delta. Compared to the no-project and 2-6.4 alternatives, power cost saving would be higher. Estimated annual pre-2000 on-peak power savings would be 77 megawatts capacity and 259 million kilowatt-hours when shifting from on- peak to off-peak pumping rates. Daily diversion rates would fluctuate more than with Alternative 2-6.4. Maximum daily diversion rates into the forebay from October through April might reach about 9,000 cubic feet per second.

San Luis Reservoir storage and future export during normal and above normal type years, including ground water,

C—105334

C-105334

would be the same as for the no-project alternative. Protection against forced outages would be provided by increased reliability of project water supply deliveries.

Alternative Operational Plans 2-7.3 (Corps), 2-8.5(Corps), 4-7.3(Corps), and 4-10.3(Corps), Including the Preferred Alternative

These four alternatives describe additional pump operation under Corps of Engineers constraints established in Public Notice 5820A, Amended. All of them represent increased pumping from December 15 through March 15 when San Joaquin River inflow is high. None would involve modifications in the southern Delta.

For any of these alternatives, Corps constraints would limit water level depressions and reverse flows resulting from operation with additional units. Except during the 3-month winter period of December 15 through March 15, daily diversions into Clifton Court Forebay would be limited to 13,870 acre-feet, or about 6,990 cubic feet per second; 3-day average diversions would be limited to 13,250 acre-feet, or about 6,680 cubic feet per second. These diversion limits would allow increased off-peak pumping on weekends. During this period it is permissible under Corps constraints to divert into the forebay a monthly flow of 6,680 cubic feet per second. However, the maximum monthly pumping rate at Banks Pumping Plant would be reduced by hydraulic constraints, seepage and evaporation from the forebay, and Byron-Bethany Irrigation District diversions from the forebay. The actual maximum monthly pumping rates at Banks Pumping Plant during unregulated flow conditions would be less than 6,680 cubic feet per second, but might be higher than the present capacity of 6,400 cubic feet per second.

From mid-December through mid-March, daily, weekly, or monthly exports for any of these alternatives could be increased by up to one-third of the flows in the San Joaquin River at Vernalis when such flows exceed 1,000 cubic feet per second. Mathematical model analysis of the proposed operation for these 3 months shows no additional reduction in water levels at Clifton Court Ferry, adjacent to the forebay, because any increased drawdown would be offset by higher stages caused by increased San Joaquin River flows. Also, analysis shows that flow direction in the channels near the forebay would not be affected substantially by this operation.

If there are no southern Delta hydraulic constraints, San Joaquin River flows determine when and to what extent diversions could be increased. It is important to realize that the San Joaquin River is only an indicator to establish export increases and that most of the water for these increased diversions would come from the north (Sacramento River) and not from the east (San Joaquin River). Also, water right standards would have to be met before the diversions could be increased.

These alternatives cover two basic categories of installation and operation under Corps constraints: two added pumps and four added pumps. For each category, two alternative operational plans were selected to investigate a range of impacts to account for uncertainties connected with estimates of southern Delta channel and Clifton Court Forebay hydraulic constraints. The two alternatives for each category define the upper and lower limits of the maximum monthly winter period exports.

The preferred alternative is the range of operations for four additional pumps under Corps constraints. In the text, when the terms "four pumps under Corps constraints" or "preferred alternative" are used, they refer generally to the range of operations and impacts of a monthly export rate between 7,300 and 10,300 cubic feet per second. If

C—105335

C-105335

specific impacts and operations are being discussed for either limit, the corresponding alternative designation is used.

For two additional pumps under the Corps constraints, the range is from a maximum monthly winter period export of 7,300 to 8,500 cubic feet per second. Reference to specific operations or impacts for the upper or lower export limit uses the corresponding designation. If the term "two pumps under Corps constraints" is used, it refers generally to the range; otherwise, specific designation is used.

Alternatives with additional pumping units would provide on-peak power savings. Estimated average annual pre-2000 on-peak power savings for Banks Pumping Plant, relative to the no-project alternative, are shown below.

Alternative 2-7.3(Corps)
Capacity: None
Energy: 140 million kWh (33 percent on-peak reduction)

Alternative 4-7.3(Corps)
Capacity: 28 megawatts
Energy: 220 million kWh (52 percent on-peak reduction)

On-peak power savings were not evaluated for Alternatives 2-8.5(Corps) and 4-10.3(Corps). The trend is that the on-peak energy savings would be of similar magnitudes, but the capacity savings would be somewhat less.

These alternatives would increase the reliability of project water supply deliveries over the no-project alternative in two ways. First, outages would be eliminated, and this could save up to 15,000 acre-feet per week during times of irrecoverable supplies. Second is incremental firm yield capability, which is needed to partially offset future project yield losses due to upstream development. This capability will also help reduce the frequency and severity of future project shortages caused by other factors in the service area, such as loss of Colorado River supplies to the Central Arizona Project and increasing urban water needs above conservation efforts.

The incremental firm yield of the lower limit export alternatives 2-7.3(Corps) and 4-7.3(Corps) would be 57,000 acre-feet compared to the no-project alternative. The upper limit export alternatives, 2-8.5(Corps) and 4-10.3 (Corps), would have an incremental firm yield of 64,000 acre-feet. The 8,500 cubic foot per second monthly average export limit would provide the same incremental yield as does the 10,300 limit, due to the low San Joaquin River inflows during the critical hydrologic base period (1928-1934) used to determine yield. During this period, maximum monthly export achieved in the operation studies representing early 1990-level conditions for these 4-pump alternatives would be about 7,600 cubic feet per second.

The increased firm yield of 57,000 to 64,000 acre-feet per year would be obtained from increased winter exports during 8 months of the critical period supply available between 1928 and 1934. The increased firm yield will remain a constant increment with present facilities, which can add to partially offset the declining base yield of the State Water Project due to upstream area of origin use. Firm yield represents critical year operations; years of higher runoff conditions would have different operations.

The operation study used to evaluate the 4-10.3(Corps) alternative showed monthly average exports of 10,000 cubic feet per second during only 4 months out of the 57 years of hydrology evaluated (0.6 percent of the time). Monthly exports exceeded 8,500 cubic feet per second during 18 months out of the 57 years (2.6 percent of the time).

For all four alternatives, average annual exports at Banks Pumping Plant

C—105336

C-105336

over the 57 years of hydrology evaluated for the early 1990s would increase by about 47,000 acre-feet relative to those for the no-project alternative. This represents about a 1.5 percent increase and will increase in the future, as discussed in Chapter 5 (Monthly Operational Changes).

The increased winter exports and reduced summer exports would slightly modify operations of Lake Oroville, San Luis Reservoir, and the other pumping and power plants of the State Water Project system. Pre-2000 average annual net energy requirements for the State Water Project would not change significantly in high runoff years when demands are met. In drier years, there could be a small increase in deliveries and net energy requirements for the State Water Project. For example, during a repeat of the 1928-1934 critical period, net energy requirements would increase by about 3 percent when compared to the no-project alternative.

With Corps constraints during conditions of the early 1990s, State Water Project storage in San Luis Reservoir would fill about 40 to 60 percent of all years.

The ground water yield potential that could be developed by local interests for any of the operational alternative plans under Corps constraints would be 191,000 acre-feet per year, an increase of 9,000 acre-feet compared to the no-project alternative for conditions of the early 1990s. This supply could be developed by using noncritical year exports.

Average annual carriage water for the preferred alternative would be reduced about 11 to 12 percent, as compared to the no-project alternative.

Alternative Operational Plans 2-8.5 and 4-8.5

These alternatives represent existing project facilities with added pumps and operation not constrained by the Corps criteria.

Achievement of maximum monthly export rates of 8,500 cubic feet per second would require two or four additional pumping units and southern Delta channel modifications. These modifications were assumed to consist of 6 miles of channel dredging and berm removal in Victoria Canal and Middle River, amounting to 2.4 million cubic yards of excavated material, and 0.5 mile of rock riprapping in Old River. A new intake structure would be built on the northeast corner of Clifton Court Forebay. Estimated total cost of these modifications is $33.3 million at 1985 price levels.

The southern Delta channel modification for these options is being assumed for this report, and the report accounts for impacts associated with these plans. Other southern Delta modifications that could provide equivalent improvements were considered in the Department publication, Alternatives for Delta Water Transfer, November 1983.

Diversions could be increased for these two alternatives from October through January or February to the extent of available Delta water supplies and available storage space in San Luis Reservoir. The higher average storage levels at San Luis Reservoir would allow storage of additional water at Lake Oroville by modifying export operations and reducing carriage water requirements. Through this combination of increased diversions of high flows and modified operation of San Luis and Oroville reservoirs, firm yield to improve the reliability of project water supply deliveries could be increased by an estimated 178,000 acre-feet per year compared to the no-project alternative. This represents Delta export increases during critical water supply conditions.

Average annual exports at Banks Pumping Plant over the 57 years of hydrology

C—105337

C-105337

evaluated for the early 1990s increased by about 83,000 acre-feet relative to those for the no-project alternative. This represents about a 2.6 percent increase.

Daily export rates from October through January or February might reach about 10,000 cubic feet per second, mostly on weekends. Daily rates during the rest of the year would also vary greatly, being highest on weekends.

State Water Project storage in San Luis Reservoir would fill more than 60 percent of all years. Ground water yield potential from local interests would increase by 43,000 acre-feet over the no-project alternative. This would be achieved by exports during normal and above normal type years. Losses from outages would be eliminated.

The increased winter exports and reduced summer exports would slightly modify operations of Lake Oroville, San Luis Reservoir, and the other pumping and power plants of the State Water Project system. Pre-2000 average annual net energy requirements would not change significantly in high runoff years when demands are met; however, in drier years, there could be a small increase in deliveries and net energy requirements. For example, during a repeat of the 1928-1934 critical period, net energy requirements would increase by about 9 percent compared to the no-project alternative.

Power assessments were not made for these alternatives. However, the 4-8.5 alternative would have power capacity and peak energy advantages over the 2-8.5 alternative.

Alternative Operational Plan 4-10.3

This operational alternative has the highest level of exports considered in this report and would not be constrained by the Corps criteria.

Achievement of maximum monthly pumping plant export rates of 10,300 cubic feet per second would require four additional pumping units and southern Delta modifications. These modifications would require a greater volume for conveyance capacity than those for plans 2-8.5 and 4-8.5. They were assumed for this report to consist of 6 miles of channel dredging and berm removal in Victoria Canal and Middle River, amounting to 3.2 million cubic yards of excavated material, and 1 mile of rock riprapping in Old River. A new intake structure would be built on the northeast corner of Clifton Court Forebay. Estimated cost of these modifications would be $47.6 million at 1985 price levels.

Monthly exports for this alternative would reach 10,000 cubic feet per second during 87 months out of 57 years investigated in the operation study, or 12.7 percent of the time during the early 1990s. These higher export rates could occur mainly in October and November and in December through March, under unregulated flow conditions.

The increase in average annual exports for the early 1990s is similar to those for Alternatives 2-8.5 and 4-8.5; that is, about a 2.6 percent increase relative to the no-project alternative.

The increased winter exports and reduced summer exports would slightly modify operations of Lake Oroville, San Luis Reservoir, and the other pumping and power plants of the State Water Project system. Pre-2000 average annual net energy requirements would not change significantly in high runoff years when demands are met; however, in drier years there could be a small increase in deliveries and net energy requirements. For example, during a repeat of the 1928-1934 critical period, net energy requirements would increase by about 10 percent compared to the no-project alternative. Modification of monthly export patterns and of San Luis and Oroville reservoir operation would be similar to Alternatives 2-8.5 and 4-8.5.

C—105338

C-105338

Critical period incremental firm yield could be increased by an estimated 188,000 acre-feet per year compared to the no-project alternative to improve the reliability of project supply deliveries.

Under this alternative, daily diversion rates into Clifton Court Forebay would probably substantially exceed 10,000 cubic feet per second, particularly on weekends, from October through January or February.

State Water Project storage in San Luis Reservoir would fill more than 70 percent of all years. Locally developed ground water yield potential would increase by 43,000 acre-feet over that of the no-project alternative through exports during normal and above normal conditions. Losses from outages would be eliminated.

Power assessments were not made for this alternative, which would have the greatest power capacity requirement of the 10 alternatives.

Water Supply and Demand Reduction Alternatives

Five water supply and two demand reduction alternatives in the service area of the Metropolitan Water District of Southern California are considered in this report. These are actions beyond those in the recommended water management plans and are not mandatory for the Urban Water Management Planning Act. Also, these are actions assumed to be achievable during conditions of severe shortages if State Water Project development is delayed.

The water supply and demand reduction alternatives would not directly meet all project purposes identified for the additional pumps. They could, however, substitute for all or part of the yield of the additional pumps. These alternatives would develop yield independent of the additional pumps, in contrast to future water storage facilities that would require the new pumps for development of additional yield. Therefore, these independent water supply and demand reduction alternatives were used in the economic analysis to define the future value of yield that would be provided by the additional pumps.

Metropolitan Water District will ultimately be allocated 68 percent of the State Water Project's urban yield. An analysis was made of the seven water supply and demand reduction alternatives potentially available to balance demand and supply in these areas in lieu of full State Water Project entitlement deliveries. These alternatives are of two types:

- Extraordinary water conservation options for demand reduction (assumed possible during times of shortage).
- Water supply augmentation options.

Extraordinary conservation options are those water demand reduction options that go beyond conservation measures identified in the Department's recommended water management plans. Because of health concerns, however, urban waste water reclamation beyond the level assumed for the water management plans was not considered. Also, industrial conservation measures beyond the level assumed in the water management plans were not considered because of the relatively small amounts and extreme complexity in assessing further potential.

The demands assumed in project operation studies accounted for various water management measures presented in the recommended water management plans. Urban water conservation was one of the measures accounted for in the operation studies, and it was assumed to reduce demands by 250,000 acre-feet per year. Conservation measures identified in the water management plans are assumed implemented with or without the

C—105339

C-105339

pumps and, therefore, are not considered as alternatives. These conservation measures are part of planning to meet water management objectives discussed in Chapter 1 (Water Conservation and Water Management Plans section). The extraordinary conservation measures would be more costly and have potential institutional problems. They are probably implementable only under a water supply shortage.

Implementation of the two extraordinary conservation measures would reduce demands during the early 1990s by an estimated 120,000 acre-feet. This represents about 3 percent of net demands in the Metropolitan service area, 8 percent of Metropolitan's demand from the State Water Project, and 3 percent of the total 1990 State Water Project demand.

Water demand reduction due to the two extraordinary alternatives is assumed to have been started by 1990, the proposed year of initial operation of the additional pumps. This is because before 1990, expected future project shortages exceed the yield of these measures and it is assumed that the least costly alternatives will be implemented first. Therefore, these alternatives are not used in computing the yield benefits of the additional pumps, because they would not be available to compete with the pumps. (This will be explained later in this chapter.)

Appendix C, Table C-5, shows the estimated demand and supply relationship in the Metropolitan Water District service area. Supplies are mainly those shown in Bulletin 160-83, but also include a Department projection of supplies from Imperial Valley. The projection is 100,000 acre-feet in 1990, increasing to 250,000 in 2010. The 1990 projection is consistent with a memorandum of understanding being considered by Metropolitan Water District and Imperial Irrigation District. Use of Imperial Valley supplies in the Metropolitan service area is discussed later in this section. The demands are also those shown in Bulletin 160-83 with its water conservation levels. This relationship was based on the following population projections for the service area.

Year	Population*
1990	15,051,000
2000	16,550,000
2010	17,821,000
2020	18,981,000
2035	19,950,000

*Based on extrapolated Department of Water Resources projections that were based on Department of Finance Second Interim E-150 projections, April 1981.

The seven water supply and demand reduction alternatives are described in the following text, including yield and cost estimates and information on potential environmental impacts and other considerations. Table 3-3 summarizes the seven alternatives. Other water supply augmentation and demand reduction alternatives were investigated, such as desalting sea water and mandating that new housing have ultra-low water using toilets. These other options would be substantially more costly than those described below or duplicate either those measures included in the water management plans or those discussed here.

The five water supply alternatives require substantial energy; therefore, unit costs vary with energy assumptions. The unit costs in the following descriptions are based on purchased capacity and energy. Table C-6 in Appendix C shows a range of unit costs by energy assumption.

Additional Toilet Dam and Showerhead Retrofit

This would be a one-time free device installation program that would supplement distribution methods in the Department's recommended water manage-

C—105340

C-105340

ment plans. The estimated initial cost of such a program is $105 million for the devices, publicity, program management, and installation. Installation and retention rates were based on a 1977 Department of Water Resources demonstration program for the Ventura County community of Oak Park. Water savings for toilet dams and low-flow showerheads were from Department of Water Resources Bulletin 191, A Pilot Water Conservation Program, October 1978. All of the free low-flow devices would be expected to be replaced by 2000 with owner purchased showerheads that would be low-flow due to State manufacturing regulations.

This option would yield an estimated 98,000 acre-feet in 1990, decreasing to 60,000 acre-feet in 2000, and zero by 2010. Estimated unit cost would be $123 per acre-foot.

No significant environmental problems are expected. However, installing the devices could incur some risk of liability in case of improper toilet operation or other reasons.

Combined State Water Project and local energy savings in 1990 would be about 295 million kilowatt-hours in normal years, when deficiencies are not being imposed.

Free Residential Landscape Design

This would be offered to owners of new homes. Cost per design is estimated to average about $78. Through the year 2000, 10,000 designs are expected to be adopted each year. After that, 5,000 designs would be adopted.

Water savings was estimated at 0.2 acre-foot per year per landscape. This would yield an estimated 22,000 acre-feet per year by 1990, increasing to 91,000 acre-feet per year by 2035. These yield estimates are gross savings at the point of use; they do include adjustments for runoff returns to usable ground water basins. Unit cost for the gross savings would be $195 per acre-foot and about 30 percent higher for net savings. No significant environmental problems are expected; however, some institutional problems might be involved, such as funding and design responsibilities and questions about the propriety of public agencies competing with private enterprise.

Combined State Water Project and local energy savings in 1990 would be about 66 million kilowatt-hours per year. These energy savings would occur in normal years, when deficiencies are not being imposed.

San Joaquin Valley Drainage Water Desalting

A program of desalting brackish agricultural drainage water would allow further local reuse of that water as a substitute for water imported from the Delta so that more water would be available to Southern California. Due to quality differences, costs of the desalted supply do not directly compare to imports. Because of leaching requirements, the 500 mg/L total dissolved solids of the desalted water is estimated to be about 94 percent as effective for crop irrigation as the 280 mg/L of State Water Project imports. Estimated yield is 190,000 acre-feet in 1990, increasing to 319,000 in 2010. Estimated unit cost is $434 per acre-foot, including desalting energy, local treatment and distribution energy, and water quality. Other factors such as the cost of drainage systems, California Aqueduct energy costs, and brine disposal could increase these costs.

Institutional problems under this alternative are not as clearly defined as for the Imperial Valley options discussed below, but they could be similar in that problems of ownership might arise. Environmental problems include salt brine disposal and location of desalting plants.

C—105341

C-105341

Table 3-3

SUMMARY OF WATER SUPPLY AND DEMAND REDUCTION ALTERNATIVES FOR THE METROPOLITAN WATER DISTRICT SERVICE AREA FOR ASSUMED CONDITIONS OF SIGNIFICANT SHORTAGES

Alternative	Estimated Unit Costs* (1985 Dollars Acre-Foot)	Estimated Yield (Thousand Acre-Feet) 1990	2020	Significant Problems Institutional	Environmental
Extraordinary Conservation:					
Additional Toilet Dam and Showerhead Retrofit**	123	98	0	Medium	Low
Free Residential Landscape Design	195	22	73	Medium	Low
Water Supply:					
San Joaquin Valley Drainage Water Desalting	434	190	319	High	Medium
Additional Imperial Valley Conservation-Transfer***	465	330	180	Medium	Medium
Riverside County Drainage Water Desalting	532	42	42	Low	Medium
Ground Water Desalting	579	73	73	Low	Medium
Imperial Valley Drainage Water Desalting	674	302	302	High	High

* Unit costs account for yield estimates, cost escalation, capital recovery, operation and maintenance, electrical power, and urban water quality. The electrical power component is for purchased energy and capacity at the same unit rates as used for the economic analysis of the additional pumps.

** A one-time free device installation program that would supplement distribution methods in the Department's recommended water management plans.

***This alternative represents conservation-transfer programs in addition to projected supplies for Imperial Valley. The projected supplies are 100,000 acre-feet in 1990, increasing to 250,000 in 2010. The 1990 projection is consistent with a memorandum of understanding negotiated between Metropolitan Water District and Imperial Irrigation District.

C-105342

C-105342

Additional Imperial Valley Conservation and Transfer

Imperial Irrigation District is the largest single user of water from the Colorado River. Flooding along the Salton Sea due to rising water levels has prompted lawsuits and focused attention on the district's water use practices and the possibilities to salvage water. A program of canal lining, reservoir regulation, irrigation management, seepage recovery systems, and on-farm measures would permit substantial irrigation water savings in Imperial Valley. This conserved water could be available for use in other areas. Studies by the Department of Water Resources and others have estimated that from 285,000 to 438,000 acre-feet of water could be saved each year.

As a result, Metropolitan Water District is negotiating with Imperial Irrigation District to obtain assurances to some of these savings. Any water that Metropolitan Water District can obtain in this way would help to offset reductions in Metropolitan's available Colorado River water supply that will occur as a result of court-approved diversions by the Central Arizona Project. It may, for a period of time, reduce its need for additional supplies from Northern California.

A recent memorandum of understanding under consideration by the two districts specifies that Metropolitan will provide $10 million annually to Imperial's conservation program in return for the assurance that an additional 100,000 acre-feet of California's firm share of Colorado River water will be available to Metropolitan Water District each year for at least 35 years. Part of the payment could be used for salinity control to mitigate for impacts of water conservation. The memorandum of understanding also provides for further studies of water conservation and transfer possibilities.

In the draft report, one supply alternative discussed for Metropolitan Water District was savings from Imperial Valley water conservation, which considered the full potential estimated by Department studies (438,000 acre-feet). However, because of the more recent developments, estimates for Metropolitan's existing supplies were revised for this final report to include 100,000 acre-feet from Imperial Valley in 1990, with the potential of increasing to as much as 250,000 in 2010. Since this 100,000 to 250,000 acre-feet is considered part of Metropolitan Water District's supplies, it would not be available as an alternative water supply to the pumps. However, the remaining potential supplies from Imperial Valley (about 180,000 acre-feet) could be considered as an alternative to State Water Project supply augmentations.

The Department of Water Resources report, Investigation Under California Water Code Section 275 of Use of Water by Imperial Irrigation District (December 1981) identified various measures that could produce Imperial Irrigation District water savings. It is assumed that the least costly of these would be used to obtain the 100,000 to 250,000 acre-feet assumed in this report to be part of Metropolitan Water District's existing supplies. Therefore the 180,000 acre-feet identified as a water supply alternative would have to come from the more costly measures. The estimated unit cost of these more costly measures (lining the All-American Canal and the main canals and laterals) would be $465 per acre-foot. Economic assumptions behind this estimate are in the Department report discussed above. The estimated unit cost includes transportation via the Colorado River Aqueduct, local energy for distribution and treatment, and substantial urban water quality costs. (The $100 per acre-foot provided under the memorandum of understanding does not include such costs.)

C—105343

C-105343

Environmental concerns related to salvage programs are the long-term effects on the Salton Sea and its recreation, fish, and wildlife values. Concerns relate to both the level of the sea and its water quality. Salinities have been gradually increasing, and a water salvage program could accelerate the increase. Such effects are likely to intensify as inflows to the sea are decreased.

Various institutional considerations are also important, but are not considered barriers to assured availability of salvaged water to Metropolitan Water District. These include obtaining the consent of parties to the California Seven Party Agreement of 1931, which was incorporated into the Department of the Interior's Boulder Canyon Project contracts and participation of Department of the Interior in any improvements to the All-American Canal.

Riverside County Drainage Water Desalting

Water provided from this source was assumed to be available directly for urban use. The quality penalty (substitution of 500 mg/L total dissolved solids desalted water for 280 mg/L State Water Project water) was taken into account in estimating the cost.

Estimated yield is 42,000 acre-feet per year by 1990 and thereafter. Estimated unit cost is $532 per acre-foot.

Institutional problems could exist for this alternative, but they may be less than for the other desalting programs. Environmental problems would be similar to those for San Joaquin Valley desalting, but on a smaller scale.

Ground Water Desalting

Locations and quantities of desalted water available from this source are:

County	Annual Yield (Acre-Feet)
San Luis Obispo	1,000
Santa Barbara	10,000
Ventura	10,000
Los Angeles	16,000
Riverside	11,000
Orange	3,000
San Diego	20,000
San Bernardino	2,000
Total	73,000

The cost of ground water pumping and the cost of substituting the poorer quality desalted water were included in the cost of this source of supply, estimated at $579 per acre-foot.

Institutional problems could exist, but they may be less than those for the other desalting programs. Environmental problems would be similar to other desalting programs.

Imperial Valley Drainage Water Desalting

Imperial Irrigation District could use desalted agricultural drainage water in lieu of Colorado River deliveries. As with the Imperial Valley conservation and transfer alternative, Metropolitan Water District would then divert a corresponding amount from the Colorado River Aqueduct. The cost of desalting and transportation through the aqueduct, as well as that of substituting poorer quality Colorado River water for urban use, was taken into account. The small benefit to irrigated agriculture of using the higher quality desalted water (500 mg/L total dissolved solids) rather than Colorado River water (700 mg/L) was not subtracted from the cost of this alternative because of complexities such as leaching requirements.

Estimated yield is 302,000 acre-feet by 1990 and thereafter. Unit cost is estimated at $674 per acre-foot, including

C—105344

C-105344

$15 per acre-foot for energy for local distribution. The unit cost also includes substantial urban water quality costs, but these are less than those associated with the Imperial Valley conservation and transfer program.

Some of the environmental impacts and institutional problems under this option would be similar to those for Imperial Valley conservation. Additional problems involved are the location of desalting plants and salt (brine) disposal.

Economic Analysis

Table 3-4 shows the capital costs, annual equivalent costs and benefits, and overall net benefits for installation of two or four additional pumping units. Capital costs for four units are based on cost projections from Bulletin 132-84 for 1985 to 1990 and include escalation and interest during construction. Similar allowances were made for two additional units. Annual equivalent costs for capital recovery are based on a discount rate of 8-3/8 percent. Minimum costs for operation, maintenance, and replacement are added to obtain total fixed annual costs. Highest overall net benefits for the alternatives shown are for 4-7.3(Corps). However, Alternative 2-7.3(Corps) has a higher benefit/cost ratio.

Table 3-4 shows annual equivalent benefits under two conditions: median water supply and firm yield analysis. Median water supply generally represents above normal water supply conditions. This analysis is based on costs of purchased capacity and energy.

The median year benefits are mainly cost savings for capacity and peak energy from on-peak to off-peak pumping shifts at Banks Pumping Plant, with the plant operational at a maximum monthly export rate of 6,400 cubic feet per second, the present capacity. These cost savings for Banks Pumping Plant are $6,039,000 with two additional units and $10,590,000 with four. They exceed total annual fixed costs of the additional units, which are $2,117,000 and $4,102,000. When operation of Banks Pumping Plant and the aqueduct system was evaluated with a pumping capacity of 7,300 cubic feet per second, the added differential cost savings was $2,413,000 for alternative 4-7.3(Corps) when compared to alternative 2-7.3(Corps). This differential cost savings was mainly for reduced system power capacity requirements with four additional units, compared to two additional units.

The firm yield analysis defines the benefits of increased reliability of deliveries that offset a portion of the future project yield loss to upstream use and reduce the frequency and severity of shortages from additional service area factors of lost supplies and increasing demands. The annual equivalent benefits for firm yield augmentation are $22,131,000 for alternatives 2-7.3(Corps) and 4-7.3 (Corps). Increased costs for delivery, distribution, treatment, and ground water operations were deducted from these benefits to determine net benefits for firm yield augmentation.

The benefit/cost ratios in Table 3-4 are the result of dividing the sum of median year cost savings and net benefits for firm yield by total fixed annual costs. The net benefits are the excess of total annual benefits over total fixed annual costs. The 4-pump alternatives have higher net benefits than do the 2-pump alternatives.

Economic analyses for alternatives 2-8.5 (Corps), 4-10.3(Corps), 2-8.5, 4-8.5, and 4-10.3 are presented in Appendix C. These alternatives also have favorable benefit/cost ratios, and net benefits for the 4-pump alternatives are higher than for the 2-pump alternatives. Alternative 4-10.3 has the highest net benefits of all the operational alternatives.

Appendix C provides details on the economic analysis for all alternatives.

C—105345

C-105345

Table 3-4

ECONOMIC ANALYSIS OF ADDITIONAL PUMPING UNITS, PURCHASED CAPACITY AND ENERGY (1990 Present Worth Values in 1,000 1985 Dollars)

Item	2-6.4	4-6.4	2-7.3 (Corps)	4-7.3 (Corps)
Capital Costs				
Pumping Units	19,051	37,085	19,051	37,085
Escalation and Interest during Construction	4,669	9,090	4,669	9,090
TOTAL	23,720	46,175	23,720	46,175
Annual Equivalent Costs				
Capital Recovery	2,023	3,938	2,023	3,938
OM&R	94	164	94	164
TOTAL Costs	2,117	4,102	2,117	4,102
Annual Equivalent Benefits				
Median Year Analysis				
1. Cost Savings for Capacity and Energy at Banks Pumping Plant for operations with 6,400 cfs maximum monthly export	6,039	10,590	6,039	10,590
2. Added differential cost savings for SWP system, alternative 4-7.3(Corps) compared to alternative 2-7.3(Corps)	--	--	--	2,413
TOTAL Cost Savings	6,039	10,590	6,039	13,003
Firm Yield Analysis				
Water Supply	--	--	22,131	22,131
Less Increased Costs for Delivery, Distribution, Treatment, and Ground Water Operations	--	--	<7,351>	<7,351>
Sub-Total	0	0	14,780	14,780
TOTAL, Median and Firm	6,039	10,590	20,819	27,783
Overall Benefit/Cost Ratio	2.8	2.6	9.8	6.8
Overall Net Benefits	3,922	6,488	18,702	23,681

C—105346

C-105346

A discount rate of 8-3/8 percent was used; assumed post-1985 cost escalation was 4 percent for general inflation, with 6 percent for construction, operation and maintenance, and energy and capacity values.

Summarized below are procedures for the median year and firm yield analyses, effects of standby capacity to protect against outages, and sensitivity analysis.

Median Year Analysis

The long-range median year operation studies of the California Aqueduct system, described in Appendix B, were the basis for the energy and capacity used and cost assessment for the additional pumps alternatives. These operation studies have been updated from those described in the draft report. The updated studies were an integral part of a broad review of economic and environmental aspects of proceeding with two or four additional pumps made for this final report. The updated power studies allowed consideration of new information on power operations as the Department gained experience operating as a utility. The variables evaluated are summarized below:

Variable	Unit Value (1985)	Start Year
Capacity	$90 per kilowatt	1997
Banks Pumping Plant, on-peak/ off-peak energy differential	$0.01 per kWh	1991
System, Net Energy	$0.02 per kWh	1991

Firm Yield Analysis

The firm yield analysis includes: (1) Delta average critical period increased exports to offset a portion of future State Water Project yield decreases, and (2) additional firm yield provided by the assumed ground water in Southern California. This water supply benefit was adjusted to account for delivery, distribution, and treatment costs. For the study, water supply benefits were based on the following categories:

- Municipal and industrial uses in the Metropolitan Water District service areas.
- Municipal and industrial uses in other State Water Project service areas.
- Agricultural uses in the San Joaquin service area.

Municipal and industrial water supply benefits in the Metropolitan service areas were estimated by comparison to yields and unit costs of independent water supply and demand reduction alternatives in those areas, which were described in this chapter. It was assumed that the availability of yield from the additional pumps would reduce or eliminate expenditures for water supply and/or demand reduction alternatives needed to balance supply and demand at any time during this study period. Water shortages will exist between now and the time the additional pumps are operational. Study assumptions are that the alternatives would be sequenced on the basis of their relative cost, with the least costly applied first. As a result, the first two demand reduction alternatives were assumed to have been implemented to meet project shortages prior to operation of the pumps and would not be available to compete with the additional pumps.

This economic analysis assumes the Department's projection of Imperial Valley conservation and transfer in the supply scenario in the Metropolitan service areas: 100,000 acre-feet in 1990, increasing to 250,000 acre-feet in 2010. Only the remaining portion of the

C—105347

C-105347

Department's estimated salvage potential of 438,000 acre-feet, or about 180,000 acre-feet, was used as an alternative for economic analysis of the additional pumps.

Municipal and industrial benefits in the service areas other than Metropolitan Water District were based on unit costs of providing landscape design for new homes before the year 2000. Thereafter, benefits were assumed to be constrained by a vendibility value of $312 per acre-foot.

Agricultural benefits for the incremental firm supplies with the additional pumps were estimated using an economic computer model. The values (in 1985 dollars) rise over time, from $162 per acre-foot in 1990 to $219 in 2035, due to the increased demand for water.

Annual costs for water supply are:

- Additional California Aqueduct energy and capacity, based on the 1985 purchase value of 35 mills per kilowatt-hour.
- Additional local energy and capacity for distribution and treatment, based on the 1985 purchase value. Metropolitan Water District energy recovery is taken into account, reducing the net energy and capacity required.
- Additional local costs for regulating ground water supplies in Southern California.

Fish Mitigation Costs

Total costs for mitigation in the proposed fish agreement (see Chapter 5, Mitigation Option 1) would be for annual costs of the additional and existing pumps and for fish that would be in the estuary if Banks Pumping Plant had not been built. Mitigation costs will increase in the future for Banks Pumping Plant, but will be incrementally less with the additional pumps and existing facilities because of shifting exports toward winter months of lower fish abundance. These future cost savings for the additional pumps were not included in the economic analysis.

Mitigation costs for those fish that would have been in the estuary without the existing pumps might be considered as a cost associated with the additional pumps. Therefore, the economic analysis for the preferred alternative, 4-7.3 (Corps), was computed with costs for prior fish mitigation. Without the costs, net benefits would be $23.7 million; with these costs, net benefits would be about $22.5 million.

Standby Capacity to Protect Against Outages

Annual costs and benefits in Table 3-4 and in Appendix C do not account for potential benefits attributable to the standby capacity of the additional pumps because of the inability to predict unscheduled outages during a period of an unretrievable water supply. This conservative assumption may reduce net benefits for the alternative operational plans with the additional pumps.

Sensitivity Analysis

Benefit/cost analysis was made to evaluate the sensitivity of the results to power cost assumptions, assuming high power plant construction rather than lower purchased capacity and energy. This analysis was made for both median year and firm yield with alternatives 2-6.4, 4-6.4, 2-7.3(Corps), and 4-7.3 (Corps).

The effect of the higher values is to increase the overall net benefits by about 40 to 80 percent for additional pumps. Alternative 4-7.3(Corps) still had the greatest net benefits. Table 3-4 uses lower purchased values.

This sensitivity analysis is described in Appendix C.

Chapter 4. ENVIRONMENTAL SETTING

This chapter describes the areas related to operation of the State Water Project and installation of additional pumps at the Harvey O. Banks Delta Pumping Plant. The areas are:

- Local Vicinity
- Southern Delta
- Delta Region
- Suisun Marsh
- San Francisco Bay Area
- Sacramento Valley
- San Joaquin Valley
- State Water Project service areas in North and South San Francisco Bay, San Joaquin Valley, Southern California, and possibly the Central Coast

The Sacramento-San Joaquin Delta and San Francisco Bay estuary, comprised of the Delta, Suisun Marsh, and the San Francisco bay system, supports major populations of fish and wildlife. An overview of the estuary is presented below, followed by specific discussions of each of the areas listed above.

The Sacramento-San Joaquin Delta is an area of 1,150 square miles where the Sacramento River, San Joaquin River, and smaller streams converge and flow into San Francisco Bay. The Cosumnes, Calaveras, and Mokelumne rivers drain into the Delta from the east. The Delta is the terminal point for most of the runoff from the 60,000-square-mile Central Valley drainage basin, which is roughly 40 percent of the total area of California.

Runoff into San Francisco Bay consists of outflow from the Delta and local tributary streams. Delta outflow results from combined effects of precipitation, upstream regulation and use, and Delta use and export. Local drainage into the bay encompasses some 3,500 square miles and responds primarily to local rainfall.

Delta outflows are fresh water. When Delta outflows meet the higher salinities of the bay and ocean, longitudinal and vertical salinity gradients result from the mixing of fresh water and ocean water. The magnitude and extent of these gradients depend on the magnitude of Delta outflows. As outflows increase, the mixing zone tends to shift seaward, increasing the salinity stratification and compressing the mixing zone.

The area where the opposing forces are equalized, or nullified, is called the "null zone". Adjacent and downstream is the "entrapment zone". These two zones are generally in the upper reaches of the mixing zone. In the entrapment zone, sediments, nutrients, *Neomysis*, phytoplankton, striped bass larvae, and other organisms tend to be more concentrated. Studies have generally shown how the location of the zones and standing crop in Suisun Bay change with Delta outflows. Phytoplankton standing crop (as measured by chlorophyll *a*) is greatest when the entrapment zone is adjacent to the shallows of Suisun Bay, generally corresponding to outflows ranging from 4,000 to 10,000 cubic feet per second.

San Francisco Bay is basically made up of four large connecting bays: San Pablo Bay, the northern and central portions of the bay, and South Bay. Hydraulic conditions in the system are primarily controlled by tides and freshwater inflow. Tides originating in the Pacific Ocean enter San Francisco Bay through the Golden Gate, where the mean diurnal range is 5.7 feet. The volume of water entering and leaving the bay system during a flood and ebb tidal

C—105349

C-105349

cycle averages about 1.1 million acre-feet. About one-fourth of this is a net exchange of bay water for new ocean water. This is equivalent to a constant flow of about 250,000 cubic feet per second.

The major source of fresh water in San Francisco Bay is outflow from the Delta. Delta outflows vary greatly according to month and hydrologic year type. Delta outflow has averaged almost 20 million acre-feet over the last 10 years, ranging from less than 2.5 million acre-feet in 1977 to more than 50 million acre-feet in 1983.

Other inflow sources to San Francisco Bay are: Alameda Creek, Napa River, Petaluma River, Coyote Creek, Guadalupe River, Walnut Creek, San Lorenzo Creek, and Sonoma Creek. These tributaries each have an average annual inflow of less than 200 cubic feet per second. Peak flows can be considerably higher, and they may be more important ecologically.

San Francisco Bay is basically a salt water environment too saline for domestic, agricultural, and industrial uses other than cooling water. Consequently, major water supplies are imported from the Central Valley via aqueduct systems, with lesser supplies being derived from ground water and local runoff.

Many of the uses of the bay depend on quality other than salt content. Waste water, whether of municipal, agricultural, or storm water origin, is a complex mixture of many types of pollutants. In the early 1960s, because of the bacterial public health hazard, many shallow areas of the bay were posted to prevent taking of shellfish and water contact recreation. Due to stricter standards for waste discharges, more recent surveys by the Department of Health Services show an improvement, especially in the area from the San Mateo Bridge to the Mare Island break-water, where bathing standards are now generally being met. Waste discharges harmful to aquatic life are also under better control.

A report by Citizens For a Better Environment, Toxics in the Bay, An Assessment of the Discharge of Toxic Pollutants to San Francisco Bay by Municipal and Industrial Point Sources, dated December 1983, concluded that industrial plants and sewage treatment plants annually discharge waste water containing about 11 million pounds of oil and grease and about 876,000 pounds of other toxic pollutants into the bay.

Toxic pollutants regularly discharged to the bay include heavy metals (cadmium, lead, zinc, chromium, copper, mercury, nickel, and silver), cyanides, arsenic, and organic chemicals (oil, phenols, solvents, pesticides, PCBs, and others). Properties of these substances that make them inherently hazardous in an estuarine environment include persistence and mobility in the environment, the ability to bioaccumulate and build to high concentrations in the food web, and acute and chronic toxicity to estuarine organisms and wildlife and to humans that eat contaminated fish and shellfish taken from the bay.

Bioaccumulation of toxic pollutants has been detected in striped bass, in mussels and other shellfish, and in harbor seals taken from the bay. Scientists at the National Marine Fisheries Service have studied a possible relationship between adverse reproductive effects on the striped bass population, which has declined in recent years, and toxic pollutants present in striped bass tissue.

A report was prepared in 1977 for the Association of Bay Area Governments titled, The Effect of Delta Outflow on the Density Stratification in San Francisco Bay. The study described in the report found that wintertime large-volume, short-duration Delta outflows

C—105350

C-105350

can cause fresh water to flow through the bay system. The study also found that these flows cause salinity stratification in the South Bay, which can persist for several weeks following the initial appearance of fresh water.

Decision 1485 did not establish specific outflow standards for San Francisco Bay, but the State Water Resources Control Board emphasized that consideration must be given to outflow needs of the bay. The Board has developed interim policy guidelines regarding unregulated flows to be used in planning future projects. Furthermore, the Board required that studies to investigate outflow needs of the bay be initiated by October 1979.

Studies for San Francisco Bay have been funded and are in progress to answer the following questions:

- What are the elements (organisms or faunal assemblages) of San Francisco Bay biota that would be affected by significant changes in inflow of fresh water from the Delta?

- How would total outflow reductions in conjunction with State and Federal water project operations change the hydraulics (e.g., velocity distributions, velocity-dependent mixing, and particle transport processes) and salinity gradients in San Pablo and San Francisco bays?

- How would outflow-related changes in hydraulics and salinity affect biological resources in San Pablo and San Francisco bays?

- What flow and salinity standards or other management strategies are recommended to maintain (or restore) biological resources at historical levels?

The San Francisco Bay studies are also discussed in Chapter 1 in the section, Ecological Studies (San Francisco Bay Outflow Study).

Local Vicinity

The local vicinity is defined as the area within and immediately adjacent to the State right of way for Clifton Court Forebay, the intake channel, and the Harvey O. Banks Delta Pumping Plant. The total area within this right of way is about 3,500 acres. This area, shown in Figure 1, page 3, encompasses the southwestern edge of the Delta at Clifton Court and extends southerly toward the foothills of the Coast Range.

The forebay has a surface area of 2,100 acres and is bounded by levees, except for the inlet and the outlet. It provides public opportunities for fishing and waterfowl hunting; estimated annual use is about 6,000 recreation-days. For safety reasons, recreation is prohibited in the intake channel, which is unlined and has rock slope protection.

At the Skinner Fish Facility, the intake channel converges into a rectangular concrete section, which is divided into seven channels by piers. Upon completion of fish facility enlargement (now being tested), all channels will be operable. The fish protective facility consists of primary and secondary louver systems to divert fish into holding tanks, from which they are returned to Delta waters by special tank trucks.

The area adjacent to the Banks Pumping Plant, including Clifton Court Forebay, provides habitat for many fish and wildlife species. Numerous birds and small mammals exist in the upland areas, including rabbits, quail, and doves. Waterfowl use Clifton Court Forebay as a resting area during annual migrations.

The species of fish found in the Delta are also found in the forebay. A significant bank fishery has developed in the forebay, mainly for white catfish. Bluegill, black crappie, and striped bass are caught occasionally.

C—105351

C-105351

The Banks Pumping Plant lifts water 244 feet from the intake channel to the California Aqueduct. Overall plant dimensions are 504 feet long, 98 feet wide, and 109 feet high. The plant has four floors.

The seven existing pumps are all vertical shaft, single-stage, centrifugal units. These units include:

Units 1 and 2 -- 350 cubic foot per second capacity driven by 11,200 horsepower electric motors.

Units 3 through 7 -- 1,067 cubic foot per second capacity driven by 34,500 horsepower motors.

The plant has an indoor bridge crane to service these units and for assembly and maintenance of major equipment. The plant's electrical installation includes a 230-KV switchyard, power transformers, motors, switchgear, and auxiliary systems.

The space reserved for four additional units consists of subfloors, pits, and intake structures at the northwestern end of the plant. The additional units would be similar to Units 3 through 7 and would discharge through existing manifolds and discharge lines.

The Delta Operations and Maintenance Center is adjacent to the Banks Pumping Plant. This complex of 6 one-story buildings is the headquarters of the Delta Field Division. This Division is responsible for the South Bay Aqueduct and the reach of the California Aqueduct north of the joint-use Federal-State facilities near Los Banos. About 100 employees at the center do work in administration, engineering, plant maintenance, civil maintenance, and water operations.

Other lands within the right of way are used for access roads, parking, landscaping, and spoil material from original plant construction.

Byron Road and the adjacent Southern Pacific Railroad offer the main transportation corridor in the area. The tracks and the road bridge the intake channel.

West Canal and Old River, immediately east of the forebay, are used for fishing and recreational boating. Nearby waterski and yacht clubs support these activities. The Delta-Mendota Canal extends westward from Old River to the Federal Tracy Pumping Plant along the south edge of Clifton Court. Along the north and west edges of Clifton Court Forebay, Italian Slough is used for fishing and some waterskiing, in addition to providing an irrigation supply to several local diverters.

Southern Delta

The southern Delta is generally the same as the area within the jurisdiction of South Delta Water Agency. The boundaries of the Agency are set forth in the Formation Act, California Statutes of 1973.

The area is roughly bordered by the city of Stockton on the north, the San Joaquin River on the east, Vernalis on the south, and Clifton Court Forebay on the west. The area contains about 148,000 acres, of which 123,000 acres is used for irrigated agriculture. The remaining area consists of waterways, levees, and lands devoted to residential, industrial, and municipal uses.

The fully developed and highly productive irrigated lands depend on the inchannel water supply for irrigation, for which about 450,000 acre-feet per year is diverted. The 75 miles of channels in the southern Delta also serve as drainage and floodwater canals, as habitat and migratory routes for fish, and as routes for recreational boating. The major waterways to the east are also used for commercial shipping.

C—105352

C-105352

The area involves complex water rights, supply, and quality issues. Portions of the southern Delta area suffer from one or more of the following problems: poor water quality, inadequate water quantity, poor water circulation, and low water levels at certain times and locations. These problems can be attributed, in varying degrees, to one or more of five basic causes:

- Central Valley Project operations.
- State Water Project operations.
- Nonproject water users.
- San Joaquin River degraded inflow.
- Existing channel conditions.

Specific concerns for various southern Delta channels include:

- Reduction in the hydraulic capacity of channels, with consequent reduced water availability at some local diversion points.

- Increase in gradient toward the Delta export pumps, which results in increased downstream advective circulation from the San Joaquin River through the east end of Old River to Clifton Court via Grant Line Canal.

- Availability at the northern boundary of the southern Delta of Sacramento River water that is drawn into portions of some southern Delta channels through tidal mixing.

- Increase in frequency of loss of prime or inability to pump (due to inadequate water depth) by pumps of local diverters.

- Reduction in tidal prism with resultant decrease of tidal flows and of tidal flushing of salts, particularly in shallow, stagnant, or blind channels.

In 1980 three documents were prepared that discuss subjects such as channel depths, water levels, water quality, and mathematical modeling. These reports are:

- South Delta Water Agency and U. S. Bureau of Reclamation, June 1980, Report on the Effects of the Central Valley Project upon the Southern Delta Water Supply, Sacramento-San Joaquin River Delta.

- South Delta Water Agency, June 1980. Proposed Solution of Southern Delta Water Problems.

- U. S. Bureau of Reclamation, September 1980. Alternative Solutions to Southern Delta Water Problems.

One of the most studied concerns in the southern Delta is the effect of the State Water Project and Central Valley Project on water levels. This matter has been investigated in three ways: (1) records of tidal fluctuation during export operations; (2) special pump test and field measurements at maximum diversions; and (3) use of hydrodynamic mathematical computer models. These investigations have evaluated different modes of gate operations at Clifton Court Forebay and resulting effects on water levels during different high tide and low tide stages. Operation of the Central Valley Project is by direct pumping from Delta channels and will uniformly affect water levels during different tide stages. Pump tests show that for both the projects, drawdown is greatest adjacent to diversions and rapidly diminishes with distance.

The first report listed above is the most recent published investigation on the effects of pumping on water levels. This report presented the findings in Table 4-1. Drawdown of high-high tide levels is an important concern because it can affect filling of Tom Paine Slough. Low-low drawdowns are important because they can affect agricultural pumping operations. The values listed in Table 4-1 are used in Chapter 5 (Impacts on Delta Agricultural Uses and Water Levels) to evaluate the potential drawdown of the additional pumps. More favorable water level conditions will probably occur in the future because of

C—105353

C-105353

more favorable methods of operating Clifton Court gates, discussed below.

Table 4-1

EFFECTS ON HIGH-HIGH TIDE OF STATE WATER PROJECT AND CENTRAL VALLEY PROJECT EXPORTS AT CLIFTON COURT FERRY*

Export Pumping	Drawdown (feet) per 1,000 Cubic Feet per Second Diverted	Maximum Drawdown (feet)
State Water Project (Intermittent)**	0.10 to 0.127	1.0 to 1.27
Central Valley Project (Steady)***	0.07 to 0.10	0.32 to 0.46

* Will rapidly diminish with distance.
** Drawdowns occur during high-high tide conditions. Low-low tide SWP effects may be negligible with future modified operations under investigation.
***Drawdowns occur uniformly during all phases of tidal cycle due to continuous pumping.

The Department and South Delta Water Agency are discussing various physical options for alleviating the problems. Along with the discussions, the Department has recently agreed to investigate a modified operation of Clifton Court Forebay. The objectives of the modified operation to protect against adverse water level problems are:

- To avoid State Water Project drawdowns at low-low tides, to protect agricultural pumping units.
- To avoid State Water Project effects on high-high tides to allow proper operation of Tom Paine Slough tide gates.

The modified operation generally involves: (1) opening the Clifton Court Forebay gates soon after high-high tides; (2) closing the gates several hours before low-low tides; and (3) opening the gates before, during, and after low-high tides. Recent hydrodynamic model studies demonstrated that, even with moderately high pumping rates during the irrigation season, the drawdowns during high-high or low-low tide can be eliminated with this modified operation. However, the modified type of operation will have drawdown effects during low-high tide conditions. Other methods of operations that have been used or tested for Clifton Court Forebay operations have resulted in low-low water drawdowns up to one-third of the drawdown amounts shown in Table 4-1 for the State Water Project.

Several alternative physical solutions have been proposed in the past to alleviate the southern Delta problems. These include:

- Control structures, which would induce higher water levels and circulation.
- New distribution channels.
- Improved forebay inlet hydraulics.
- Dredging existing channels.
- Extension of Tom Paine Slough to the San Joaquin River so that water can be pumped from Old River into Tom Paine Slough and then into the San Joaquin River to provide circulation.
- Modification of operating criteria of New Melones Reservoir to provide additional dilution and increased flows to raise water levels.

On September 4, 1985, the Department and South Delta Water Agency signed a letter of intent to establish a program for ameliorating water level and water circulation problems in the southern Delta. The letter is the first step toward a binding agreement between the two agencies.

The most important part of the letter of intent establishes a cooperative planning program, which envisions construction of facilities in some channels, an additional inlet gate to Clifton Court Forebay, and widening and

C—105354

C-105354

deepening some channels. It also provides procedures for working cooperatively to prevent or minimize irrigation pumping draft problems before the new plan can be put into effect.

The final agreement would provide for dismissal of the Department from the lawsuit by South Delta Water Agency against the Bureau of Reclamation and DWR. It would also contain provisions as to how the costs of the facilities and other work will be handled.

Delta Region

The Delta is generally bordered by the cities of Sacramento, Stockton, Tracy, and Pittsburg. The 738,000 acres in the Delta are part of the largest estuary in California (see Figure 5). The former swamplands have been reclaimed into more than 60 islands and tracts, largely devoted to farming (about 550,000 acres), which produce an average gross income of more than $400 million. The Delta is interlaced with about 700 miles of waterways. The islands, many of which lie below sea level, are bordered by levees. The islands are subject to seepage from the surrounding channels, and to inundation if the levees fail.

The Delta islands are sparsely populated; the 1980 population of the Delta was about 150,000. Most of the population is in upland areas on the eastern and western fringes of the Delta. The Stockton area, on the east, and the Antioch-Pittsburg area, on the west, have undergone steady industrialization and urbanization.

Several municipal and industrial water users in the western Delta maintain dual supply systems for fresh water -- offshore diversion and the Contra Costa Canal. Offshore water is used when the quality is adequate for the intended use, and Contra Costa Canal supplies are used when offshore quality is degraded beyond acceptable limits due to low Delta outflows. The Contra Costa Canal is the sole source of municipal water for other Contra Costa Water District customers.

The Delta is basically a freshwater environment, which serves as a migratory route and nursery area for chinook salmon, striped bass, sturgeon, American shad, and steelhead trout. There are numerous resident warmwater fish in the Delta. White catfish are heavily fished by anglers casting from the banks.

The Delta also supports many animals and birds associated with riparian and upland habitats. Pheasants are abundant. The Delta contributes about 20 percent of the pheasant population taken by California hunters each year. The area also serves as a feeding and resting area for millions of ducks, geese, swans, and other migrant waterfowl.

Eight rare or endangered vertebrate species are known to live in the Delta, but none is confined exclusively to that area. Five are birds -- the bald eagle, American peregrine falcon, California black rail, Aleutian Canada goose, and California yellow-billed cuckoo. Two are mammals -- the salt marsh harvest mouse and the San Joaquin kit fox. One is a reptile -- the giant garter snake.

There are three endangered invertebrate species in the Delta -- Lange's metalmark butterfly, Sacramento anthicid beetle, and Delta green ground beetle.

Twelve rare or endangered plant species, most of which are associated with vernal pools or freshwater marshes, can also be found in the Delta.

A complete list of Delta plant and animal species is contained in Sacramento/San Joaquin Delta Wildlife Habitat Protection and Restoration Plan, California Department of Fish and Game and U. S. Fish and Wildlife Service, December 1980.

Delta waterways provide a major recreation area for fishing, boating, waterskiing, hunting, and scenic enjoyment.

C—105355

C-105355

There are 125 marinas and two State parks in the Delta.

Delta agricultural water users divert directly from the many waterways. There are about 1,900 unscreened pumps and siphons to meet this agricultural water use. These pumps and siphons are from 4 to 30 inches in diameter, with flow rates of 4 to about 200 cubic feet per second. Total diversions vary between 2,500 and 5,000 cubic feet per second during April through August, with maximum rates in July.

The Sacramento-San Joaquin Delta is one of the most intensively studied water resource areas in the United States. Federal, State, and local agencies have conducted, jointly or separately, a wide range of studies in the Delta; subjects include flood control, water supply, navigation, recreation, water quality, fish and wildlife, and habitat evaluation and preservation.

The 60 or so islands in the heart of the Delta were reclaimed over many years by individual owners or reclamation districts, and levees are maintained to widely varying standards. Since 1980, levees on 12 of the islands have failed. Factors contributing to these levee failures include: instability of the levee section and foundation materials, subsidence, rodent burrows, erosion from wind waves and boat wakes, inadequate height (freeboard), and seepage. Current programs have proved inadequate to solve the problems.

Recent studies on repairing the Delta levees have been released by the U. S. Army Corps of Engineers, the Department of Water Resources, and a Citizens' Emergency Delta Task Force established by the Assembly Committee on Water, Parks, and Wildlife. Funding for Delta levee rehabilitation requires legislative, congressional, and local action.

Levee failures in the Delta have affected, and will continue to affect, operation of the State Water Project and Central Valley Project. Effects can be short-term or long-term, depending on timing of failure, size and location of islands flooded, and whether or not a flooded island is reclaimed.

If a large Delta island floods during an extended low-flow period, salty water from Suisun Bay can be drawn into the Delta. This would have an adverse effect on diversions for the State Water Project, the Central Valley Project, and Delta uses. Extra reservoir releases would be required to flush out the salts. If the levee were repaired and the flooded island pumped out, effects on project operation would be short-term.

If a flooded island is not reclaimed, long-term water problems could affect the State Water Project and Central Valley Project. Evaporation from a flooded island may exceed the consumptive use of agriculture, and the water projects might then have to make up the difference. In wet or normal years there would be little loss of project yield, but in a dry year exports could be decreased.

In addition, permanent flooding of certain western Delta islands -- Sherman, Jersey, Bradford, Twitchell, Hotchkiss, Webb, and Holland -- could increase salinity intrusion and cost the projects additional water to maintain water quality.

Levee improvements would benefit many interests, including the water projects, Delta agriculture, cities and industry, gas fields, highways, railroads, pipelines, and wildlife habitat.

Hydraulics of the Delta are discussed in Chapter 5.

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C-105356

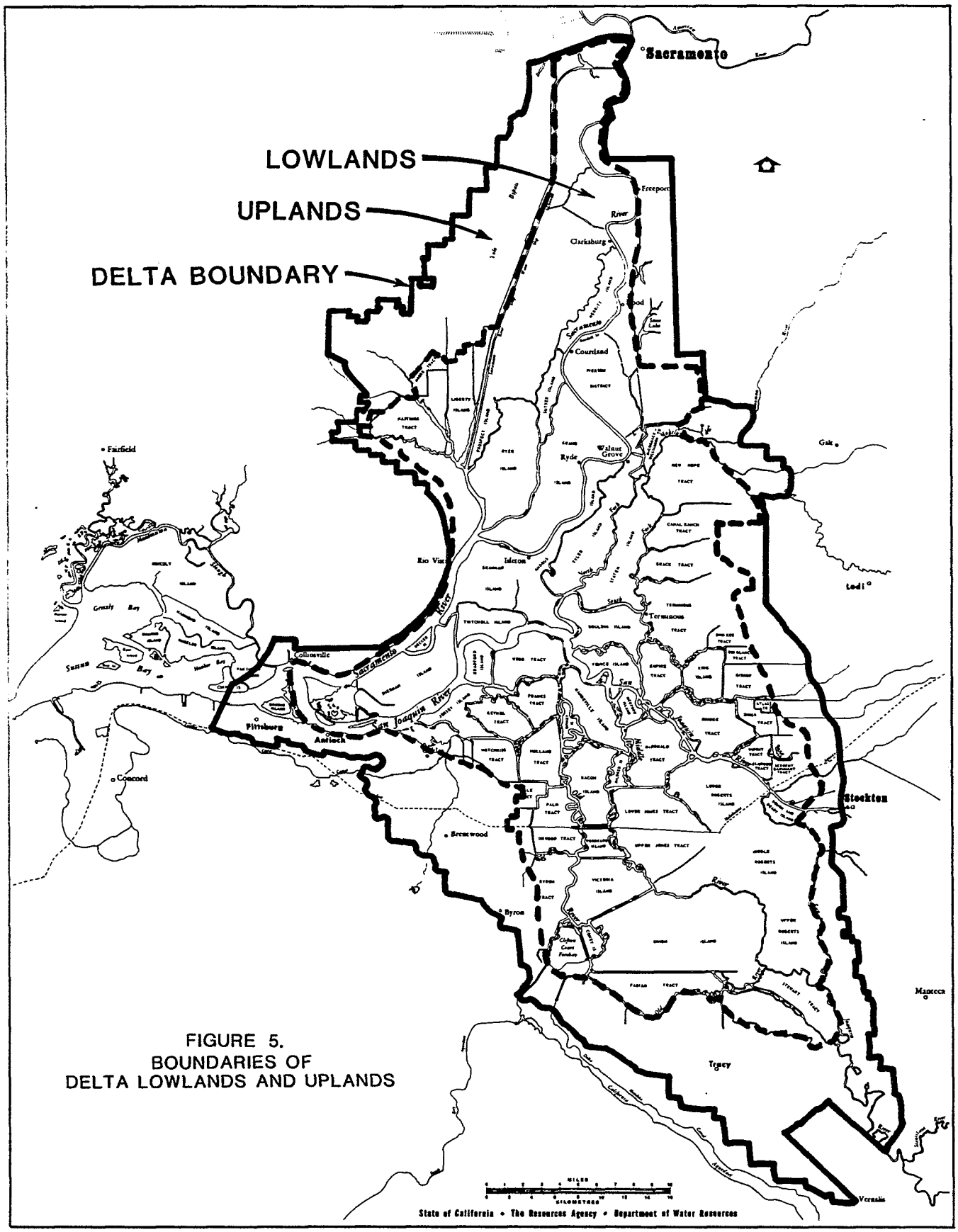

FIGURE 5.
BOUNDARIES OF
DELTA LOWLANDS AND UPLANDS

Suisun Marsh

The Suisun Marsh, an important wildlife area, is at the northern edge of Suisun Bay, just west of the confluence of the Sacramento and San Joaquin rivers and south of the city of Fairfield (see Figure 5). The primary managed area contains 58,600 acres of total marsh, managed wetlands, and adjacent grasslands, plus 29,500 acres of bays and waterways. An additional 27,900 acres of varying land type acts as a buffer zone.

The marsh includes more than 10 percent of the remaining wetland in California. Waterfowl are its major wildlife. Millions of ducks, geese, swans, and other migrant waterfowl use the marsh as a feeding and resting area. As much as 25 percent of California's wintering waterfowl inhabit the marsh in dry winters. The marsh also supports 50 species of animals, 35 species of reptiles and amphibians, and 200 species of birds.

Fish in marsh channels are mainly anadromous species -- chinook salmon, striped bass, sturgeon, American shad, and steelhead trout. The marsh is also an important nursery area for most of these fish. Catfish also support a major sport fishery.

Most of the managed wetlands are enclosed within levee systems, and about 73 percent are privately owned by more than 150 duck clubs. The California Department of Fish and Game owns and manages 12,600 acres. Another 1,400 acres on the channel islands is owned by the Federal Government.

Waterfowl are attracted to the marsh by the water and the abundance of natural food plants, most valuable of which are alkali bulrush, fat hen, and brass buttons. Growth of such plants depends on proper soil salinity, which is affected by salinity of applied water. Suisun Marsh is above average in food production compared to other marshes.

From October through May, outflows of fresh water from the Delta into Suisun Bay and Marsh channels have been reduced by water development. This has led to increasing marsh salinities and has reduced waterfowl food production.

Facilities, agreements, standards, and planning are important aspects of marsh protection efforts. The Department constructed the initial facilities required by Decision 1485 to provide water from Montezuma Slough to certain wetland areas that formerly used water from Honker, Suisun, and Grizzly bays. These initial facilities cost about $12 million and include the Roaring River Slough Unit, the Morrow Island Distribution Facility, and the Goodyear Slough Outfall.

In December 1978, the Department of Water Resources, the Department of Fish and Game, and the Suisun Resources Conservation District signed a contract that spelled out responsibilities of the parties for water quality delivered by the initial facilities and for construction, operation, and maintenance of the facilities. Subsequently, the Department of Water Resources and the Bureau of Reclamation entered into an agreement for the Bureau to reimburse the Department $2.5 million for the cost of those facilities. The contract was authorized by Public Law 96-495.

Decision 1485 ordered the State Water Project and the Central Valley Project to mitigate their impacts on the marsh by meeting specific standards for the Sacramento River at Collinsville and seven other stations in the marsh. The standards apply in all year types and became effective in October 1984. The Department has advised the State Water Resources Control Board that all the facilities would not be completed by October 1984.

A plan of protection and environmental impact report for the Suisun Marsh facilities was released in February 1984. This report showed detailed

C—105358

C-105358

studies to the year 2000 with the additional pumps and a corresponding plan of protection for the marsh as mitigation for the effects of the Central Valley Project and the State Water Project. This plan outlined $100 million in potential activities, specifying five projects for phased construction in addition to the initial facilities. These are:

- Montezuma Slough Control Structure
- Boynton-Cordelia Ditch
- Cordelia-Goodyear Ditch
- Grizzly Island Unit
- Potrero Ditch

Negotiations were successfully concluded on a Suisun Marsh Preservation Agreement in August 1985. This agreement assures that a dependable water supply will be maintained in the marsh to grow duck food and preserve other habitat. This is necessary to mitigate for adverse effects that upstream water projects have on the marsh environment. Parties to the agreement are the U. S. Bureau of Reclamation, Department of Water Resources, Department of Fish and Game, and Suisun Resource Conservation District.

The preservation agreement defines water quality standards that will be maintained for the marsh. It provides for relaxation of these standards in a series of dry or critical years so that the State and Federal water projects can still operate successfully in those years. At the same time, to protect and supply the marsh with water of adequate quality, the agreement calls for staged construction of the extensive marsh water control facilities discussed above and sets a construction schedule ranging from 1988 to 2000. It is possible that some of the planned facilities will not be needed.

The agreement calls for extensive water quality monitoring. After construction of initial facilities, test periods are provided to determine if and when the additional facilities are needed.

The marsh water quality standards are similar to those of State Water Resources Control Board Decision 1485. Therefore, the parties have agreed to jointly petition the Board to substitute the agreement quality standards for those of Decision 1485.

San Francisco Bay Area

The San Francisco Bay area includes San Pablo, Suisun, Grizzly, and Honker bays. It extends about 85 miles from the east end of Chipps Island westward and southward to the mouth of Coyote Creek, near the city of San Jose. The Golden Gate connects San Francisco Bay with the Pacific Ocean. Figure 6 is a map of the area. The hydraulics of the northern, central, and southern portions of San Francisco Bay are discussed earlier in this chapter.

San Francisco Bay covers about 435 square miles at mean tide, about a 21 percent reduction from its original size. This reduction is due to fill and marshland reclamation. Most of the shoreline has a flat slope, which causes the intertidal zone to be relatively large. The volume of water in the bay changes by about 21 percent from mean higher-high tide to mean lower-low tide. The depth of the bay averages only 20 feet overall, with the central bay (from the Bay Bridge to Point Richmond) averaging 43 feet and the south bay averaging 15 feet.

The bay area is highly urbanized, with an economy based on commerce and industry. Water requirements are met from local surface water and ground water supplies and importations via Hetch Hetchy, Mokelumne River, and South Bay aqueducts and the Contra Costa and Putah South canals. Ground water is an important source of supplies in localities such as the Santa Clara and Livermore valleys and the bay plain area of Alameda County.

C—105359

C-105359

Nine counties surround the San Francisco bays: Marin, San Francisco, San Mateo, Santa Clara, Alameda, Contra Costa, Solano, Napa, and Sonoma. Population in the bay area counties, about 5.2 million in 1980, continues to increase.

The bays and surrounding lands support a wide variety of fish, migratory birds, and mammals. The anadromous species of fish include chinook salmon, striped bass, sturgeon, American shad, and steelhead trout. Marine fish, found mainly in the lower bays, include flatfish, sharks, and surf perch. Shellfish in the San Francisco bays include mussels, oysters, clams, crabs, and shrimp. Human consumption of bay shellfish is limited in some areas by health standards. Seasonal variations in salinity in the bays, due to varying Delta outflows, affect the seasonal distribution of fish and invertebrates.

Water-oriented recreation includes sight-seeing, picnicking, boating, nature walking, and camping. Swimming and water-skiing take place where water quality permits. Stricter standards for waste discharge have reduced pollution problems in recent years. This reduction should continue. (See discussion in this chapter on pollution in San Francisco Bay.)

Sacramento Valley

The environment in the estuary is directly affected by industrial and agricultural growth in Sacramento Valley and the accompanying depletion of quantity and quality of water flowing into the Delta. Anadromous fish that migrate through the Delta use Sacramento Valley streams for spawning.

Sacramento Valley encompasses the drainage areas of California's largest river, the Sacramento. Valley lands comprise the westerly drainage of the Sierra Nevada and the Cascade Range, the easterly drainage of the Coast Ranges, and the valley floor (34 percent of the basin). The overall valley includes the McCloud and Pit River basins, the portion of Goose Lake basin within California, and the American River and Putah Creek drainage. Other major river basins are those of the Feather, Yuba, and Bear rivers (which flow from the Sierra Nevada) and Cottonwood, Stony, and Cache creeks (which drain the Coast Ranges).

Within Sacramento Valley are eight terrestrial habitat types: coniferous forests, hardwood forests, chaparral and mountain brush, pinion and juniper, grass and forbs, desert shrubs, cultivated and pasture lands, and barren ground.

Interspersed with the terrestrial habitats are four aquatic habitat types: the Delta, riparian, marshland, and open water.

These habitats support hundreds of species of mammals, amphibians, reptiles, birds, and plants, including rare and endangered species.

For more information on plant and animal life in Sacramento Valley, see the Water Quality Control Plan Report for Basins 5A and 5B, State Water Resources Control Board (1975).

Ground water is pumped from 21 principal basins, most of which underlie the valley floor. The safe ground water yield is about 1.6 million acre-feet per year and the annual overdraft is about 140,000 acre-feet.

Population in 1980 for 15 counties in the region was about 1.6 million, of which about half was in Sacramento County. Urban areas are Sacramento, Redding, Chico, Davis, Placerville, Woodland, Roseville, Yuba City, Auburn, Marysville, Oroville, Willows, Red Bluff, Quincy, and Alturas.

Agriculture (primarily irrigated) is the major economic activity in Sacramento Valley and the surrounding foothills.

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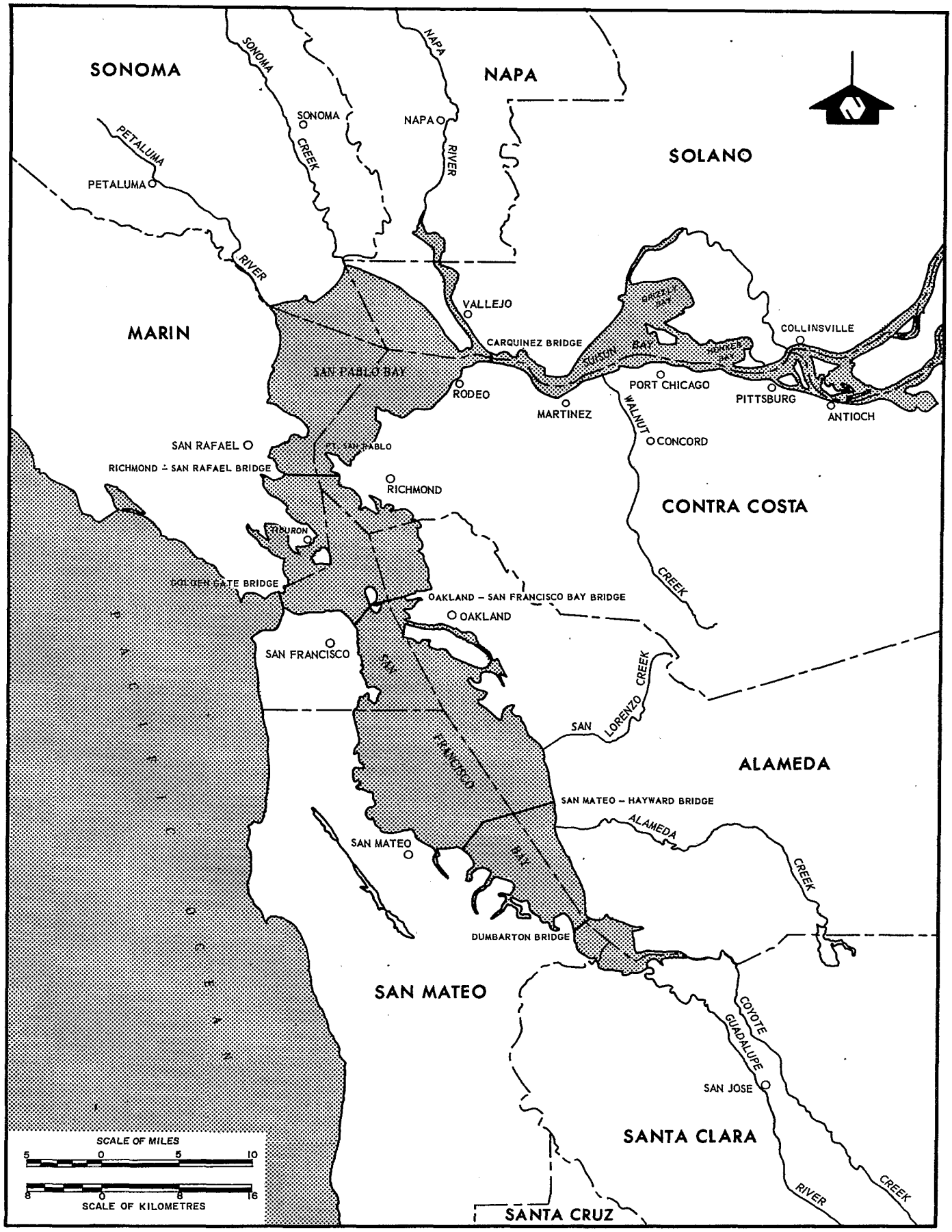

FIGURE 6. SAN FRANCISCO BAY COMPLEX.

Industrial activity is closely allied with agriculture and, more recently, with national defense. Population growth has given rise to many service industries. Lumbering and timber industrial installations are centered in the Sierra Nevada, Cascade Range, Modoc Plateau, and a portion of the Coast Ranges. Plants that process logging and milling residues to form timber byproducts are located throughout the valley. Other industries are engaged in extraction or mining and production of natural gas, clay, limestone, sand, gravel, and other minerals.

At elevations above 5,000 feet, a large proportion of winter precipitation occurs as snow, which accumulates through the spring, then gradually melts to maintain streamflow into summer. Floods in the basin normally result from prolonged general rainstorms during the winter, but snowmelt and intense local rainstorms also cause flooding.

Existing flood control measures consist of more than 2.2 million acre-feet of flood control storage, a highly developed system of flood control levees, channels, and bypasses, and various nonstructural measures.

Water resources in the valley have been extensively developed for a wide range of purposes. Water is also imported into the valley from the Truckee and Cosumnes rivers and from the Trinity River Division of the Central Valley Project. The first two importations are small, but the third is substantial.

San Joaquin Valley

Development in the San Joaquin Valley has affected the Delta environment. Therefore the general environmental setting and a discussion of San Joaquin Valley drainage studies are presented.

General Setting

The San Joaquin River basin portion of the valley drains to the Delta and the bay via the San Joaquin River. Principal tributaries of the San Joaquin River include the Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno rivers, all originating in the Sierra Nevada. Also draining into the Delta are the Cosumnes, Mokelumne, and Calaveras rivers, which also originate in the Sierra and become part of the San Joaquin River in the Delta before it joins the Sacramento River.

These Sierra streams provide the northern part of the San Joaquin Valley with its largest surface supplies, which are of high quality. Most of this water is regulated by reservoirs and used on the east side of the valley, but some is diverted to the East Bay area via the Mokelumne Aqueduct and to the San Francisco area via the Hetch Hetchy Aqueduct. The streams entering from the west run only intermittently, are often highly mineralized, and contribute little to water supplies.

Types of habitat in San Joaquin Valley are similar to those of Sacramento Valley. More information on plant and animal life in San Joaquin Valley is contained in the Water Quality Control Plan Report for Basins 5B, 5C, and 5D, State Water Resources Control Board.

The San Joaquin River basin is subjected to two types of floods: those due to prolonged rainstorms during the late fall and winter and those due to snowpack melting in the Sierra during the spring and early summer, particularly during years of heavy snowfall. Major problem areas lie along valleys, foothill streams, and the San Joaquin River, where floodflows often exceed channel capacities and damage urban and highly developed agricultural areas.

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The San Joaquin River basin is one of the most important agricultural areas of the United States and the world. Its long growing season, mild climate, good soils, and available water provide conditions suitable for a wide variety of crops. Major crops grown include cotton, grapes, tomatoes, hay, sugar beets, and various orchard and vegetable crops.

Agriculture and closely related industries provide the economic base that supports a large and growing population. U. S. Census figures for 1980 show a population of 810,920 for San Joaquin, Stanislaus, Merced, and Madera counties.

Water is the most critical and limiting agricultural resource in the San Joaquin River basin. Although a great amount of water is available, deriving mainly in the watershed of the Sierra Nevada, it is not enough to meet demand. This is evidenced by the annual overdraft of ground water. Imported water, generally ranging from 200 to 500 mg/L total dissolved solids, is used mainly on the west side. Water used on the east side is generally of better quality than that used on the west side and in the valley trough areas. In most parts of the basin, irrigation water is reused at least once, and water quality worsens progressively with each reuse.

The Tulare Lake basin, essentially a closed basin, makes up the southern part of the San Joaquin Valley. This important area of the San Joaquin service area of the State Water Project is discussed later in this chapter.

Agricultural Drainage and Salt Management Studies

For many years, the Bureau of Reclamation, the Department of Water Resources, and the State Water Resources Control Board have studied the problems of agricultural drainage and salt management in the San Joaquin Valley. The objective was to develop a management plan for collection, reuse, and disposal. Many alternatives for drainage disposal were considered. In 1979, the San Joaquin Valley Interagency Drainage Program published a recommended plan, which included extension of the Federal San Luis Drain northward from Kesterson Reservoir and National Wildlife Refuge to a discharge point in Suisun Bay near Chipps Island. Discharge requirements were to be established by the State Water Resources Control Board. The plan included a possible southward extension of the drain into the Tulare Lake basin and the State Water Project service area.

The Bureau of Reclamation proceeded with studies of the northward extension, and the Department continued studies for interim solutions for reusing agricultural waste water, such as desalting, developing marshes, and irrigating salt-tolerant crops. The Department also worked with local agencies on repayment contracts that would be necessary for a joint Federal/State San Luis Drain to provide drainage service for the entire valley. The Department is not actively pursuing construction of drainage disposal facilities, because local agencies in the State service area did not desire to contract for repayment.

Since 1983, the focus of drainage investigations has shifted from studies of the northward extension to a solution for toxicity problems at Kesterson Reservoir. These problems have raised national concern about present and planned methods of drainage disposal. A constituent of particular concern is selenium, which enters the San Luis Drain Canal and Kesterson Reservoir. Selenium is the most likely cause of dead and deformed waterfowl. The area of heaviest concentration of selenium is the Panoche Fan in the Federal San Luis service area. Present plans for a short-term solution call for stopping drainage into Kesterson by July 1986 and diverting the drain water to another

C—105363

C-105363

site, where salt-resistent crops might be grown. Studies are underway for long-term solutions within the valley. Discharges to the Bay-Delta estuary or to the Pacific Ocean are not probable.

Highly productive farmland throughout the west side of San Joaquin Valley is adversely affected by inadequate drainage. The acreage affected -- some 300,000 acres -- is likely to double within the next few decades. An environmentally and economically sound water and drainage management program must be developed to protect the agricultural, economic, and environmental resources of the region. Current practices in drainage disposal have resulted in adverse effects on valley fish and wildlife resources.

In August 1984, Governor George Deukmejian and then-Secretary of the Interior William Clark appointed a State-Federal Intergovernmental Coordination Team to ensure the program for identifying and evaluating alternatives for correcting the drainage problem would be fully coordinated and proceed expeditiously. The San Joaquin Valley Drainage Program was established under supervision of the Intergovernmental Coordination Team, with scientific oversight by the National Academy of Sciences. Objectives of the drainage program are to:

- Protect public health;
- Protect, restore, and enhance fish and wildlife resources;
- Ensure the long-term productivity of agricultural lands; and
- Protect and improve surface and ground water resources.

The study area encompasses the complete watershed of the San Joaquin River, including the Tulare Lake basin. At present, the focus is on western San Joaquin Valley, with particular emphasis on source areas of agricultural drainage. These areas include parts of the Federal San Luis Unit and Delta-Mendota Canal service areas and the agricultural lands farther south that are served by the State Water Project or local developments. Other areas pertinent to the study include possible sites for drainage transport, disposal, or reuse.

Each cooperating agency in the drainage program has a particular expertise and is generally responsible for completion of studies related to that expertise.

The Bureau of Reclamation is mainly concerned with studies related to drainage water management, treatment, reuse, and disposal; socioeconomic and financial analyses; and design of facilities.

Studies planned and underway by the Fish and Wildlife Service address: the geographic extent and severity of agricultural drainage-created contamination of fish and wildlife resources; fish and wildlife toxicity; food-chain bioaccumulation of toxic constituents; restoration of damaged habitats; and identification of opportunities for fish and wildlife habitat enhancement.

The Geological Survey's study program addresses the sources, distribution, transport, and fate of selenium and other trace elements in the water and soils. Specific study topics include: ground water flow patterns; trace element mobilization; and agricultural drainage effects on surface waters.

The Departments of Fish and Game and Water Resources provide assistance and direct technical staff support in the cooperative studies. The Department of Fish and Game provides assistance under the "Selenium in California" program, funded by the State Water Resources Control Board. Fish and Game activities include: collection of fish, bird, and invertebrate samples to complement Fish and Wildlife Service sampling programs; sampling of selenium "hot spots" outside the study area, such as the Salton Sea; and expanded monitoring under the "Toxic Substance Monitoring" and "Mussel Watch" programs.

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C-105364

The Department of Water Resources role includes: expanded water quality monitoring; assistance in drainage system inventory work; and applied research in desalting techniques for treatment of drainage water.

Several other Federal and State agencies participate in the drainage program as members of an Interagency Technical Coordinating Committee, which provides technical guidance for the drainage program and has established subcommittees covering valley biology, estuarine and ocean biology, geochemistry, drain water treatment and disposal, and data management. The agencies serving on the ITCC in an advisory role include: U. S. Agricultural Research Service, U. S. Environmental Protection Agency, California Department of Health Services, State Water Resources Control Board, Central Valley Regional Water Quality Control Board, and University of California.

The Department is working closely with the Central Valley Regional Water Quality Control Board and the San Joaquin Valley Westside Water District in compiling data on present agricultural drainage systems. To provide insight into current water use and disposal operations, the Regional Board has sent inquiries to 80 local districts, asking them to provide information on water supply sources, surface drainage facilities, collector and onfarm subsurface drainage systems, location and frequencies of operational spills, discharge points, and flow monitoring stations. This information will be valuable in developing overall water management programs and operating strategies to protect agricultural production, the wetlands regions, and ultimately ground water quantity and quality in the San Joaquin River. The Department will assist the Regional Board and the local water districts in compiling and processing this information and in planning future drainage management measures.

Desalting agricultural drainage water (through reverse osmosis or other processes) has the potential to assist in solving both the immediate and long-term drainage problems in San Joaquin Valley. Research at the Department's Los Banos Test Desalting Facilities will investigate new techniques. Specific technology for removing selenium has yet to be developed.

State Water Project Service Areas

The 30 water supply contractors of the State Water Project are organized into six service areas: Feather River, North Bay, South Bay, San Joaquin Valley, Central Coastal, and Southern California. These service areas (except for Feather River) are shown in Figure 7.

The Feather River service area has area of origin priorities for State Water Project supplies and would not be affected by the additional pumps. The other service areas are described in this section. Table 4-2 lists rare and endangered fish and wildlife in these service areas.

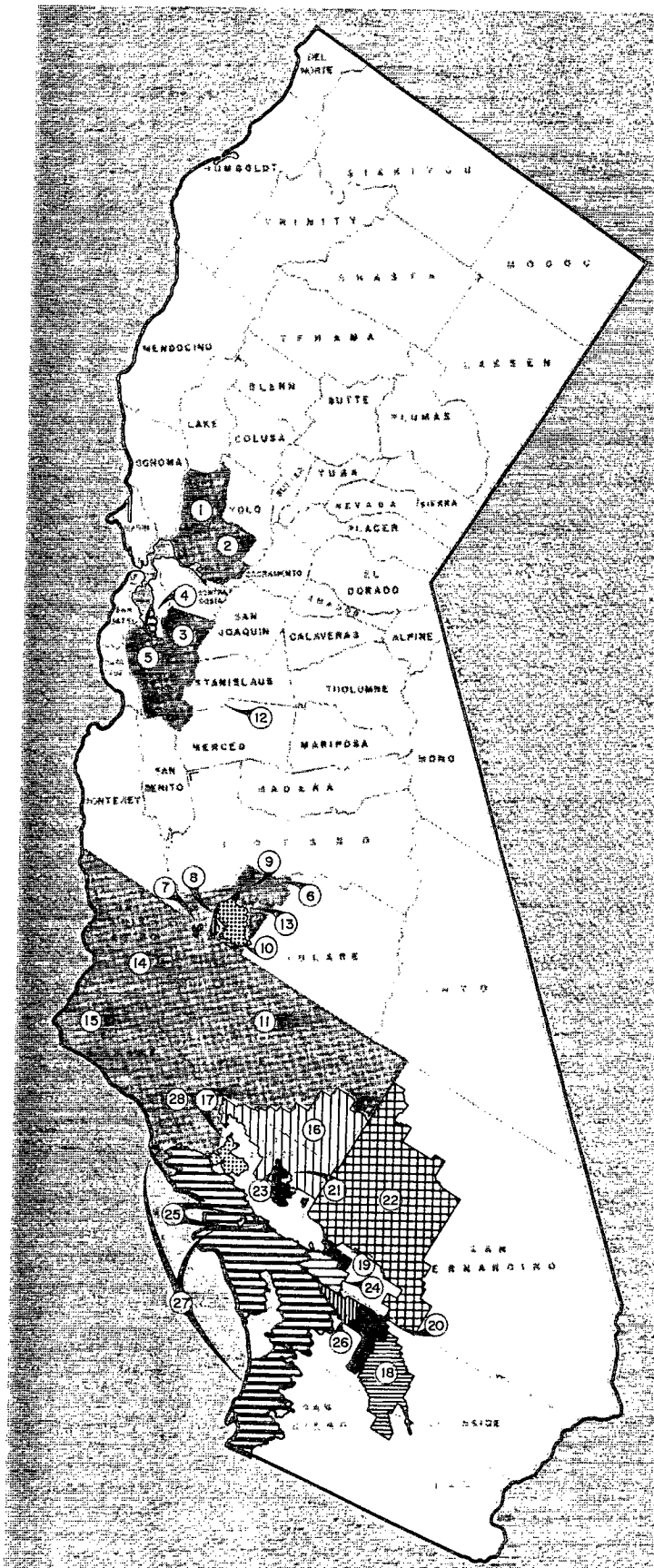
North Bay Service Area

Full service to the North Bay service area (Solano and Napa counties) would require construction of Phase II of the North Bay Aqueduct. An environmental impact statement/report distributed for that project describes the environment of that area in considerable detail.

The North Bay service area coincides with Napa and Solano counties, which lie between the San Francisco Bay area and the Sacramento Valley. Napa County and northeastern Solano County are characterized by mountainous terrain and narrow valleys. The south and southeastern portions of Solano County

C—105365

C-105365



Location No.	Contracting Agency	Maximum Annual Entitlement (acre-feet)
	NORTH BAY AREA	
1	Napa County Flood Control and Water Conservation District	25,000
2	Solano County Flood Control and Water Conservation District	42,000
	Subtotal	67,000
	SOUTH BAY AREA	
3	Alameda County Flood Control and Water Conservation Dist., Zone 7	46,000
4	Alameda County Water District	42,000
5	Santa Clara Valley Water District	100,000
	Subtotal	188,000
	SAN JOAQUIN VALLEY AREA	
6	County of Kings	4,000
7	Devil's Den Water District	12,700
8	Dudley Ridge Water District	57,700
9	Empire-West Side Irrigation District	3,000
10	Hacienda Water District*	8,500
11	Kern County Water Agency	1,153,400
12	Oak Flat Water District	5,700
13	Tulare Lake Basin Water Storage District	110,000
	Subtotal	1,355,000
	CENTRAL COASTAL AREA	
14	San Luis Obispo County Flood Control and Water Conservation District	25,000
15	Santa Barbara County Flood Control and Water Conservation District	45,486
	Subtotal	70,486
	SOUTHERN CALIFORNIA AREA	
16	Antelope Valley-East Kern Water Agency	138,400
17	Castaic Lake Water Agency	41,500
18	Coachella Valley Water District	23,100
19	Crestline-Lake Arrowhead Water Agency	5,[illegible]00
20	Desert Water Agency	38,[illegible]00
21	Littlerock Creek Irrigation District	2,300
22	Mojave Water Agency	50,800
23	Palmdale Water District	17,300
24	San Bernardino Valley Municipal Water District	102,600
25	San Gabriel Valley Municipal Water District	28,800
26	San Gorgonio Pass Water Agency	17,300
27	The Metropolitan Water District of Southern California	[illegible]011,500
28	Ventura County Flood Control District	20,000
	Subtotal	2,497,500
	TOTAL	4,177,986

NOTE: 1 ACRE-FOOT = 1233.5 CUBIC METRES

* Consolidated with Tulare Lake Basin Water Storage District Feb. 11, 1981

FIGURE 7. SWP DELTA EXPORT SERVICE AREAS.

C—105366

C-105366

Table 4-2

RARE AND ENDANGERED FISH AND WILDLIFE IN STATE WATER PROJECT SERVICE AREAS*

Common Name	Scientific Name	Location	Status**
MAMMALS:			
Mojave Ground Squirrel	Spermophilus mohavensis	Southern California	SR
Stephen's Kangaroo Rat	Dipodomys stephensi	Southern California	SR
Salt Marsh Harvest Mouse	Reithrodontomys raviventris	North and South Bay	SE, FE
San Joaquin Kit Fox	Vulpes macrotis mutica	San Joaquin Valley	SR, FE
San Joaquin Antelope Squirrel	Amnospermophilus nelsoni	San Joaquin Valley	SR
Giant Kangaroo Rat	Dipodomys ingens	San Joaquin Valley	SE
Morro Bay Kangaroo Rat	Dipodomys heermanni morroensis	San Luis Obispo County	SE, FE
BIRDS:			
California Brown Pelican	Pelecanus occidentalis californicus	Southern California	SE, FE
California Condor	Gymnogyps californianus	Southern California, San Joaquin Valley	SE, FE
Southern Bald Eagle	Haliaeetus leucocephalus leucocephalus	Statewide	SE, FE
American Peregrine Falcon	Falco peregrinus anatum	Statewide	SE, FE
California Black Rail	Laterallus jamaicensis coturniculus	Statewide	SR
California Clapper Rail	Rallus longirostris obsoletus	North and South Bay	SE, FE
Light-Footed Clapper Rail	Rallus longirostris levipes	Southern California	SE, FE
California Least Tern	Sterna albifrons browni	Southern California	SE, FE
California Yellow-Billed Cuckoo	Coccyzus americanus occidentalis	Statewide	SR
Belding's Savannah Sparrow	Passerculus sandwichensis beldingi	Southern California	SE
Least Bell's Vireo	Vireo bellii pusillus	Southern California	SE
REPTILES:			
Blunt-Nosed Leopard Lizard	Gambelia silus	San Joaquin Valley	SE, FE
Southern Rubber Boa	Charina bottae umbratica	Southern California	SR
Alameda Striped Racer	Masticophis lateralis euryxanthus	South Bay	SR
Coachella Fringe-Toed Lizard	Uma inornata	Southern California	SE, FT
AMPHIBIANS:			
Tehachapi Slender Salamander	Batrachoseps stebbinsi	Kern County	SR
Desert Slender Salamander	Batrachoseps aridus	Southern California	SE, FE
Kern Canyon Slender Salamander	Batrachoseps simatus	Kern County	SR
FISH:			
Unarmored Threespine Stickleback	Gasterosteus aculeatus williamsoni	Southern California	SE, FE

* California Department of Fish and Game, At the Crossroads -- 1980, 1981.

**SR = State Rare, SE = State Endangered, FT = Federal Threatened, FE = Federal Endangered.

C—105367

C-105367

consist of gently rolling hills, which grade into the flat landscape of the Central Valley.

Principal native plant communities include hardwood forest, chaparral, blue oak and digger pine forest, grassland, riparian habitat, and marshlands. The prairie grasslands are now mostly cultivated, but dense and varied riparian vegetation still exists along most rivers and streams. The marshes are mostly in the south-central portion of Solano County and the southern portion of Napa County. In addition to the principal plant communities, unique flora occur in vernal pools in the Jepson Prairie area of Solano County.

Game fish abound in the Sacramento River and in the salt and brackish water marshes on the borders of the two counties. Migrating waterfowl use the marshes as stopovers and winter habitat. Native fauna include several of the rare and endangered species listed in Table 4-2.

Napa and Solano counties have the mild Mediterranean climate characteristic of Central California. A warm, dry season typically extends from May through October; November through April are usually cool and wet. Summer daytime temperatures are frequently high, especially in Solano County; nights are generally cool. Annual precipitation varies from 17 inches in eastern Solano County to 40 inches at the higher elevations in eastern Napa County.

Strong regional winds, predominantly from the west and southwest, continually bring ocean air to both Napa and Solano counties, except during periods of high temperature in the fall and spring. Summer winds are strongest.

Napa and Solano counties make up the total service area and encompass 1,093,000 acres. About 64,000 acres were in urban use in 1980. Table 4-3 shows land use in 1980 for the two North Bay counties.

An estimated 95,000 people live in Napa County, mostly in the Napa Valley communities. Many are retired or work outside the county, commuting to as far away as San Francisco and Sacramento. In November 1980, Napa County voters approved a measure that would institute a growth management policy geared to a 1 percent annual growth rate. However, residential development controls were recently rescinded in the city of Napa, where about half the county population is concentrated.

The population of Solano County, about 233,000, is distributed among seven cities and scattered rural areas. The State Department of Finance has projected that Solano County population will grow 23.2 percent between 1980 and 1985, the third largest percentage gain for California counties with 1980 populations of 100,000 or more.

Pollutants carried by west winds from the bay area and hydrocarbons generated locally by traffic on Interstate 80 and other highways frequently degrade air quality to levels in excess of Federal standards for carbon monoxide and oxidants. In addition, suspended particulates (dust and agricultural burnings) often exceed Federal standards in the portion of Solano County in the Sacramento Valley Air Basin.

Napa County is famed for its production of wine grapes and for the manufacture of premium wines and brandies. There is also a substantial livestock and dairy industry. Solano County agriculture

Table 4-3

1980 LAND USE, NORTH BAY SERVICE AREA
(in Thousand Acres)

County	Agri-cultural	Urban	Water Surface	Other	Total
Napa	22.9	21.4	24.9	440.8	510.0
Solano	189.3	42.4	52.0	229.3	583.0
Total	212.2	63.8	76.9	670.1	1,093.0

C—105368

C-105368

centers on field crops, with substantial values of fruit and nut crops and a significant livestock industry. Heavy water-using industries include two meat packing companies and a cannery in Dixon, a refinery in Benicia, a brewery in Fairfield, and two food processors in Vacaville. Two major defense facilities are located in the region: Mare Island Naval Shipyard and Travis Air Force Base.

Developed water supply sources in Napa County include Lake Berryessa, principal storage facility of the Federal Solano Project, plus several small reservoirs and a number of springs and wells. Most of the developed supplies are for urban use.

Water supply for Solano County includes surface water from Lake Berryessa, Lake Solano, and several small reservoir and stream projects, plus ground water, agricultural return flows, and reclaimed waste water. In addition, Sacramento River water is imported to Vallejo via the Cache Slough Conduit.

North Bay Aqueduct water delivered to Napa County would be used in the city of Napa. Deliveries to Solano County would supply municipal and industrial uses in five cities: Benicia, Fairfield, Suisun, Vacaville, and Vallejo.

A major constraint to the use of ground water, particularly for municipal and industrial needs, is the variable and uncertain quality in both counties. In Napa County, ground water quality is generally poor north of St. Helena and south of Napa. Because most of any additional demand for water in Napa County would be for municipal and industrial use, where both quality and quantity are crucial, ground water supplies are expected to continue to be used as a supplemental local source, mainly for agriculture. In any case, usable ground water storage capacity is restricted to the area between Napa and St. Helena, and the safe yield is currently overdrafted.

Solano County contains two major ground water basins, Putah Plain and Suisun-Fairfield Valley, and several smaller basins. Most ground water supplies are used for irrigation, although Vacaville, Rio Vista, and Dixon rely on ground water for domestic supply.

Ground water salinity levels in the Suisun and Fairfield areas typically range from 300 to 6,000 mg/L total dissolved solids, with average values generally exceeding 900 mg/L. Putah Plain ground water quality is somewhat better, with average levels of total dissolved solids generally under 600 mg/L. However, the supply is far from municipal and industrial water demand centers.

South Bay Service Area

The South Bay service area is within the San Francisco Bay area, previously described, and includes Santa Clara County and a portion of Alameda County. Only Santa Clara County has significant surface water supplies, used primarily for ground water recharge. The county has opened some of the recharge areas to recreational use. In Alameda County, the natural runoff from Alameda Creek, supplemented by supplies from the South Bay Aqueduct, is used for ground water recharge.

In this service area, ground water basins have been intensively developed for domestic, industrial, and irrigation purposes and have been overdrawn, with resultant sea water intrusion, and land subsidence problems. Extensive recharge programs using local and imported water supplies have allowed substantial recovery of the ground water basins.

Water is imported from the Tuolumne River, via the Hetch Hetchy Aqueduct, and from the South Bay Aqueduct.

Poor quality ground water exists in the eastern part of Livermore Valley, where total dissolved solids (especially

chloride and boron) are high, requiring water softening. State Water Project supplies reduce reliance on ground water.

In Santa Clara County, mercury leached from cinnabar mines and tailings contaminates the water in Calero and Almaden reservoirs, but concentrations are still within drinking water standards. In areas adjoining San Francisco Bay, poor quality ground water results from salinity intrusion caused by overdraft.

The southern portion of San Francisco Bay has water quality problems caused by uncontrolled agricultural waste water and urban runoff. A program is underway to move municipal waste water discharges from the shallow portions of the bay to deeper portions.

Air from the ocean divides and flows north, south, and east through Carquinez Strait. This pattern usually provides constant air movement, except during periods of high temperature in the fall and spring. A subsidence inversion prevails for most of the year.

The automobile is the major contributor of carbon monoxide and oxidants. Petroleum production and chemical and metallurgical industries are the major emitters of particulates. Health warnings have been issued in Santa Clara Valley.

Some rare or endangered species exist in the marshes in and around San Francisco Bay. Their habitat has been significantly reduced by bay filling and diking. Undisturbed areas are now protected by various State, Federal, local, and private interests. Bay fill proposals now require approval from the San Francisco Bay Conservation and Development Commission.

Counties in this service area encompass 1,370,500 acres. About 305,000 acres were in urban use in 1980. Table 4-4 shows land use in 1980 for South Bay counties.

Population has increased rapidly in Alameda and Santa Clara counties. Santa Clara County population almost doubled between 1960 and 1970. Growth continues in both counties, but at a slower rate. Estimated 1980 population for the South Bay service area, by contractor, was:

Alameda County Flood Control and Water Conservation District, Zone 7	99,200
Alameda County Water District	203,500
Santa Clara Valley Water District	1,300,000
Total Service Area	1,602,700

The South Bay service area is Northern California's leading business center. The economy of the area is diversified, with manufacturing, commerce, services, and government sectors employing significant numbers of people. The rapid growth of the electronics industry is particularly important.

Agriculture is still important in the region, especially in the lower Santa Clara Valley, but its significance has declined because of urbanization.

Table 4-4

1980 LAND USE, SOUTH BAY COUNTIES
(in Thousand Acres)

County	Agri-cultural	Urban	Water Surface	Other	Total
Alameda	15.1	136.4	59.2	317.6	528.3
Santa Clara	37.1	168.2	8.9	628.0	842.2
Total	52.2	304.6	68.1	945.6	1,370.5

Central Coastal Service Area

The Central Coastal service area includes San Luis Obispo and Santa Barbara counties. Service to this service area would require construction of Phase II of the Coastal Branch of the

C—105370

C-105370

California Aqueduct. Voters in Santa Barbara County have opted not to finance an in-county distribution system from the Santa Maria terminus of the Coastal Branch. Water delivery from Phase II facilities was originally scheduled for 1980; however, the two water contracting agencies have requested several delays for delivery of entitlement water. Design of the Coastal Branch has been rescheduled, and initial deliveries are scheduled for the early 1990s.

The Santa Ynez, Santa Maria, and Salinas rivers constitute the major drainages of the Central Coastal service area. A system of dams and canals has been built on these rivers to conserve runoff. No water is imported to the area. Ground water is the main source of water supply. Over-use of the ground water resources has led to overdrafting and water quality problems in some locations, such as the Santa Maria Valley and southern coastal Santa Barbara County.

Estimated 1980 net water demand for the two counties was 357,000 acre-feet per year, of which 79 percent was for agricultural use and 21 percent was for municipal and industrial use.

Estimated 1980 water supplies total 268,000 acre-feet per year, of which 25 percent was from local surface supplies, 73 percent from ground water, and 2 percent from waste water reclamation. The deficit in supply will probably be managed by overdrafting the ground water basins, by establishing mandatory conservation in some areas, and possibly by denying new hookups.

The State Water Resources Control Board has indicated that adequate sewage treatment facilities should be available in this area, and foresees no serious water quality problems from municipal discharges.

Total population in San Luis Obispo and Santa Barbara counties grew from 103,700 in 1940 to 456,000 in 1980. Santa Barbara County is the larger of the two counties. Santa Barbara is the largest city in the area.

The economy of this area depends on agriculture and related activities. In the coastal lowlands, there is considerable high-value fruit and vegetable farming. In the drier lowlands, inland from the coast, livestock and dry-farmed grains are produced. Manufacturing is limited, but heavy water-using industries, such as petroleum production, food processing, and stone, clay, and glass products, are present. Some mining and military installations also contribute to the region's economy. Recreation and retirement activities are increasing in the coastal communities.

Housing demand varies throughout this area. In southern coastal Santa Barbara County, controls on growth, desirable climate, and the natural beauty of the region have created a high demand and high prices for housing. Growth controls that prevent new construction from keeping up with demand have tended to shift the demand to other areas. Other locations within this region have a more balanced supply and demand housing situation.

There are about 3,885,000 acres in this region. Table 4-5 shows expected 1980 land use.

Table 4-5

1980 LAND USE, CENTRAL COASTAL REGION
(in Thousand Acres)

County	Agricultural	Urban	Water Surface	Other	Total
San Luis Obispo	62.8	40.4	6.6	2,019.0	2,128.8
Santa Barbara	94.4	66.3	4.3	1,591.6	1,756.6
Total	157.2	106.7	10.9	3,610.6	3,885.4

The agricultural preserve program, under the Williamson Act, has helped limit urbanization of agricultural lands in Santa Barbara County. Land committed to public purposes includes Vandenberg Air Force Base, Los Padres National Forest,

C—105371

C-105371

and other U. S. Forest Service land. Unlike other State Water Project service areas, this area is primarily undeveloped. Several factors limit growth in Santa Barbara County, including the amount of vacant urban land that can be developed, the economy, city and county land use and growth policies, and availability of water supplies.

San Joaquin Valley Service Area

The San Joaquin Valley service area includes Kern County, Kings County, and part of Stanislaus County.

Four major rivers -- Kings, Kaweah, Tule, and Kern -- drain westward from the Sierra Nevada and terminate in the Tulare Lake or Buena Vista Lake beds. Dams on each of these rivers provide flood control and water supply for urban and agricultural uses and ground water replenishment. The Tulare Lake basin is an important area in the San Joaquin Valley service area.

Vast amounts of good quality ground water in the southern end of San Joaquin Valley are the major source of water supply for this service area. A large portion of the State Water Project service area in the San Joaquin Valley overlies the intensively developed San Joaquin Valley ground water basin. The basin extends from the Delta to the Tehachapi Mountains. Parts of the basin have been in overdraft since the 1920s, resulting in land subsidence, increased pumping lifts, and water quality problems.

Water is imported to the southern San Joaquin Valley via the Friant-Kern Canal (Central Valley Project) and by the State Water Project. Central Valley Project water is also transported through the California Aqueduct to Kern County under an agreement between the U. S. Bureau of Reclamation and the State of California.

The wind pattern in the southern San Joaquin Valley varies, flowing southward from San Francisco Bay during the warm season and northward during the late fall and winter, when cold air drains from the surrounding mountains. During the warm season, pollutants carried into the southern end of the valley couple with sunshine and contribute to photochemical smog. Mineral and petroleum industries and automobiles are major contributors of sulfur dioxide, oxidant, and carbon monoxide. Excess particulate matter in the San Joaquin Valley is due primarily to agricultural operations.

The San Joaquin Valley service area is generally arid, sparsely populated, and characterized by large farms. Agriculture in Kern and Kings counties may continue developing toward larger, fewer, and more economically efficient farms. The trend toward fewer farms has accentuated the migration from rural to urban areas. Table 4-6 shows land use in the counties encompassing this service area.

Table 4-6

1980 LAND USE, SAN JOAQUIN VALLEY COUNTIES
(in Thousand Acres)

County	Agricultural	Urban	Water Surface	Other	Total
Kern*	930.0	52.4	11.5	2,673.6	3,667.5
Kings	582.0	13.6	26.0	297.2	918.8
Total	1,512.0	66.0	37.5	2,970.8	4,586.3

* Tulare basin portion only.

The 1980 census population of Kern and Kings counties was 476,800; about 84 percent was in Kern County. From 1940 to 1970, population of these two counties increased 133 percent (from 170,200 to 396,500), and it is expected to continue growing. Bakersfield, in Kern County, is the largest city in the area, with 35 percent of the total county population in 1980. Hanford is the largest city in Kings County.

Estimated 1979 population for the contractors in the San Joaquin Valley service area was:

C—105372

C-105372

County of Kings	71,900
Devils Den Water District	50
Dudley Ridge Water District	50
Empire Westside Water District	50
Kern County Water Agency	328,100
Oak Flat Water District	50
Tulare Lake Basin Water District	50
Total Service Area	400,250

Agriculture and the oil industry are the primary economic activities in this region. Crops raised in the San Joaquin Valley service area include alfalfa, barley, safflower, sugar beets, fruits, vegetables, nuts, cotton, sweet potatoes, cantaloupe, and grapes. Beef cattle, dairy products, and poultry are also significant. Other sources of income include manufacturing, trade, services, and government.

Despite substantial variations in annual State Water Project deliveries, total irrigated acreage in the service area does not normally fluctuate. Farmers rely heavily on ground water pumping in dry years and local surface water diversions in wet years to maintain the same irrigated acreage. State deliveries in 1981 totaled 1,556,000 acre-feet, for irrigation of an estimated 496,330 acres. This comprised about 71 percent of total agricultural water requirements in the service area. Additional deliveries of about 245,000 acre-feet were used for a variety of other purposes, such as ground water recharge, municipal and industrial uses, recreation, wildlife, and oil field steam injection.

Further details on crop production values, crop labor requirements, and employment and economic trends in this area are available in Department of Water Resources Bulletin 132-82, Appendix F, San Joaquin Valley, Post-Project Economic Impact, 1981, December 1982.

The Department's drainage water monitoring program has generally shown relatively low selenium levels in the Kings-Kern County area. However, high levels have been found in farm drain water at two widely separated sites in Kern County.

Of particular interest in the San Joaquin Valley service area are the endangered blunt-nosed leopard lizard and the rare San Joaquin kit fox. The principal reason for the past decline in rare or endangered species in the service area has been the loss of habitat to agricultural development. Consequently, any increased agricultural development in the service area could affect this trend. Recovery plans have been prepared for the rare blunt-nosed leopard lizard and the rare San Joaquin kit fox. These are described in Blunt-Nosed Leopard Lizard Recovery Plan, Blunt-Nosed Leopard Lizard Recovery Team, January 1980 (draft), and San Joaquin Kit Fox Recovery Plan, Thomas P. O'Farrell, U. S. Fish and Wildlife Service, Endangered Species Program, 1983 (draft). These reports are incorporated here by reference.

The primary objective of the plan for the lizard is to halt the decline and restore the lizard to a nonendangered status. The plan recommends that management practices be encouraged along the California Aqueduct to enhance the lizard's habitat and that possible habitat restoration measures be determined. The plan calls for establishment of several ecological reserves and identifies land units within southern San Joaquin Valley considered important to the lizard's recovery.

A similar plan for the San Joaquin kit fox would stabilize and then improve populations of kit fox at about 1981 levels and restore this subspecies to a nonendangered status. The plan also proposes a number of actions that emphasize management and restoration of existing public lands and acquisition of additional lands to protect the kit fox.

Southern California Service Area

The Southern California service area includes Ventura, Los Angeles, and Orange counties and parts of San Diego, Riverside, Imperial, San Bernardino, and Kern counties.

There are no major rivers in the desert plateau region of this service area. The intermittent streams that flow from the mountains primarily percolate into ground water basins. A limited surface water supply has been developed, and most local water supplies are fully used. In the coastal portion of the basin, most local surface supplies have been developed for flood control, ground water recharge, and water supply.

Ground water supplies a significant portion of the water in this service area. The South Coastal hydrologic basin, which encompasses this service area, has at least 44 major ground water basins. Although further development is possible in a few local areas, some of the basins have been over-used. In 1974, an annual ground water overdraft of 160,000 acre-feet led to sea water intrusion problems in some areas along the coast. Sea water barrier and artificial recharge programs have been developed to correct these situations.

In Ventura and Los Angeles counties, some State Water Project supplies are released into natural stream channels. Piru Creek, a tributary to the Santa Clara River, serves as a conveyance to Ventura County users. In Los Angeles County, State Water Project water is released into Gorman Creek for recreational use as part of the Hungry Valley recreational area. Additional opportunities exist for streamflow augmentation where the East Branch of the California Aqueduct crosses natural streams.

Supplemental water is being imported from three sources:

- Los Angeles Aqueduct from the Owens Valley, on the east side of the Sierra Nevada, to the city of Los Angeles
- Colorado River via the Colorado River Aqueduct
- State Water Project

Many water quality problems exist in this service area. In the coastal area, thermal discharges from electrical generation plants and nutrient overloading of streams cause local problems. In the desert areas, the problems are more general and relate to increasing salinity of ground water and of lakes such as the Salton Sea.

The quality of imported water ranges from less than 220 mg/L total dissolved solids for State Water Project supplies to 750 mg/L for Colorado River water. In some areas, State Water Project water is blended with imported Colorado River water to provide a better overall quality.

Atmospheric conditions and heavy urbanization in the South Coast and San Diego air basins, which overlie the Southern California service area, are conducive to severe air pollution. Although both onshore and offshore winds occur almost daily, the effect is that of a single air mass moving back and forth across the service area. Air movement is further restricted by inversion conditions. Poor quality air masses are often transported through passes in the mountains into eastern valleys. During winter, a combination of low storm activity, inversions, and fog holds pollutants near the ground for several days at a time.

The automobile contributes over 70 percent of the carbon monoxide emissions and lesser quantities of nitrogen oxides. Combustion of natural gas and petroleum for power generation produces oxidants, particulate emissions, nitrogen oxides, and sulfur dioxide. The

C—105374

C-105374

oxidant standard is exceeded on two of every three days in parts of Southern California. Heaviest emissions in all pollutant categories originate in Los Angeles County.

In Southern California, steps have been taken to preserve habitats that have unique biological significance. One endangered fish, the unarmored three-spine stickleback, occurs in the service area but is no longer found in the Los Angeles, San Gabriel, and Santa Ana rivers. The fish population in the Santa Clara River is threatened by increased recreational use and development.

Land use in the Southern California service area has changed dramatically since the early part of the century, when the citrus industry dominated the economy. Several factors have led to the changes: discovery of oil, construction of the Los Angeles-Owens River Aqueduct, increase of port facilities to accommodate shipping and trade brought about by the Panama Canal, location of the 11th Naval District in San Diego, the movie and entertainment industry, and location of heavy industry (especially aircraft and ship-building). These factors have caused a shift from agricultural to urban and suburban development. Table 4-7 lists 1980 land use data for the Southern California counties encompassing this service area.

Table 4-7

1980 LAND USE, SOUTHERN CALIFORNIA COUNTIES
(in Thousand Acres)

County	Agri-cultural	Urban	Water Surface	Other	Total
Ventura	114.8	97.2	8.0	972.7	1,192.7
Los Angeles	37.1	770.2	12.3	1,791.1	2,610.7
Orange	18.0	135.8	2.0	346.6	502.4
San Diego	81.0	289.0	16.4	2,353.2	2,739.6
Riverside	244.4	199.9	42.3	4,148.9	4,635.5
San Bernardino	69.1	214.6	21.1	12,599.9	12,904.7
Imperial	496.4	30.0	200.6	2,215.3	2,942.3
Total	1,060.8	1,736.7	302.7	24,427.7	27,527.9

Since the 1940s, Southern California has changed from a largely rural lifestyle with an agricultural economy to a highly urban-industrial society. Population has grown from 3.7 million in 1940 to 12.8 million in 1979. The most rapid growth was between 1940 and 1965. Los Angeles County, the most populous in California, has had the largest increase. The rapid economic growth that Southern California experienced during the 1950s and 1960s has slowed, but diversification of the economy continues. This region is the State's leading center of business. Southern California contains the State's largest concentration of manufacturing activity, particularly the aerospace industry. Other major industries include petroleum, fabricated metals, chemical production, food processing, and paper production.

In the coastal areas of Southern California, agriculture is important economically, despite urbanization. Farms generally produce high value crops on small irrigated parcels. Agriculture is also important in the Colorado Desert, especially in the Coachella and Imperial valleys. Livestock, field crops, truck crops, sugar beets, and cotton are important. Poultry, livestock, and field crops are produced in the Mojave Desert.

C—105375

C-105375

Chapter 5. ENVIRONMENTAL IMPACTS OF INSTALLING AND OPERATING ADDITIONAL PUMPS

This chapter discusses potential environmental impacts from installing and operating additional pumps at the Harvey O. Banks Delta Pumping Plant for the alternative operational plans. Impacts are discussed for construction activities, changes in project operations, Bay-Delta fishery, and project service areas.

The evaluation in this chapter covers conditions in the early to late 1990s, considering gradually increasing project demands that will occur with or without the additional pumps. Emphasis is on conditions of the early 1990s. The late-1990s impacts are covered in a separate section of this chapter. For the pre-2000 period, operations of Banks Pumping Plant with added pumping units under various alternatives were discussed in Chapter 3 (Physical and Operational Comparison of Alternative Operational Plans) with existing project storage facilities and Suisun Marsh protective facilities. Some of the higher export alternative operational plans also considered southern Delta modifications.

Two types of operation studies were used to evaluate pre-2000 operational impacts: (1) water supply studies using 57 years of past hydrologic variations adjusted to 1990-level demands, which are considered to represent early 1990 operations, and (2) long-range studies used to evaluate project energy and capacity requirements based on median water supply conditions and gradually increasing project demands. Median water supply conditions represent normal and above normal year types, which have a high level of unregulated Delta water supplies during the winter and early spring. Both studies allow incremental impacts of the additional pumps to be isolated and evaluated.

The first type of study investigated the highest level of detail and was the basis for determining the incremental firm yield of the alternatives. Even though these studies represented early 1990-level operations, the calculation of incremental yield is based on the historical 1928-1934 critical period and is assumed to remain a constant future incremental supply to offset a portion of future project yield losses from upstream area of origin use. This incremental yield value was used in the economic analysis of the additional pumps and also for the service area impact analysis. However, operations during normal and above normal water supply conditions occur more frequently in these studies and were used in the investigation of various impacts such as fish impacts.

The second type of study was used for power evaluations and to investigate the median year export effects of the existing and additional pumps under the Corps constraints. The impacts were evaluated for pre-2000 conditions without other potential State Water Project development for Delta water transfer or added surface storage. By adding only the additional pumps to the State Water Project, associated incremental impacts were isolated and evaluated. During the pre-2000 period and with existing facilities, the State Water Project can meet contractor entitlement requests about 25 to 30 percent of the time. The high water supply and peak export condition is investigated by this second type of study, focusing on the alternatives that would meet Corps constraints.

The median year assumptions for pre-2000 conditions do not represent future water supply planning objectives of the Department of Water Resources. Department planning and future legislation may

C—105376

C-105376

define development within the pre-2000 study period. To cover possible future development, such as new storage or improved Delta water transfer systems, the relationships between the additional pumps and possible related projects are discussed in Chapter 6, "General Impacts of Additional Pumps with Potential Related Projects". Chapter 6 also discusses post-2000 operations with the additional pumps but without improved Delta transfer or added surface storage (Post-2000 Operation of Banks Pumping Plant without Added Storage or Improved Delta Water Transfer).

The analyses in Chapter 6 represent post-2000 conditions. However, if the other developments were earlier, the relationships would still apply. The cumulative impact review is broader in scope and more general than the impact evaluation in this chapter.

This chapter concludes with a summary of significant operational impacts under the preferred alternative, mitigation options, unavoidable significant impacts, and other information required by the California Environmental Quality Act.

Impacts of Construction

Table 5-1 summarizes the construction impacts of installing the additional pumping units, of adding a second Clifton Court Forebay intake, and of improving the southern Delta channels. The impacts, which are of short duration except for the effects on fish and wildlife habitat and two rare plants, are discussed in this section.

Additional Pumping Units

Procurement and installation of additional units would take about 5 years after approval to proceed. Procurement would consist of final design and development of specifications, advertising, award of contract, and factory fabrication. Manufacturing the pumps and associated equipment and shipping them to the site could require some services from over 1,000 people.

Installation of the units in the Banks Pumping Plant would involve structural, mechanical, and electrical work. Permanent change would be only inside the existing pumping plant building. Following installation, there would be a testing period of about 8 weeks before the units could be operational. If four units were installed, installation and testing would be staged, with the first pair of units operational about 4 months before the second pair.

Major construction activities would consist of erecting a temporary concrete batch plant near the pumping plant; hauling in cement and aggregates; transporting the mechanical and electrical equipment to the site; and placing forms, reinforcement bars, and concrete in the plant building. About 100 State and private contractor employees would be involved in the construction, with a maximum of about 35 at any one time. Construction would not significantly affect the environment, either on a short-term or long-term basis.

For four additional units, transporting materials and equipment to the site would require an estimated 600 truck trips. About 14 trips would be required for the large, heavy equipment (pumps, motors, transformers, and spherical valves). These trips would require special procedures, such as escort vehicles, temporary closure of lightly traveled county roads, or compliance with local ordinances where mandated by regulatory authorities.

Construction would generate some additional local vehicular movement, but no significant inconvenience to the public is expected because of light traffic in the area. All trucks delivering materials and equipment to the site would

C—105377

C-105377

Table 5-1
SUMMARY OF ENVIRONMENTAL IMPACTS OF CONSTRUCTION

	A*	B*
1. Earth. Will the proposal result in:		
a. Unstable earth conditions or in changes in geologic substructures?	N	N
b. Disruptions, displacements, compaction or overcovering of the soil?	N	M
c. Change in topography or ground surface relief features?	N	M
d. The destruction, covering or modification of any unique geologic or physical features?	N	N
e. Any increase in wind or water erosion of soils, either on or off the site?	N	N
f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake?	N	N
g. Exposure of people or property to geologic hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards?	N	N
2. Air. Will the proposal result in:		
a. Substantial air emissions or deterioration of ambient air quality?	N	N
b. The creation of objectionable odors?	N	N
c. Alteration of air movement, moisture or temperature, or any change in climate, either locally or regionally?	N	N
3. Water. Will the proposal result in:		
a. Changes in currents, or the course or direction of water movements, in either marine or fresh waters?	N	M
b. Changes in absorption rates, drainage patterns or the rate and amount of surface water runoff?	N	N
c. Alterations to the course or flow of flood waters?	N	N
d. Change in the amount of surface water in any water body?	N	N
e. Discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen or turbidity?	N	M
f. Alteration of the direction or rate of flow of ground waters?	N	N
g. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations?	N	N
h. Substantial reduction in the amount of water otherwise available for public water supplies?	N	N
i. Exposure of people or property to water related hazards such as flooding or tidal waves?	N	N
4. Plant Life. Will the proposal result in:		
a. Change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, and aquatic plants)?	N	M
b. Reduction of the numbers of any unique, rare or endangered species of plants?	N	M
c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species?	N	N
d. Reduction in acreage of any agricultural crop?	N	N
5. Animal Life. Will the proposal result in:		
a. Change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms or insects)?	N	M
b. Reduction of the numbers of any unique, rare or endangered species of animals?	N	N
c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals?	N	N
d. Deterioration to existing fish or wildlife habitat?	N	M
6. Noise. Will the proposal result in:		
a. Increases in existing noise levels?	N	N
b. Exposure of people to severe noise levels?	N	N
7. Light and Glare. Will the proposal produce new light or glare?	N	N
8. Land Use. Will the proposal result in a substantial alteration of the present or planned land use of an area?	N	N
9. Natural Resources. Will the proposal result in:		
a. Increase in the rate of use of any natural resources?	N	N
b. Substantial depletion of any nonrenewable natural resource?	N	N
10. Risk of Upset. Will the proposal involve:		
a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?	N	N
b. Possible interference with an emergency response plan or an emergency evacuation plan?	N	N
11. Population. Will the proposal alter the location, distribution, density, or growth rate of the human population of an area?	N	N
12. Housing. Will the proposal affect existing housing, or create a demand for additional housing?	N	N
13. Transportation/Circulation. Will the proposal result in:		
a. Generation of substantial additional vehicular movement?	N	N
b. Effects on existing parking facilities, or demand for new parking?	N	N
c. Substantial impact upon existing transportation systems?	N	N
d. Alterations to present patterns of circulation or movement of people and/or goods?	N	N
e. Alterations to waterborne, rail or air traffic?	N	N
f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians?	N	N
14. Public Services. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas:		
a. Fire protection?	N	N
b. Police protection?	N	N
c. Schools?	N	N
d. Parks or other recreational facilities?	N	N
e. Maintenance of public facilities, including roads?	N	N
f. Other governmental services?	N	N
15. Energy. Will the proposal result in:		
a. Use of substantial amounts of fuel or energy?	N	N
b. Substantial increase in demand upon existing sources of energy, or require the development of new sources of energy?	N	N
16. Utilities. Will the proposal result in a need for new systems, or substantial alterations to the following utilities:		
a. Power or natural gas?	N	N
b. Communications systems?	N	N
c. Water?	N	N
d. Sewer or septic tanks?	N	N
e. Storm water drainage?	N	N
f. Solid waste and disposal?	N	N
17. Human Health. Will the proposal result in:		
a. Creation of any health hazard or potential health hazard (excluding mental health)?	N	N
b. Exposure of people to potential health hazards?	N	N
18. Aesthetics. Will the proposal result in the obstruction of any scenic vista or view open to the public, or will the proposal result in the creation of an aesthetically offensive site open to public view?	N	N
19. Recreation. Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?	N	N
20. Cultural Resources.		
a. Will the proposal result in the alteration of or the destruction of a prehistoric or historic archeological site?	N	N
b. Will the proposal result in adverse physical or aesthetic effects to a prehistoric or historic building, structure, or object?	N	N
c. Does the proposal have the potential to cause a physical change which would affect unique ethnic cultural values?	N	N
d. Will the proposal restrict existing religious or sacred uses within the potential impact area?	N	N
21. Mandatory Findings of Significance.		
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	N	M
b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time while long-term impacts will endure well into the future.)	N	N
c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of those impacts on the environment is significant.)	N	N
d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	N	N

* A= Proposed additional pumping units; B= Southern Delta modifications
N = No, M = Maybe

C—105378

C-105378

meet standards or regulations for air quality, safety, and noise abatement. Travel to the site would be on paved roads, so no dust problems are expected. Dust control measures would be taken in operating the concrete batch plant and delivering aggregates.

Procuring and installing only two pumping units would take slightly less time; amount of material and equipment would be half that for four units. There would be no significant difference in construction impacts.

Estimated air emissions for transporting materials and equipment to the site and for mixing and placing concrete for four units are:

Pollutant	Tons
Sulfur oxides	1.0
Carbon monoxide	2.9
Total organics	1.4
Nitrogen oxides	12.9
Total suspended particulates	0.8

Project construction would be in the path of winds flowing to the interior valley. Local dissipation would be excellent and the overall air quality impact would be negligible.

Second Clifton Court Forebay Intake

Alternatives 2-8.5, 4-8.5, and 4-10.3 were assumed to require a second intake at the northeast corner of Clifton Court Forebay, as discussed in Chapters 2 (Southern Delta Modification) and 3 (Alternative Operational Plans 2-8.5 and 4-8.5, and Alternative Operational Plan 4-10.3). The capacity of the new intake would be greater for Alternative 4-10.3. The impacts of constructing a new intake would be similar for all these alternatives.

A new intake would require building a cofferdam, dewatering, excavation, a reinforced concrete gate bay structure, and installing the gates and other equipment. New fish screens might also be required. Intake construction would cause some local temporary and minor disruption, but should not significantly affect the nearby environment or project operation.

Southern Delta Channel Modifications

Southern Delta channel modifications were assumed for Alternatives 2-8.5, 4-8.5 and 4-10.3. Modifications assumed for this report are for evaluating the alternatives. The Department has considered other options as well, such as a Delta water transfer facility in a 1983 publication, Alternatives for Delta Water Transfer. These or others could be considered in the future.

The cross section in Victoria Canal is now about 4,500 square feet; this would be increased to about 7,200 square feet for Alternative 4-10.3 by removing about 84 acres of berm islands from the center of the channel. Middle River constrictions, as small as 3,000 square feet, would also be enlarged to about 7,200 square feet by deepening the channel and removing about 12 acres of berm islands. Old River would probably require only riprapping of levee and channel edges on the outside of bends for a length of about one mile. These channel improvements would provide additional flood control capacity in the southern Delta as well as transfer capacity.

Short-term impacts of dredging these channels are: removal of benthic organisms, increased turbidity, loss of endangered plants and riparian vegetation, and dredged material disposal.

Most benthic organisms would be removed during dredging. Natural migration and the remaining benthic community between the canal and the levee would supply organisms for repopulation. According

C—105379

C-105379

to a study in Coos Bay, Oregon, where 75 percent of the organisms were removed during dredging, most dredged sites had repopulated to predredge levels within 14 days (McCauley, et al., Benthic Infauna and Maintenance Dredging, 1976), although complete recovery of the benthic ecosystem could take up to 2 years (U. S. Fish and Wildlife Service, Draft Detailed Report to Corps of Engineers on Effects of Deepening the Sacramento Deep Water Ship Channel, June 1977).

Most of the suspended solids would be drawn into Clifton Court Forebay when the gates were open. The increased turbidity in these channels would return to ambient conditions shortly after completion of dredging.

The dredged material could be placed in spoil areas within the State's right of way. This would cover the vegetation, producing short-term impacts on wildlife habitat, but the disposal areas would revegetate naturally within 2 to 3 years.

Potential long-term effects of dredging and berm removal are:

- Reduced quality of resident fish habitat.
- Reduced wildlife habitat.
- Disturbance of areas where two rare plants are found, the Delta hibiscus and the mudflat quill plant.

Additional field surveys would be needed for detailed assessments of the construction impacts.

Operational Impacts, Conditions During the Early 1990s

Comprehensive project operation studies were used to evaluate the environmental effects of operating additional pumping units at the Banks Pumping Plant for all alternatives. Monthly water supply studies of the overall State Water Project and Central Valley Project system for the 57-year period of 1922 through 1978 were used to establish base conditions and to evaluate impacts north of the Delta, in the Delta, and south of the Delta. Five computer model studies were made at projected 1990 demand levels for the alternative operational plans. All these studies assume operations that meet State Water Resources Control Board Decision 1485 standards. The preferred alternative also meets the Corps of Engineers constraints for navigable capacity, which are described in Figure 2 in Chapter 1.

For this final report the operation studies have been updated from those used in the draft report. The preferred alternative has about the same firm yield in both the new studies and the studies done for the draft report. These new studies include recent assumptions in connection with:

- State Water Project and Central Valley Project operations based on the Coordinated Operation Agreement described in Chapter 1.
- Maximum storage for New Melones Reservoir.
- Minimum allowable storage in Lake Oroville.
- Post-1990 date for Auburn Dam.
- Updated computer mathematical modeling work, which has developed more precise correlations between Delta outflow and salinity.
- Updated estimates of water demands and available supplies.
- Improvements in the statewide operations study computer model.
- Updated Delta channel depletion estimates.
- Operation of ground water facilities.

C—105380

C-105380

Both sets of studies assumed Suisun Marsh protective facilities.

Assumptions and criteria concerning Banks Pumping Plant, Clifton Court Forebay, and southern Delta channel modifications are described in Chapter 3, "Physical and Operational Comparison of Alternative Operational Plans".

Other assumptions and further details of the operation studies are in Appendix B, which shows monthly average flow and salinity data with Decision 1485 standards for various locations in the Delta.

The operation study for Alternative 2-8.5(Corps) was accomplished by making adjustments for the 57-year operation study of Alternative 4-10.3(Corps). In the latter study, there were 18 months when exports from December 15 through March 15 exceeded 8,500 cubic feet per second, and minor adjustments were necessary.

The increased firm yield estimates from these six studies were comparable to those with the four operation studies used for analysis in the draft report. However, because of the updated assumptions and greater diversion of unregulated flows, the results of all six studies differed in some respects from those of the studies used for the draft report. The most important change was that exports at Banks Pumping Plant were reduced from April through September and increased from October through March. This change reflects more prudent operation to minimize carriage water, as discussed in Chapter 3, "Operational Considerations" (Efficient Operation of the State Water Project).

Appendix B presents a summary comparison of the four prior and the five updated computer model operation studies, including average monthly exports and resulting calculated losses for striped bass and chinook salmon. The calculated losses with the updated studies are significantly lower. For example, with the existing pumps, the estimated average annual losses of striped bass yearling equivalents were reduced by about 17 percent when comparing the operation studies used in the draft report to the updated studies in the final report. Another important change for the updated studies was to lessen the effects of off-peak pumping with additional pumps on screening efficiencies for striped bass, since less water would be pumped during the summer months.

The format for discussing operational impacts is explained below.

- Background: Information pertinent to the impact under discussion.
- No-Project Alternative: A brief review of past, present, and anticipated conditions under Alternative 0-6.4.
- Preferred Alternative: An assessment of incremental impacts, based on a comparison with the no-project alternative to quantify impact differences.
- Other Alternatives: A similar assessment of incremental impacts under the other alternatives.

Impacts on fish, an important part of this analysis, are covered in two parts:

- A qualitative discussion of general impacts, by species, of the effects on migration, survival, and entrainment. Flow and salinity data from the operation studies are presented to assess these effects.
- A quantitative analysis and discussion of direct losses and salvage of screenable sized fish at the Delta Complex, which consists of Banks Pumping Plant, Skinner Fish Protective Facility, and Clifton Court Forebay. This analysis is based on historical

C—105381

C-105381

(1968-1980) number of fish salvaged at the screen and export patterns from operation studies. It includes: fish salvaged at the screens; handling and hauling losses; predation in Clifton Court Forebay; and loss of striped bass eggs and larvae through the Delta Complex. Use of historical fish salvage values assumes that, on the average, fish populations in the estuary will remain constant even though yearly population may vary. Current populations of striped bass have decreased and are below this value. If a lower population value were used in the fish impact assessment, lower fish impacts would be calculated. Use of historical values may over-estimate fish impacts for the additional pumps.

Other operational impacts on the estuarine environment that are evaluated or discussed include: aquatic invertebrates, Tracy Pumping Plant operations, Suisun Marsh, and biological resources of San Francisco Bay.

Monthly Operational Changes

Operation of the State Water Project and Central Valley Project has affected the seasonal and monthly pattern of Delta inflows, exports, and outflows. Generally, winter and spring inflows and outflows have been decreased, while summer and early fall inflows and outflows have been increased. Upstream of the Delta, the projects and local facilities have altered flow regimes, habitat, and fish populations on the Sacramento, San Joaquin, and Trinity river systems. These past effects are summarized in the final environmental statement on the existing Harvey O. Banks Delta Pumping Plant, filed in September 1980. These past effects are also discussed in this chapter in connection with the no-project alternative.

The following tabulation shows actual average monthly pumping rates at the Banks Pumping Plant for five years, 1978 through 1982, and computed average rates for conditions during the early 1990s with the existing pumps. Values are in cubic feet per second.

	1978-82 Average	1982	1990 Average
January	4,217	3,426	6,287
February	4,067	5,608	6,308
March	2,863	6,239	5,845
April	3,000	6,107	4,889
May	1,864	2,890	2,463
June	2,081	766	2,306
July	2,695	967	3,120
August	3,881	3,567	2,672
September	3,688	3,071	2,165
October	3,073	3,010	4,837
November	3,046	2,594	5,557
December	3,446	5,247	6,092
Annual total (million acre-feet)	2.28	2.62	3.16

Table 5-2 shows monthly and annual average exports at Banks Pumping Plant for conditions of the early 1990s as computed by each operation study, by water classification year type. In all studies, all water quality and flow standards are met. These exports include State Water Project intermittent export deliveries to ground water in Southern California. Exports at Tracy Pumping Plant, shown in Appendix B, Table B-4H, do not change with the operation studies.

No-Project Alternative. With the existing pumping units, export increases above the 1978-1982 average would occur during most months. For conditions during the early 1990s, project operations would best use unregulated flows within the constraints of Decision 1485 and pumping capacity. San Luis Reservoir would fill only after a series of high runoff years.

Preferred Alternative. Under the preferred alternative, exports at Banks Pumping Plant would be increased during winter (December 15 through March 15), with proportionately small reductions of Delta outflow volumes. In all months and years, Decision 1485 requirements

C—105382

C-105382

would be met. San Luis Reservoir would have slightly higher average storage levels and fill more frequently. After San Luis filled, there would be a reduction of exports through April. Exports would also be reduced during the summer to conserve water in Lake Oroville. This net reduction would occur even with intermittent export deliveries for ground water storage in the Southern California service area.

On the average, the preferred alternative exports at Banks Pumping Plant would be decreased about 2.8 percent from August to November, increased 7.8 to 9.7 percent from December to March, and decreased 5.5 to 9.0 percent from April to July.

Average seasonal changes in total exports (Banks and Tracy pumping plants) are:

August	- November	-1.4 percent
December	- March	+4.5 to 5.7 percent
April	- July	-4.3 percent

Monthly exports between December 15 and March 15 would be regulated by the U. S. Army Corps of Engineers constraints* so that historical diversion rates to Clifton Court Forebay would not be exceeded. The Corps constraints during this period would limit the possible monthly diversion into Clifton Court Forebay to ten 3-day periods of 6,680 cubic feet per second, or a monthly maximum average of 6,680 cubic feet per second. However, after delivering Byron-Bethany Irrigation District water from the forebay, and allowing for evaporation and seepage losses from the forebay, the actual maximum pumping rate at Banks Pumping Plant during unregulated flow conditions would be less than 6,680 cubic feet per second, but could be higher than the present pumping capacity of 6,400 cubic feet per second.

Other Alternatives. With the 2-8.5, 4-8.5, and 4-10.3 alternatives, exports of Banks Pumping Plant would increase significantly during the early months of the wet season under unregulated flow conditions. Therefore, San Luis Reservoir would fill earlier and more frequently. After filling of San Luis Reservoir, exports would often be reduced significantly through April because there would be no capacity in San Luis to store the water. This reduction would occur in nearly all years and includes intermittent export deliveries for ground water storage in the Southern California service area.

Calculated changes in average seasonal export at Banks Pumping Plant relative to the no-project alternative are:

Months	2-8.5 4-8.5	4-10.3
August to November	- 0.6%	+ 5.6%
December to March	+ 8.3%	+ 7.1%
April to July	- 4.2%	-10.0%

Such changes in monthly exports would slightly affect releases from Lake Oroville. Generally, upstream releases would be decreased with decreases in exports and increased with increases in exports. During July and August, Oroville storage would be increased by an average of about 2 percent because of reduced carriage water requirements.

The minor differences in storage at San Luis and Oroville reservoirs for the 2-8.5, 4-8.5, and 4-10.3 alternatives would not affect recreation or the fishery.

* Referred to in this report as "Corps constraints".

C—105383

C-105383

Table 5-2

AVERAGE MONTHLY AND ANNUAL EXPORTS AT BANKS PUMPING PLANT BY YEAR TYPE

(Monthly Values in Cubic Feet per Second and Annual Values in Thousand Acre-Feet; Early 1990s)

Year Type	Alternative*	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Annual
Wet	1	5,607	6,077	6,243	6,336	6,305	6,057	5,659	2,989	2,868	3,884	2,915	3,621	3,527
	2	5,893	6,294	6,842	7,236	7,040	6,075	5,404	2,989	2,843	3,225	1,940	3,820	3,586
	3	5,893	6,294	7,047	7,844	7,712	5,400	4,911	2,989	2,842	2,995	1,938	3,872	3,589
	4	5,893	6,294	7,076	7,952	8,106	4,926	4,883	2,989	2,842	2,995	1,938	3,872	3,589
	5	5,162	6,713	7,776	7,623	7,051	5,251	5,030	2,917	2,308	2,771	2,568	4,245	3,575
	6	5,670	7,422	8,627	7,398	6,630	4,451	4,596	2,917	2,308	2,596	2,530	4,278	3,577
Above Normal	1	4,364	5,333	6,266	6,247	6,336	6,195	6,240	2,992	2,669	3,409	3,391	2,296	3,356
	2	4,762	5,753	6,639	6,831	6,851	6,440	6,126	2,992	2,501	3,020	1,766	2,207	3,363
	3	4,767	5,756	6,754	7,058	7,258	6,388	5,786	2,992	2,501	2,814	1,672	2,208	3,364
	4	4,767	5,756	6,754	7,058	7,307	6,427	5,767	2,992	2,501	2,794	1,638	2,208	3,365
	5	4,372	5,154	5,219	7,501	7,640	6,325	6,803	2,899	2,074	2,885	2,571	2,398	3,355
	6	4,624	5,655	5,297	7,309	7,787	6,710	6,141	2,765	1,686	2,710	2,433	2,353	3,333
Below Normal	1	5,112	5,939	6,400	6,408	6,372	6,250	5,097	2,504	2,812	3,261	2,812	1,644	3,289
	2	5,561	6,134	6,878	6,928	7,069	6,464	5,028	2,532	2,254	2,495	1,750	1,674	3,296
	3	5,561	6,134	6,808	7,117	7,590	6,308	4,519	2,532	2,200	2,425	1,750	1,679	3,285
	4	5,561	6,134	6,808	7,117	7,676	6,234	4,519	2,532	2,200	2,425	1,750	1,679	3,285
	5	5,170	5,581	5,689	7,127	7,579	6,824	4,981	2,025	1,613	3,066	3,237	1,632	3,280
	6	5,683	5,706	5,357	5,987	8,410	7,143	4,966	2,256	1,909	3,377	3,515	1,899	3,377
Dry	1	4,447	4,973	5,408	6,408	6,392	5,985	4,706	2,321	1,985	3,165	2,812	1,197	3,098
	2	4,411	5,304	5,746	6,966	7,141	6,481	5,070	2,621	2,087	2,487	1,750	1,345	3,091
	3	4,409	5,291	5,743	7,036	7,417	6,361	4,947	2,621	2,087	2,527	1,734	1,345	3,096
	4	4,409	5,291	5,743	7,036	7,417	6,361	4,947	2,621	2,087	2,527	1,734	1,345	3,096
	5	3,728	4,598	4,951	7,558	7,642	6,893	5,837	2,454	1,936	3,333	3,007	1,462	3,222
	6	3,920	4,796	4,871	7,369	7,892	7,291	5,902	2,204	1,664	3,141	2,848	1,497	3,209
Critical	1	3,745	4,855	5,985	5,916	6,095	4,221	1,342	679	290	709	850	407	2,108
	2	3,783	5,130	6,123	6,351	6,664	4,212	1,153	671	300	618	604	410	2,161
	3	3,763	5,132	6,146	6,345	6,698	4,196	1,153	671	300	620	669	422	2,167
	4	3,763	5,132	6,146	6,345	6,698	4,196	1,153	671	300	620	669	422	2,167
	5	3,842	3,874	3,569	7,485	7,623	4,060	2,032	819	359	831	1,775	416	2,197
	6	4,336	3,859	2,954	5,339	8,040	5,328	1,958	805	380	921	2,606	433	2,212

* 1 = 0-6.4, 2-6.4, and 4-6.4
2 = 2-7.3(Corps) and 4-7.3(Corps)
3 = 2-8.5(Corps) The operation study was calculated by adjusting the operation study of Alternative 4-10.3(Corps)
4 = 4-10.3(Corps)
5 = 2-8.5 and 4-8.5
6 = 4-10.3

(Corps) = Constrained by Public Notice 5820A Amended, U. S. Army Corps of Engineers.

Daily Operational Changes at Clifton Court Forebay

Clifton Court Forebay diversions vary on a daily cycle according to tidal fluctuations. Diversions are stopped at different times during the day to avoid low tide conditions, providing a buffer between Delta channels and the pumps. This section discusses how the changes in daily pumping schedules would affect daily diversions into the forebay.

Table 5-3 shows typical variations in diversions into Clifton Court Forebay from April through November for the 10 alternative operational plans. These months are important for fishery needs and irrigation. The table reflects the more effective operations shown by the updated operation studies used for the final report. Peak daily weekend rates of diversion into the forebay (export condition 2) and peak daily midweek rates (export condition 3) reflect maximum off-peak pumping and minimum on-peak pumping for the 57-year average monthly export rates determined in the project operation studies (export condition 1). Peak daily diversions

C—105384

C-105384

into the forebay would occur on Sundays; daily diversions on Saturdays and Mondays would be about 93 percent of those on Sundays. In all cases, midweek daily diversions would be significantly lower than the average monthly rates.

During May through September, monthly exports for all operational alternatives averaged less than 3,200 cubic feet per second. This means that all pumping could be off-peak during those months, with or without additional pumps.

Changes in pumping schedules with additional pumps are not expected to affect waterfowl use of Clifton Court Forebay. Forebay simulation studies show increased fluctuation on weekends, due to increased off-peak pumping, and decreased fluctuation during the week. Such changes are not expected to disturb waterfowl using the area.

Recreational opportunities at Clifton Court Forebay should not be affected by changes in pumping schedules. The body of water remains essentially the same at all times, although access to the shoreline is restricted by muddy banks when the forebay level is low. The limits of fluctuation are not expected to differ among the alternatives.

Changes in hourly operations are not expected to affect entrainment of migratory fish. Such fish are entrained based on export patterns of several days or weeks because the movement of water through the Delta is not instantaneous. Estimates of entrainment losses in the analysis for the additional pumps use monthly average flows from the operation studies.

No-Project Alternative. The variation between weekend and midweek diversions into the forebay would generally be least with the present pumps, and peak daily variations would not be as high as with operation of the additional pumps. From May through September, peak daily rates would be about 150 percent of monthly rates, and midweek diversion rates would be about 67 percent of monthly rates. Peak daily rates would be greatest for the months of highest exports, April, October, and November.

Preferred Alternative. In April, October, and November, peak daily rates into the forebay would be increased as shown in Table 5-3. These peak rates would be limited by the 1-day Corps constraint of 13,870 acre-feet (about 7,000 cubic feet per second daily flow). In May through September, peak daily rates would be about the same or slightly less than for the no-project alternative. The 1-day limit under Corps constraints would seldom be controlling during these months.

Other Alternatives. With Alternatives 2-6.4 and 4-6.4, peak daily diversions into the forebay would be increased in April, October, and November but would not be increased during May through September. With Alternatives 2-7.3 (Corps) and 2-8.5(Corps), daily diversions would be similar to those under the preferred alternative in all months shown. With Alternatives 2-8.5, 4-8.5, and 4-10.3, the variations between week and midweek diversions would be greatest during April, October, and November. In May through September, peak daily rates would be about the same or slightly less than for the no-project alternative.

C—105385

C-105385

Table 5-3

TYPICAL OPERATIONAL CHANGES AT CLIFTON COURT FOREBAY
(Values in Thousand Cubic Feet per Second; Early 1990s)

		Alternative Operational Plan									
					Corps*						
Month	Condition	0-6.4	2-6.4	4-6.4	2-7.3	2-8.5	4-7.3	4-10.3	2-8.5	4-8.5	4-10.3
April	1	4.9	4.9	4.9	4.8	4.5	4.8	4.5	5.1	5.1	4.8
	2	6.0	7.3	8.4	7.0	7.0	7.0	7.0	7.5	8.4	8.3
	3	4.2	3.3	2.5	3.4	2.8	3.4	2.8	3.5	2.8	2.5
May	1	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.7	2.7	2.4
	2	3.7	3.7	3.7	3.8	3.8	3.8	3.8	4.1	4.1	3.5
	3	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.6
June	1	2.3	2.3	2.3	2.2	2.2	2.2	2.2	1.8	1.8	1.7
	2	3.5	3.5	3.5	3.3	3.3	3.3	3.3	2.7	2.7	2.6
	3	1.6	1.6	1.6	1.5	1.5	1.5	1.5	1.2	1.2	1.2
July	1	3.1	3.1	3.1	2.6	2.4	2.6	2.4	2.7	2.7	2.6
	2	4.7	4.7	4.7	3.8	3.7	3.8	3.7	4.0	4.0	3.9
	3	2.1	2.1	2.1	1.7	1.7	1.7	1.7	1.8	1.8	1.8
August	1	2.7	2.7	2.7	1.7	1.6	1.7	1.6	2.7	2.7	2.8
	2	4.0	4.0	4.0	2.5	2.5	2.5	2.5	4.0	4.0	4.1
	3	1.8	1.8	1.8	1.1	1.1	1.1	1.1	1.8	1.8	1.9
September	1	2.2	2.2	2.2	2.2	2.3	2.2	2.3	2.4	2.4	2.5
	2	3.2	3.2	3.2	3.4	3.4	3.4	3.4	3.7	3.7	3.7
	3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.6	1.7
October	1	4.8	4.8	4.8	5.1	5.1	5.1	5.1	4.6	4.6	5.0
	2	6.2	7.3	8.3	7.0	7.0	7.0	7.0	7.3	7.9	8.1
	3	4.0	3.2	2.5	3.9	3.9	3.9	3.9	2.8	2.4	2.9
November	1	5.6	5.6	5.6	5.8	5.8	5.8	5.8	5.5	5.5	5.9
	2	6.2	7.5	8.5	7.0	7.0	7.0	7.0	7.5	8.5	8.9
	3	5.3	4.3	3.7	5.2	5.2	5.2	5.2	4.2	3.5	4.0

Conditions: 1 = Average monthly export rate, 57-Year Average.
2 = Peak daily diversion into Clifton Court Forebay (Sundays).
3 = Midweek daily diversion into Clifton Court Forebay.

*Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

C-105386

C-105386

Impacts on Delta Outflows

The Central Valley Project and State Water Project reduce Delta outflows during winter and spring and increase them during summer and early fall. Mean monthly outflows for four selected years with and without the Central Valley Project and State Water Project are shown in the Corps of Engineers' Final Environmental Statement, Operation of the Delta Pumping Plant (Table 2c). Except for the wet year, summer outflows without the projects are shown as negative values, which indicates significant salinity intrusion well into the Delta. Delta outflows are important for salinity and fish needs. Migratory fish require a gradual salinity gradient between the fresh water of the Delta and the salt water of the bay and Pacific Ocean. The salinity gradient would not change substantially with the alternative operational plans, because all the plans would maintain a hydraulic barrier with freshwater outflows. Salinity conditions for alternative operational plans are shown in Appendix B.

Table 5-4 shows average monthly and annual Delta outflows for six operational plans. Outflows are averaged according to the five main water year classification types in Decision 1485. Averages for wet, above normal, and below normal years each include some "subnormal snowmelt" years. Averages for dry years include some "dry years following critical". For both of the special year types, outflow requirements for fish and wildlife are reduced as allowed by Decision 1485 (see Appendix B).

Outflow surges for shorter periods are discussed in the next section.

No-Project Alternative. Delta outflows will vary due to project operations and natural hydrologic variations. Outflows will range from about 3,800 cubic feet per second under summertime regulated flow conditions in critical years to over 100,000 cubic feet per second in unregulated flow periods in the winter of wet years. Regulated, or balanced, flow conditions exist when minimum Delta protective outflow requirements established by Decision 1485 are being met, in whole or part, by project reservoir releases or when carriage water is being released. Carriage water is the volume of water above the Decision 1485 outflow requirements to provide quality control for export operations. This volume of water is needed to compensate for inefficient hydraulics of transferring water across the northern Delta.

Preferred Alternative. Under the preferred alternative, high winter outflows would be changed from December through March in the amounts shown in Table 5-4. After San Luis Reservoir filled, normally by April, outflows would increase slightly. The average annual percent reduction in outflows under the preferred alternative is 0.4 percent compared to the no-project alternative. Reductions of this magnitude do not appear to affect beneficial uses in the Delta, as discussed in later sections of this chapter. The relationship to cumulative effects is addressed in Chapter 6, "General Impacts of Additional Pumps with Potential Related Projects".

Other Alternatives. Delta outflows shown in Table 5-4 for the 2-8.5, 4-8.5, and 4-10.3 alternatives reflect export increases from October until San Luis Reservoir fills. Some export reductions after San Luis Reservoir fills would occur for these alternatives. Modified operation of Lake Oroville would also occur due to changes in San Luis Reservoir operation. Average annual reduction in outflow is 0.6 percent for the 2-8.5 and 4-8.5 alternatives and 0.7 percent for the 4-10.3 alternative.

C—105387

C-105387

Table 5-4

AVERAGE MONTHLY AND ANNUAL DELTA OUTFLOWS
BY YEAR TYPE

(Monthly Values in Cubic Feet per Second and Annual Values in Thousand Acre-Feet; Early 1990s)

Year Type	Alternative*	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Annual
Wet	1	8,522	13,446	41,264	76,384	82,401	54,632	43,515	33,916	21,168	9,787	6,812	5,347	23,767
	2	8,951	13,698	41,111	76,039	81,791	54,558	43,913	33,866	21,167	9,762	6,782	5,575	23,769
	3	8,896	13,793	41,092	75,573	81,144	55,242	44,407	33,879	21,167	9,763	6,783	5,580	23,784
	4	8,986	13,793	41,063	75,465	80,750	55,716	44,435	33,879	21,167	9,763	6,783	5,580	23,784
	5	7,568	12,548	41,792	77,358	81,893	55,638	44,254	33,875	21,169	9,795	6,795	5,329	23,819
	6	6,951	11,930	41,970	77,713	82,372	56,426	44,702	33,897	21,169	9,777	6,795	5,260	23,876
Above Normal	1	5,543	7,532	13,325	16,711	37,218	40,577	20,990	18,646	11,819	8,124	6,567	4,847	11,488
	2	5,798	7,830	13,103	16,207	36,548	40,153	21,108	18,521	11,819	7,906	5,985	4,830	11,364
	3	5,800	7,931	12,994	15,980	36,176	40,309	21,462	18,591	11,819	7,800	5,985	4,830	11,356
	4	5,800	7,931	12,994	15,980	36,219	40,348	21,437	18,591	11,819	7,780	5,951	4,830	11,357
	5	5,074	6,828	12,931	15,855	38,932	41,155	20,509	18,617	11,819	7,898	6,255	4,723	11,400
	6	4,829	6,395	12,611	15,994	39,037	40,927	20,938	18,514	11,821	7,794	6,214	4,724	11,350
Below Normal	1	7,556	7,364	11,524	11,915	30,884	20,180	8,641	10,090	8,453	6,578	5,616	4,292	7,943
	2	7,951	7,495	11,529	11,731	30,291	20,194	8,966	9,887	8,455	6,268	5,245	4,294	7,897
	3	7,971	7,490	11,423	11,625	30,034	20,145	9.023	9.971	8,456	6,242	5,245	4,294	7,874
	4	7,971	7,490	11,423	11,625	29,948	20,219	9,023	9,971	8,456	6,242	5,245	4,294	7,874
	5	7,155	6,564	11,558	11,977	30,297	19,604	8,640	10,144	8,460	6,530	5,772	4,287	7,818
	6	6,662	6,653	11,383	12,299	29,436	19,301	8,692	10,051	8,458	6,579	5,822	4,297	7,740
Dry	1	6,248	6,576	7,928	11,502	17,806	12,629	8,065	7,714	6,262	5,951	5,484	4,134	6,011
	2	6,244	6,754	7,824	10,963	17,437	12,342	8,213	7,726	6,268	5,587	5,050	4,139	5,905
	3	6,250	6,753	7,821	10,892	17,208	12,469	8,141	7,726	6,268	5,647	5,047	4,139	5,895
	4	6,250	6,753	7,821	10,892	17,208	12,469	8,141	7,726	6,268	5,647	5,047	4,139	5,895
	5	5,653	6,072	7,525	10,386	16,839	11,882	8,406	7,732	6,272	5,985	5,461	4,138	5,775
	6	5,478	5,865	7,260	10,067	16,472	11,596	8,366	7,727	6,297	5,956	5,418	4,139	5,672
Critical	1	7,361	5,956	6,344	6,229	6,183	4,672	4,298	4,007	3,933	4,108	4,056	3,824	3,676
	2	7,300	5,985	6,469	6,125	5,958	4,788	4,290	4,003	3,935	4,106	4,029	3,824	3,668
	3	7,300	5,981	6,446	6,125	5,947	4,773	4,290	4,003	3,933	4,106	4,027	3,821	3,664
	3	7,300	5,981	6,446	6,125	5,947	4,773	4,290	4,003	3,933	4,106	4,027	3,821	3,664
	4	6,579	4,863	6,841	5,973	5,857	4,759	4,296	4,007	3,933	4,049	4,387	3,826	3,582
	5	6,131	4,901	6,961	5,863	5,949	4,810	4,298	4,007	3,933	4,045	4,865	3,824	3,595

* 1 = 0-6.4, 2-6.4, and 4-6.4
2 = 2-7.3(Corps) and 4-7.3(Corps)
3 = 2-8.5(Corps) The operation study was calculated by adjusting the operation study of Alternative 4-10.3(Corps)
4 = 4-10.3(Corps)
5 = 2-8.5 and 4-8.5
6 = 4-10.3

(Corps) = Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

Impacts on Delta Outflow Surges

Surges are short-term increases in flow above base flows. Concerns have been raised about the interrelationship between outflow surges and the biological resources of the bay. The State Water Resources Control Board has outlined interim policy guidelines for project planning. The guidelines allow for surges in Delta outflow of at least 10,000 cubic feet per second within a 5- to 10-day interval for an average of four times a year for the historical hydrologic period, 1939 to 1976. According to these guidelines, for the historical dry period 1928 to 1934, such surges should occur at least once each year. Surges are evaluated below, and their interrelationships with biological resources are discussed in connection with cumulative impacts in Chapter 6, "General Inpacts of Additional Pumps with Potential Related Projects".

The operation studies computed mean monthly outflows, and shorter periods are necessary to evaluate occurrence and magnitude of short-term outflow surges. Therefore, analysis of the effects of increased diversion capability on outflow surges was based on historical

C—105388

C-105388

daily outflows. The analysis was for the 24-year period of daily outflow estimates from October 1955 through September 1979. During this period, outflow estimates were affected by:

- Storage regulation by Folsom, Oroville, and other reservoirs.
- Gradually increasing Delta exports and upstream water uses.
- Changing Delta water quality standards and minimum outflow requirements.
- The 1976-1977 drought and several floods.

During the 24-year period, there was an average of six surges per year. There were no surges during the drought, which was before the guidelines were established. Sizes of outflow surges were categorized as follows:

Size	Number	Cubic Feet per Second
Small	64	10,000 to 25,000
Medium	53	25,000 to 100,000
Large	27	>100,000

Procedures used for the analysis included increasing historical exports and reducing surges to reflect increase of pumping schedules for the existing and additional pumps. Table 5-5 summarizes the analysis in terms of average magnitudes for the three size categories and the number of surges for each category. In all cases, the State Water Resources Control Board's guidelines would be met.

No-Project Alternative. Under the no-project alternative, outflow surges during the 24-year historical period could decrease using the capacity of the existing pumps to meet increasing demands. About ten of the historical surges could be decreased to slightly below 10,000 cubic feet per second. The number of medium and large surges would not be changed.

Preferred Alternative. With four additional pumping units operated under Corps constraints, there would be a slight decrease in the number of surges with a magnitude less than 10,000 cubic feet per second. However, no historical condition was reduced below four annual surges. The number of medium and large surges was not changed. These appear to be minimal incremental effects. Outflow requirements for the bay's biological resources are not well understood, and there was insufficient information to determine significance, as discussed later in this chapter (Summary of Impacts under Preferred Alternative).

Other Alternatives. Alternatives 2-7.3 (Corps) and 2-8.5(Corps) could have impacts similar to the preferred alternative. Under Alternative 4-10.3, one additional surge would be decreased to slightly below 10,000 cubic feet per second and no medium or large surge numbers would be changed.

Table 5-5

COMPARISION OF AVERAGE MAGNITUDE OF DELTA OUTFLOW SURGES

(Values in 1,000 Cubic Feet per Second)

	Small* Surges (Avg.)	(No.)	Medium** Surges (Avg.)	(No.)	Large*** Surges (Avg.)	(No.)
Historical (1955 to 1979)	16	(64)	48	(53)	189	(27)
Adjusted for present standards and capabilities (No Project Alternative)	15	(54)****	46	(53)	187	(27)
Adjusted for Alternatives 4-7.3(Corps) and 4-10.3(Corps)	14	(52)	45	(53)	186	(27)
Adjusted for Alternative 4-10.3	14	(51)	45	(53)	186	(27)

* Small = 10,000 - 25,000 cfs
** Medium = 25,000 - 100,000 cfs
*** Large = 100,000 cfs
****Number in parentheses is total number of surges for the category. For the small surges category, the reduced numbers occurring for adjusted conditions represent surges that were reduced slightly below 10,000 cubic feet per second.

(Corps) = Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

C—105389

C-105389

Impacts on Delta Municipal and Industrial Uses

Major diversions from the Delta for municipal and industrial uses, other than Delta-Mendota Canal and California Aqueduct diversions, are the Contra Costa Canal intake on Rock Slough and offshore diversions in the western Delta from Antioch to Crockett. Decision 1485 municipal and industrial standards for the Contra Costa Canal intake and for Antioch are similar, but they allow use of Contra Costa Canal supplies as a substitute for those at Antioch when offshore water quality is inadequate for the intended use. The 250 mg/L maximum mean daily chlorides must always be met at Contra Costa Canal intake. Quality of these supplies is affected by Delta outflows, reverse flows of the San Joaquin River at Antioch, and local agricultural return flows.

Department of Water Resources contracts with the city of Antioch and Contra Costa Water District recognize that availability of usable river water will decrease in the future, due in part to State Water Project operation. The contracts establish formulas for State reimbursement for the additional cost of substitute water from Contra Costa Canal.

Decision 1485 municipal and industrial standards for the Clifton Court Forebay intake and the Delta-Mendota Canal also specify a maximum of 250 mg/L mean daily chlorides. State Water Project export quality objectives at Clifton Court Forebay are 100 mg/L chlorides on a monthly average basis.

Tables B-5 and B-6 in Appendix B show projected salinities from the operation studies for various locations. Monthly salinities vary slightly for all alternatives, and in all cases they comply with Decision 1485 municipal and industrial standards.

No-Project Alternative. Under the no-project alternative, reverse flows would occur at Antioch as listed below:

Wet Years:	52% of the time
Below Normal Years:	69% of the time
Critical Years:	46% of the time

Under such reverse flow conditions, Decision 1485 municipal and industrial standards at Antioch could not always be met, even in wet years (see Appendix B, Table B-4G). Thus, by 1990 the allowable substitute supplies from the Contra Costa Canal would be used to a greater extent than at present, and State reimbursement under existing contracts would increase.

Table B-5E in Appendix B shows salinities under the no-project alternative for Old River at Rock Slough, about 2.5 miles east of the Contra Costa Canal intake. The Decision 1485 standards shown are for the intake. At times, salinities at the two locations are different; some degradation is caused by local agricultural return flows. The salinities shown at Old River meet Decision 1485 standards for all year types and should be met at the intake.

Preferred Alternative. Under the preferred alternative, Decision 1485 municipal and industrial standards and export quality objectives would be met, similar to the no-project alternative. There would be small variations in water quality, but overall there appears to be no significant adverse incremental effects on municipal and industrial uses of water supplies from the Delta.

Other Alternatives. Similar results occurred for the other alternatives and, therefore, none should significantly affect municipal and industrial uses.

Impacts on Delta Agricultural Uses and Water Levels

In the western and interior Delta, agricultural uses of Delta water supplies can be affected by varying outflows and corresponding variations in salinity concentrations. In the southern Delta, agricultural uses are affected most directly by high salinity concentrations from the San Joaquin River. Also, southern Delta users have expressed concern about possible adverse effects of State Water Project and Central Valley Project export pumping on water levels and water circulation, and thus on water quality. (See discussion in Chapter 4, "Southern Delta".)

Tables B-5 and B-6 in Appendix B show projected salinities from the operation studies for various locations in the interior and western Delta. Salinities are also shown for Decision 1485 agricultural standards at Emmaton, Jersey Point, and San Andreas Landing. Monthly salinities vary slightly with the alternatives, but overall there appears to be no significant adverse effect. In all cases they are within standards. Thus, operation with additional pumps, even with southern Delta modifications, should not significantly affect agricultural uses in the western and interior Delta.

Water level drawdowns resulting from the State Water Project and the Central Valley Project are of concern; information on this matter can be found in Chapter 4, under the heading "Southern Delta". As noted, impacts are evaluated using Table 4-1, developed from the most recent available information. Continuing investigations have identified a modified type of operation for Clifton Court Forebay that has demonstrated, by hydrodynamic mathematical modeling, a reduction of total State Water Project drawdown effects to surrounding channels. Therefore, the drawdown impacts identified in Table 4-1 may be higher than what will occur in the future.

In general, the evaluation of additional pumps did not find significant incremental impacts for any of the alternatives when compared to the no-project alternative. Three factors important to the evaluation are:

- Operations with the additional pumps and existing facilities shifted exports from the irrigation season and toward winter months that would slightly improve water levels for local agricultural pumping.

- Increased diversion that occurred in winter for the alternatives operated to meet the Corps criteria were limited to the mid-December to mid-March period when San Joaquin River flow exceeds 1,000 cubic feet per second. Analysis of this operation by the Corps of Engineers showed no additional reduction in water levels at Clifton Court Ferry, because any increased drawdown would be offset by higher stages caused by increased San Joaquin River flows. For all other months, historical maximum diversions could not be exceeded.

- Increased exports for alternatives not operated to meet the Corps criteria would require southern Delta channel improvements and these improvements would lessen total project drawdown effects.

Operations with the additional pumps required evaluation of changes in daily diversion as well as monthly changes. Some daily changes with the additional pumps occurred between mid-week and Sundays to efficiently use off-peak energy sources. Table 5-6 shows total Central Valley Project and State Water Project effects on water levels at Clifton Court Ferry for early 1990 conditions. These amounts will rapidly diminish with distance. Incremental changes for the various alternatives can be determined by comparison to the 0-6.4 no-project alternative. The lower

C—105391

C-105391

Table 5-6

ESTIMATED TOTAL DRAWDOWN EFFECTS OF STATE AND FEDERAL WATER CONDITIONS*
AT CLIFTON COURT FERRY
(Early 1990s High-High Tides)

Alternative	April	May	June	July	August	September
0-6.4	0.9 to 1.2	0.5 to 0.8	0.5 to 0.7	0.7 to 1.0	0.7 to 1.0	0.6 to 0.9
2-6.4	0.8 to 1.4	0.5 to 0.8	0.5 to 0.7	0.7 to 1.0	0.7 to 1.0	0.6 to 0.9
4-6.4	0.7 to 1.5	0.5 to 0.8	0.5 to 0.7	0.7 to 1.0	0.7 to 1.0	0.6 to 0.9
2-7.3 and 4-7.3(Corps)**	0.8 to 1.3	0.5 to 0.8	0.5 to 0.7	0.6 to 0.9	0.6 to 0.8	0.6 to 0.9
2-8.5 and 4-10.3(Corps)**	0.8 to 1.3	0.5 to 0.8	0.5 to 0.7	0.6 to 0.9	0.6 to 0.8	0.6 to 0.9

* Drawdowns shown in feet for high-high tides during main irrigation season for Tracy Pumping Plant drawdowns are included as follows: April 0.42 feet; May and June 0.30 feet; June, July, and August 0.44 feet. Effects will diminish rapidly with distance.
**Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

drawdown figures in Table 5-6 are for the mid-week diversion rates shown in Table 5-3; the higher drawdown figures are for the peak diversion rate on Sundays. Values are for high-high tide conditions; low-low tide would be much less, if any because Clifton Court Forebay gates are closed.

Alternatives with southern Delta improvements are not shown because such improvements are expected to lessen total drawdown impacts.

No-Project Alternative. For conditions during the early 1990s, forebay operations during the irrigation season would not differ much from present. With existing pumping units, total high-high tide drawdowns at Clifton Court Ferry would reach about 1.0 foot on weekends during July and August and about 1.2 feet during April. This effect will rapidly diminish with distance. In May and June drawdowns would be slightly less in accordance with State Water Resources Control Board Decision 1485 export limits.

Preferred Alternative. Operation under the Corps constraints would have no significant incremental effect on tidal fluctuations at Clifton Court Ferry and should not aggravate the agricultural water supply problem in the southern Delta. In making this conclusion, the Department has considered concerns about effects of exports on water levels, circulation, and quality discussed in the June 1980 report of the South Delta Water Agency and the Bureau of Reclamation (discussed in "Southern Delta", Chapter 4).

During the irrigation season there would be a slight incremental improvement of water level from reduced midweek and Sunday diversion during July and August. Also, a similar improvement in April midweek diversions would occur. No incremental change would occur in May, June, and September. A 0.1-foot increase in drawdown would occur during peak Sunday diversions in April adjacent to the forebay; this effect would rapidly diminish with distance. Increased winter exports would only occur when adequate San Joaquin River inflows were present to offset drawdown. This does not appear to affect any uses or other conditions in the Delta and is, therefore, considered insignificant.

Other Alternatives. Alternatives 2-6.4 and 4-6.4 would increase off-peak pumping and diversions on weekends, with incremental drawdown effects reaching about 0.3 foot in April.

C—105392

C-105392

Alternatives 2-8.5, 4-8.5, and 4-10.3 would lessen drawdown impacts due to the second Clifton Court Forebay intake and southern Delta channel improvements that were assumed.

Impacts on Channel Velocities, Scour, and Siltation

There is concern that the present export facilities cause erosion and siltation in addition to that caused by natural tidal action and that the new units could worsen the problem. Department of Water Resources personnel have met with these interests to discuss the Department's scour monitoring program and ways to better document any changes in channels near the Tracy and Banks pumping plants.

The Department, aware that pumping could contribute to changes in southern Delta channels, initiated a scour monitoring program to document any changes. Part of the program consists of surveying channel cross sections periodically at preselected sites. Cross-sectional area data from surveys conducted since 1969 are published in Department memorandum reports. Records show fluctuations between scour and siltation but little overall change between the first and last channel cross-sectional area measurements.

The Bureau of Reclamation cooperates in the program by a periodical aerial photogrammetric survey of channel levees near the pumping facilities to document levee conditions above the water surface. Copies of these photos are on file in the Department's Central District office and the Bureau's Sacramento office.

Potential scour problems with future export and existing channels were evaluated by means of estimated magnitude and duration of velocities in southern Delta channels. The scour evaluation considered full capacity pumping at the Tracy Pumping Plant concurrently with peak State Water Project diversions. This evaluation of the southern Delta is based on field observations indicating that velocities below 3.0 feet per second will probably not cause scouring.

For this final report, updated hydrodynamic computer model studies were made using the relationship between State Water Project forebay diversions and San Joaquin River inflows according to the Corps constraints, which allow greater diversions in winter when flows of the San Joaquin River are high. (See Chapter 3, "Operational Considerations", for details.) It was shown that high inflows and diversions will occur infrequently. The hydrodynamic studies investigate extreme velocity conditions that occur during all phases of a tidal cycle for combined Federal and State project export rates ranging from 0 to 15,000 cubic feet per second. In these studies, channels adjacent to the export facilities would have maximum velocities below 2.7 feet per second. Study results are on file with the Department of Water Resources.

No-Project Alternative. Operation with existing units for conditions during the early 1990s involves monthly diversion rates at Clifton Court Forebay of over 6,000 cubic feet per second about 40 to 50 percent of the time. During these months, San Joaquin River inflows in the operation studies averaged about 3,500 cubic feet per second. Hydrodynamic computer model studies for the no-project alternative showed that channel velocities would be less than minimum scouring velocity (3.0 feet per second), thus trends would probably continue in nearby channels.

Preferred Alternative. Under the upper limit of the preferred alternative (4-10.3(Corps)), monthly diversion rates exceeding 6,400 cubic feet per second could occur about 75 percent of the time from December to March. Hydrodynamic studies with variable flows in the San Joaquin River showed about the same

C—105393

C-105393

channel velocities as for the no-project alternative. Thus, there would probably be no scouring problems.

Other Alternatives. The second Clifton Court Forebay intake and dredged southern Delta channels would enable more frequent high diversion rates independent of San Joaquin River inflows and tidal cycles, without the potential for channel scour.

Impacts on Cross-Delta Flows and on Levees

Changes in cross-Delta flows for the alternative operational plans have been evaluated. Increased flows in the Delta Cross Channel (Bureau of Reclamation facility) and in Georgiana Slough could increase the potential for levee deterioration. Flows in these channels are related primarily to Sacramento River inflows and are, therefore, affected by upstream releases and natural flow conditions.

Decision 1485 includes operational constraints on flows in the Delta Cross Channel to protect salmon and striped bass. All alternative operational plans meet Decision 1485 standards. Cross-Delta flows and impacts on salmon, steelhead, and American shad are discussed later in this chapter. Generally, these constraints require closure of the Cross Channel gates from January 1 through May 31 when the Delta outflow exceeds 12,000 cubic feet per second. Normal operation of the Cross Channel for flood control requires that the gates be closed when Sacramento River flows reach about 30,000 cubic feet per second. This occurs during winter and spring.

Flows induced by use of the Delta Cross Channel have scoured the North Fork Mokelumne River near New Hope. This scour may have accelerated placement of rock riprap on Mokelumne River levees. Flood control is probably better due to increased capacity of the North Fork Mokelumne River. Delta Cross Channel flows that go down the South Fork Mokelumne River pass through Dead Horse Cut and flow into the Staten Island levee at a right angle. There have been complaints about the scour of the bank in this area.

Table B-4B in Appendix B shows combined monthly flows in Georgiana Slough and the Delta Cross Channel from the 1990-level operations studies. Table B-4C shows flows in the Delta Cross Channel only. Flows shown meet Decision 1485 constraints on the Delta Cross Channel gates. More information on cross-Delta flows is presented later in this chapter for fish impacts.

No-Project Alternative. Georgiana Slough and Delta Cross Channel average annual combined flows for the no-project alternative are about 6,580 cubic feet per second in wet years, 6,120 in below normal years, and 5,380 in critical years.

Preferred Alternative. Flows in the Delta Cross Channel and Georgiana Slough would not be changed significantly under the preferred alternative, because exports would be increased only under unregulated flow conditions during winter, when the Cross Channel gates are normally closed for flood control.

Other Alternatives. Alternatives 2-8.5, 4-8.5, and 4-10.3 would change monthly upstream reservoir operation and exports somewhat, slightly affecting monthly flows in the Delta Cross Channel and Georgiana Slough during regulated flow conditions. These changes are minimal. During unregulated flow conditions flows would not change significantly, for the same reasons as for the preferred alternative.

General Impacts on Salmon and Steelhead

Chinook salmon and steelhead rainbow trout are the principal salmonids that migrate through the Sacramento-San Joaquin estuary to and from upstream spawning grounds. Over 90 percent of the Central Valley's salmon and virtually all of its steelhead are produced in the Sacramento River system.

The biology, life history, and environmental requirements for steelhead are similar to those of salmon, except that many adult steelhead return to the ocean after spawning and juveniles migrate to the ocean at a larger size. Figure 8 shows the general migration patterns of the various salmon and steelhead runs using the estuary and the range in the number of fish in the salmon runs. The salmon runs are for upstream migration of mature adults and downstream migration of juveniles. Most of the downstream migration is in the spring; however, outmigrants can be found in the Delta most of the year. A significant number of juvenile salmon from the San Joaquin River migrate through the Delta in the fall.

Numerous facilities have been developed in the Sacramento-San Joaquin river system to maintain anadromous fishery resources. These include hatcheries, spawning channels, fish screens, and fish ladders. Salmon and steelhead hatcheries constructed to mitigate the loss of spawning area include Coleman, Nimbus, and Feather River hatcheries; the Merced River Fish Facility; and the Mokelumne River Fish Installation (consists of salmon spawning channels and a steelhead hatchery). Such mitigation measures have had variable results. In the American and Feather rivers, the combination of hatcheries and maintaining suitable flows has generally been successful in mitigating effects on fall and winter run salmon. However, numbers of spring run salmon have generally been reduced.

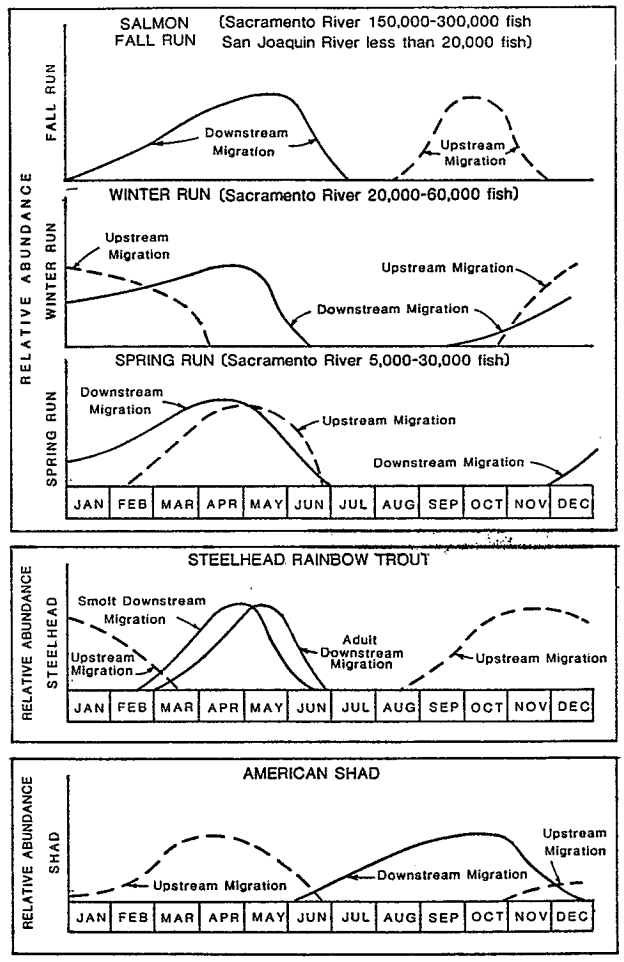


FIGURE 8 GENERAL MIGRATION PATTERNS OF SALMON, STEELHEAD RAINBOW TROUT, AND AMERICAN SHAD IN THE SACRAMENTO-SAN JOAQUIN ESTUARY

(Source SWRCB's EIR, Page II-78)

Environmental requirements of salmon and steelhead adults migrating upstream include adequate temperature and dissolved oxygen levels, sufficient flows, and net downstream flow of homestream water. Juvenile salmon migrating to the ocean also depend on adequate water temperature, dissolved oxygen, and net downstream flow patterns.

Decision 1485 requirements to protect salmon consist of:

- Flow and salinity standards to maintain adequate food supplies for juvenile out migrating salmon.

- Minimum flow standards for the Sacramento River at Rio Vista to facilitate upstream and downstream migration.

- Closure of Delta Cross Channel gates from January 1 to April 15 when Delta outflows exceed 12,000 cubic feet per second. (Similar standards for young striped bass extend this to May 31.)

- Operating standards for the State Water Project and Central Valley Project fish protective facilities.

Also, export limits for striped bass in May, June, and July reduce exposure of young salmon and steelhead to the screens.

Decision 1485 was not designed to meet without-project levels for salmon, but the State Water Resources Control Board determined that it was reasonable until final determinations were made regarding other means of mitigation for project effects in the estuary.

Sacramento River. The Sacramento River system supports average adult populations of about 50,000 steelhead and up to 390,000 salmon.

Preliminary analysis by the Department of Fish and Game and U. S. Fish and Wildlife Service (data and analysis are on file) has resulted in development of strong correlations between measurements of salmon survival and Sacramento River flows.

Diversions in the southern Delta by the State Water Project and Central Valley Project, combined with flows through the Delta Cross Channel, increase the proportion of Sacramento River water present in the interior Delta. Also, southern Delta diversions frequently cause reverse flows in the lower San Joaquin River during August through November, the period when most Sacramento River adult salmon and steelhead migrate upstream. Some of these fish use the lower San Joaquin River and Mokelumne River on their way upstream, returning to the Sacramento River through the Delta Cross Channel and Georgiana Slough. Altered flow patterns result in straying and delay of migrating fish. Delays cause some fish to die before reaching spawning grounds and cause some to stray into areas unsuitable for spawning. The magnitude of these effects on the population as a whole is unknown.

Ability of Sacramento River juveniles to take the most direct route through the estuary is affected by flows being diverted from the Sacramento River into the interior Delta through the Delta Cross Channel and Georgiana Slough. Fish drawn into the interior Delta along these paths experience higher mortality than those remaining in the Sacramento River. Studies to quantify this additional loss will not be completed for several years. Preliminary results suggest that mortality is 20 to 40 percent higher for fish entering the interior Delta than for fish remaining in the Sacramento River. Smaller juvenile salmon (fry) migrating in January through March depend more on food produced in the estuary than do larger juveniles (smolts) migrating in spring. Fry use the estuary as nursery habitat, while smolts pass through rapidly.

The number of salmon of Sacramento River origin arriving at the fish screens in the southern Delta is influenced to a great extent by export rates in spring, especially in April and May. The number also depends on winter flows in the Sacramento River, which cause variations in spawning, egg, and fry conditions.

San Joaquin River. Salmon runs in the San Joaquin River system have declined to less than a fifth of their abundance of 40 years ago as a result of various actions, water development projects, and increased pollution. Flows that support fall run salmon in the San Joaquin River and its tributaries (Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers), particu-

C—105396

C-105396

larly flows in the spring, determine to a large extent the number of juvenile salmon produced and the number of adults that return. Flow patterns in the Delta and the amount of water of San Joaquin River origin that is exported at State Water Project and Central Valley Project diversions in the southern Delta also affect San Joaquin River salmon. Studies of tagged juvenile salmon indicate that the majority collected at State Water Project and Central Valley Project fish screens are of San Joaquin River origin.

Water export in the southern Delta affects adult San Joaquin River salmon in two ways. Low dissolved oxygen levels each fall in the San Joaquin River near Stockton are caused by low flows in the river and organic sediments in the Stockton Deep Water Channel. These appear to be the major cause of the oxygen depression, since the city of Stockton has improved its sewage facilities. Southern Delta pumping may aggravate this situation by reducing or reversing flows in this area. Any delay caused by this oxygen block interferes with successful migration, and increased exports during fall could extend the period of unsuitable conditions. Mitigation for this condition has included installation of a temporary barrier in Old River to create a downstream flow in the San Joaquin River past Stockton. The Department of Water Resources has done this every fall since 1963, except in a few years when San Joaquin River flows and dissolved oxygen levels were adequate for fish passage.

Southern Delta exports also affect adult San Joaquin River salmon by reducing the amount of San Joaquin River water in the western Delta. The proportion of San Joaquin River water in the Delta was low before project export pumping, and State Water Project and Central Valley Project operations have further decreased this proportion of flow.

The number of juvenile San Joaquin River salmon exposed to project fish screens during spring is related to the proportion of San Joaquin River inflows drawn through the upper end of Old River by the export facilities. This proportion varies considerably with San Joaquin River flows and, to a lesser extent, with export rates during spring, but in all years the majority of San Joaquin River flow is drawn to the pumps. In drier years all water from the San Joaquin River enters the head of Old River and water from this source not used for local irrigation is diverted by the State Water Project and Central Valley Project.

Table 5-7 summarizes seasonal Delta flows and relationships under alternative operational plans that could affect salmon and steelhead migration. All values shown are 57-year averages from the early 1990 condition operation studies. These are flows in the lower San Joaquin River and ratios of flows diverted toward the export pumps from the San Joaquin and Sacramento rivers. Tables 5-8 and 5-9 show, by month, flows and ratios diverted from the Sacramento and San Joaquin rivers during months of high juvenile salmon abundance. A higher ratio indicates greater displacement of juveniles from normal migration routes. The San Joaquin flow ratio is low in October and November because of the temporary barrier in Old River.

Dissolved oxygen, temperatures, and nursery areas in Delta channels should not be changed with the alternative operational plans, nor should the net downstream flow of homestream water.

No Project Alternative. With the existing units, monthly export rates vary considerably from year to year, but the trend in the operation studies is that exports will be increased in fall and winter to meet increasing entitlement deliveries. Unsatisfactory conditions for salmon and steelhead in the estuary would gradually worsen. Since effects of Central Valley Project and State Water Project operations are most pronounced on San Joaquin River salmon,

C—105397

C-105397

these populations would be most directly affected.

Preferred Alternative. Under the preferred alternative, there would be slight changes (compared to the no-project alternative) in Sacramento River monthly average flows as shown in Table 5-8. There would be no change in average ratios of cross-Delta to Sacramento River flows and salmon migration is not expected to be affected. Reduction of reverse flows in the lower San Joaquin River would be slightly beneficial for salmon migration. Exposure of juvenile salmon to the fish screens would vary with monthly average abundance and monthly average diversions during fall, winter, and spring. More salmon could be entrained into the Delta Complex. (See "Direct Impacts of the Delta Complex on Chinook Salmon" in this chapter for entrainment and loss estimates.)

With respect to daily operational changes at Clifton Court, there would probably be some increased entrainment of juvenile migrants on weekends during spring. Assuming that the entrainment of juvenile salmon into Clifton Court Forebay is a function of their density in the water (an assumption supported by salvage records), this would be offset with lesser effects during the week, with probably no significant overall effect.

Other Alternatives. Alternatives 2-6.4 and 4-6.4 would have no significant incremental effect on salmon and steelhead migration or on exposure to fish screens due to daily operational changes. Changes in daily operations are assumed to have an offsetting effect, as previously discussed.

The effects of Alternatives 2-7.3 (Corps) and 2-8.5(Corps) on salmon and steelhead would be similar to those of the preferred alternative.

Alternatives 2-8.5, 4-8.5, and 4-10.3 would cause no significant change in flow ratios for either river. However, there would be a slight increase in reverse flows in the lower San Joaquin River during the period when Sacramento River adults are migrating upstream (August through November). This could aggravate the problem of straying and delay. On the average, more juvenile salmon could be lost at the Delta Complex than for the no-project alternative, but the loss would be less than for the preferred alternative.

Table 5-7

SUMMARY OF SEASONAL DELTA FLOWS AFFECTING SALMON AND STEELHEAD
(Flows Are 57-Year Averages in Cubic Feet per Second; Early 1990s)

Alternative Operational Plan	Lower San Joaquin River Flows* August-November	Upper San Joaquin River Flows** November	Average Flow Ratios	
			Sacramento River*** October-June	San Joaquin River**** October-June
0-6.4, 2-6.4, 4-6.4	-460	1,161	0.28	0.73
2-7.3(Corps)x 4-7.3(Corps)x	-384	1,161	0.28	0.73
2-8.5(Corps)x 4-10.3(Corps)x	-381	1,161	0.28	0.73
2-8.5, 4-8.5	-623	1,161	0.28	0.73
4-10.3	-828	1,161	0.28	0.73

x Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.
* Lower San Joaquin River at Antioch. Negative sign indicates reverse flows.
** San Joaquin River below Old River. Flows are estimated with the temporary barrier to provide a minimum net downstream flow of 500 cubic feet per second in October and November.
*** Flow ratio of Delta Cross Channel and Georgiana Slough to Sacramento River (see Table 5-8). This ratio is an indicator of the displacement of Sacramento River juveniles from normal migration routes.
****Flow ratio of Old River to San Joaquin River (see Table 5-9). This ratio is an indicator of San Joaquin River juveniles drawn to the CVP and SWP export facilities.

Table 5-8

RATIO OF CROSS-DELTA FLOWS TO SACRAMENTO RIVER FLOWS
FOR MONTHS OF HIGH SALMON ABUNDANCE

(Flows are 57-Year Averages in Cubic Feet per Second; Early 1990s)

Alternative*		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
0-6.4, 2-6.4	Sacramento River	13,911	16,943	24,334	29,332	37,353	32,013	23,209	21,972	18,407
4-6.4	Cross-Delta	6,048	6,567	6,650	5,589	5,909	5,798	6,430	6,026	6,671
	Ratio	0.435	0.388	0.273	0.191	0.158	0.181	0.277	0.274	0.362
2-7.3(Corps)**	Sacramento River	14,382	17,405	24,645	29,640	37,501	32,024	23,365	21,956	18,291
4-7.3(Corps)**	Cross-Delta	6,183	6,691	6,718	5,646	6,005	5,803	6,476	6,027	6,637
	Ratio	0.430	0.384	0.273	0.190	0.160	0.181	0.277	0.275	0.363
2-8.5(Corps)**	Sacramento River	14,398	17,451	24,676	29,701	37,581	32,013	23,250	21,987	18,281
4-10.3(Corps)**	Cross-Delta	6,188	6,699	6,719	5,653	6,016	5,707	6,442	6,033	6,634
	Ratio	0.430	0.384	0.272	0.190	0.160	0.178	0.277	0.274	0.363
2-8.5, 4-8.5	Sacramento River	13,043	16,069	24,201	30,483	38,289	32,206	23,597	21,885	17,856
	Cross-Delta	5,792	6,294	6,374	6,040	6,130	5,817	6,547	6,001	6,510
	Ratio	0.444	0.392	0.263	0.198	0.160	0.180	0.277	0.274	0.365
4-10.3	Sacramento River	13,019	16,151	24,284	29,967	38,399	32,412	23,556	21,828	17,795
	Cross-Delta	5,786	6,313	6,333	5,873	6,076	5,877	6,532	5,983	6,492
	Ratio	0.444	0.391	0.261	0.196	0.158	0.181	0.277	0.274	0.365

* Cross-Delta flows are sum of flows in Delta Cross Channel and Georgiana Slough. Flows in the Cross Channel reflect flood control operations and Decision 1485 constraints from January 1 to May 31 to minimize cross Delta movement of salmon and diversion of young striped bass into Central Delta.
**Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

Table 5-9

RATIO OF OLD RIVER FLOWS* TO SAN JOAQUIN RIVER FLOWS**
FOR MONTHS OF HIGH SALMON ABUNDANCE

(57-Year Average Values; Early 1990s)

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Average
San Joquin River Flow, in cubic feet per second	2,377	1,935	2,464	3,366	4,763	3,658	3,199	2,511	2,241	
Flow Ratios -- (Old River/San Joaquin River)										
0-6.4, 2-6,4, 4-6.4	0.40	0.40	0.96	0.85	0.77	0.82	0.83	0.79	0.76	0.73
2-7.3(Corps)*** 4-7.3(Corps)***	0.40	0.40	0.96	0.87	0.79	0.82	0.82	0.79	0.76	0.73
2-8.5(Corps)*** 4-10.3(Corps)***	0.40	0.40	0.96	0.83	0.80	0.81	0.81	0.79	0.76	0.73
2-8.5, 4-8.5	0.40	0.40	0.95	0.88	0.79	0.82	0.83	0.79	0.74	0.73
4-10.3	0.40	0.40	0.95	0.87	0.80	0.82	0.82	0.79	0.74	0.73

* Old River at Head
** San Joaquin River at Mossdale
***Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

C—105399

C-105399

General Impacts on Striped Bass

Striped bass, introduced in 1879 from the East Coast, are one of California's most important sport fish, although populations have declined significantly over the last 30 years. Most adults stay in Suisun, San Pablo, and San Francisco bays, but some larger ones leave the bay area and spread north and south along the Pacific Coast.

During fall, there is a general migration of adult striped bass into the Delta, where some stay during winter; the rest return to the bay. During spring, the adults migrate to spawning areas: about two-thirds to the Sacramento River above Sacramento, and the rest to the San Joaquin River and adjacent sloughs from Antioch to Venice Island. On the average, a female lays about 800,000 eggs, which drift with the currents until hatching several days later. Natural mortality rates are high from the time eggs are laid until the middle of the first winter. Based on Department of Fish and Game survival estimates, about one of 21,000 eggs survives to the end of the year.

Most spawning in the lower San Joaquin River occurs at salinities less than 200 mg/L total dissolved solids, although successful spawning does occur at higher salinities. In the laboratory, egg survival does not decrease until salinity exceeds 1,000 mg/L total dissolved solids. Salinities in the Sacramento River are much less than in the lower San Joaquin River.

Four to six weeks after spawning, the larvae and young bass are mainly in the entrapment zone, an area of high biological productivity in the estuary. The young bass stay in the entrapment zone through fall, and many move downstream to San Pablo Bay in early winter. During the second year, they scatter from San Pablo Bay upstream into the Sacramento and San Joaquin rivers.

Larval bass initially depend on small zooplankton for food, but within a few weeks Neomysis become their principal food and continue so until the second summer, when smaller fish become the major diet item.

The number of bass that survive to become adults depends on many factors, among which are:

- Egg viability and number
- Losses at diversions
- Habitat size and suitability
- Food supply
- Predation
- Competition
- Pollution
- Disease

From the late-1950s to the mid-1970s, much of the variation in survival of young bass could be explained by variations in Delta outflows and exports during May, June, and July. Basically, higher outflows and lower diversions were correlated with better young striped bass survival. Abundance of young striped bass in Suisun Bay was highly correlated with the logarithm of June-July Delta outflow during the entire period from 1959 to 1976. Abundance of young striped bass in the Delta during that period was correlated with exports (State Water Project, Central Valley Project, and local) and Delta outflow during June and July. Decision 1485 standards for striped bass are based on these outflow/export relationships.

Since 1976, the outflow/export relationships have failed to accurately predict the abundance of young striped bass in the estuary, actual abundance being much less than that predicted.

Causes of the striped bass decline are still unknown, but have been investigated by the Striped Bass Working Group, a group of scientists working at the request of the State Water Resources

Control Board. The group's findings, published in The Striped Bass Decline in the San Francisco Bay-Delta Estuary, November 1982, indicate that the recent decline is probably due to one or more of the factors discussed below:

- The plankton food supply of young striped bass in the western Delta and Suisun Bay has been greatly reduced each spring. Export pumping by the Central Valley Project and State Water Project is a prime suspect.

- Large numbers of young bass are lost by entrainment in diversions.

- Additional stresses are placed on the population by toxic substances such as petrochemicals and pesticides.

- The adult population is now so low that egg production may be inadequate.

With regard to inadequate food supply, the Working Group found that, since 1977, zooplankton have been generally low in abundance or delayed in development beyond the time they are needed. Zooplankton, in turn, feed on phytoplankton, which have also been extremely low in abundance or late in development since 1977, especially in the Delta. The Working Group found evidence that the reduced or delayed production of these organisms in the striped bass food chain may be related to the use of Delta channels to convey water to the State Water Project and Central Valley Project export pumps in the southern Delta. Some other factor, such as improved waste treatment, with resulting reduced organic material discharge, could also contribute to the recent changes in phytoplankton and zooplankton production.

The Working Group presented information on a possible negative relationship between peak phytoplankton levels in the western Delta (as measured by chlorophyll a) during the spring bloom and State Water Project and Central Valley Project average export levels seven days before the start of the bloom. The only major spring blooms in the western Delta since 1976 occurred in May 1981 and June 1982, immediately following partial shutdown of the State Water Project pumps for repairs, which greatly reduced total daily export rates.

The Working Group findings suggest that Central Valley Project and State Water Project exports may in some way affect the phytoplankton population and basic productivity of the central and western Delta. Increased water exports in recent years may have caused phytoplankton populations to decline and blooms to be delayed. This may have created a food shortage for zooplankton and caused populations to decline. In turn, the decline in zooplankton may have created a food shortage for young bass at the time most needed, leading to decreased survival.

Curtailment of export pumping does not, however, explain why phytoplankton blooms:

- Are not related to export pump shutdown prior to the 1976-1977 drought.

- Failed to occur during the 1976-1977 drought, when exports were drastically reduced.

- Occurred in post-drought times, such as fall 1980, when export pumping was not reduced or stopped.

- Failed to occur in 1983 when export pumping was reduced.

One further complication is that blooms, such as in June 1982, continued to be high even when export pumping resumed. Considering the export pumps as an "on-off" switch for phytoplankton blooms does not take into account numerous interrelated factors affecting phytoplankton, which are discussed later (see "General Impacts on Phytoplankton").

C—105401

C-105401

The Working Group recommended that the impact of export operations on food production and survival of larval striped bass be evaluated through carefully controlled field studies. This would involve reducing total export pumping to about 3,000 cubic feet per second, primarily in April. The idea would be to try to increase phytoplankton and zooplankton production by the time larval striped bass reach the western Delta and Suisun Bay and begin feeding. Phytoplankton, zooplankton, and young striped bass would have to be sampled intensively during this period to provide suitable data for evaluation.

An interagency work plan has been implemented that includes field studies and associated monitoring and data analysis. A major component of the work plan is the Phytoplankton Task Force.

Field experiments that modified project operations in spring 1984 and 1985 were not conclusive. The field studies will continue in spring 1986 and 1987.

When the studies are completed, there will be several options. If results indicate that export operations play a dominant role in the diminishing young striped bass food chain, the State Water Resources Control Board can initiate action to modify export standards in the Delta Water Quality Control Plan and Water Right Decision 1485. If results indicate that other factors are more important, the Board can direct its efforts toward modifications of the Regional Basin Plans to ensure that suitable environmental conditions are provided to increase food supply and bass survival. If the studies are conclusive, the potential for restoring the striped bass fishery will be measurably enhanced, and understanding of Delta productivity dynamics will be greatly expanded.

With respect to toxic substances, another possible cause of the striped bass decline, there is evidence that adult bass have accumulated some toxins in their flesh and organs at levels exceeding those recommended for aquatic life. There is also evidence that pesticides drained from rice fields in the spring could affect eggs, larvae, or adults in the Sacramento River. Due to a lack of long-term data on body burdens and their impacts, it is not now possible to state whether toxic substances are a major cause of the striped bass decline.

Relationships between toxic materials in Bay and Delta waters and the striped bass fishery have been investigated under the Cooperative Striped Bass Study by the State Water Resources Control Board, National Marine Fisheries Service, and California Department of Fish and Game. The study is completed. On August 5, 1982, the investigators issued a report, which stated that chronic toxic chemical exposure seriously affects every stage of the striped bass life cycle, from egg to adult. They found PCB and toxaphene residues in bass ovaries at potentially harmful levels. In addition, they pinpointed the cause of open lesions of fish in the Bay and Delta to be a parasitic infection by tapeworm larvae.

Uncertainties about factors affecting striped bass, and failure of the outflow/export relationships to predict population levels, complicate analysis of striped bass impacts associated with the existing pumps and the proposed additional pumps. Impacts on the food supply for young striped bass cannot be analyzed completely because of a lack of information and understanding.

Direct entrainment losses of screenable-sized striped bass and of striped bass eggs and larvae, analyzed later in this chapter, are considered to be a component of the overall general impact.

The food supply for young striped bass is also discussed later in this chapter (see sections on Fish Food Supply, Phytoplankton, and Aquatic Invertebrates).

Important factors that could be quantified and that were considered in the analysis of general impacts on young striped bass survival and abundance under the operational alternatives are:

- Salinities in the western Delta during spawning (April and May). High salinities could be detrimental to spawning and egg survival (see Table 5-10).

Table 5-10

MEAN MONTHLY SALINITIES IN THE WESTERN DELTA (ANTIOCH) DURING STRIPED BASS SPAWNING (APRIL AND MAY)

(Values in Milligrams per Liter of Total Dissolved Solids; Early 1990s)

	Alternative Operational Plan				
Year Type	0-6.4 2-6.4 4-6.4	2-7.3 (Corps)* 4-7.3 (Corps)*	2-8.5 (Corps)* 4-10.3 (Corps)*	2-8.5 4-8.5	4-10.3
Wet	177	174	173	173	172
Below Normal	469	464	464	476	492
Critical	2,305	2,296	2,299	2,304	2,292

*Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

- Exports and outflows during May, June, and July. These are probably important to the abundance of young bass (see Table 5-11).

Evaluation of general impacts included a review of daily changes in operations and potential changes in channel velocities that may adversely affect fish and benthic organisms. No adverse effects were found.

No-Project Alternative. Decision 1485 includes several standards to protect striped bass spawning in the lower San Joaquin River and for survival of the young. The spawning standards (salinities and minimum Delta outflows) are effective April 1 through May 5; the survival standards (minimum Delta outflows) are effective May 6 through July 31. These standards have a relaxation provision when the projects impose deficiencies in firm supplies. Operational constraints consist of:

- May, June, and July diversion limits for the State Water Project and Central Valley Project. The limits

Table 5-11

EXPORTS AND OUTFLOWS FOR YOUNG STRIPED BASS ABUNDANCE DURING MAY, JUNE, AND JULY (57-Year Averages, in Cubic Feet per Second; Early 1990s)

	Total Exports*			Delta Outflows			Average	
Alternative	May	June	July	May	June	July	Export	Outflow
0-6.4	5,433	5,211	7,463	18,263	12,263	7,462	6,036	12,663
2-7.3(Corps)** 4-7.3(Corps)**	5,490	5,093	6,900	18,189	12,264	7,297	5,828	12,583
2-8.5(Corps)** 4-10.3(Corps)**	5,490	5,083	6,778	18,221	12,264	7,285	5,784	12,590
2-8.5, 4-8.5	5,352	4,656	7,009	18,256	12,266	7,414	5,672	12,645
4-10.3	5,323	4,596	6,954	18,228	12,265	7,393	5,624	12,629

* Banks and Tracy Pumping Plants
**Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

C—105403

C-105403

are 3,000 cubic feet per second in May and June and 4,600 cubic feet per second in July.

- Closure of Delta Cross Channel gates from April 16 to May 31 to minimize diversion of young striped bass from the Sacramento River into the central Delta. The constraint applies when Delta outflows exceed 12,000 cubic feet per second and can be applied up to 20 days during that period.

- Operating standards for the State Water Project and Central Valley Project fish protective facilities. (The recent $4.5 million expenditure to enlarge the State facility should increase screening efficiencies for young striped bass by about 30 percent, once they reach a length of about 1 inch.)

The high critical year salinities shown in Table 5-10 reflect the Decision 1485 relaxation for striped bass spawning. Salinities are higher than those known to be detrimental to spawning, but effects on the population as a whole are unknown. Occasional occurrences might have little effect, but prolonged occurrences during a drought could gradually reduce spawning in the lower San Joaquin River due to cumulative effects of small differences in survival or due to migratory preferences. In the Sacramento River, salinities are always adequate for spawning because of flows provided by project reservoir releases.

As discussed earlier in this section, it is not known whether increased exports under the no-project alternative, will increase overall or general striped bass losses. Under this alternative, however, direct striped bass entrainment is expected to increase. (See later discussion of "Direct Impacts of the Delta Complex on Striped Bass, including Eggs and Larvae").

Preferred Alternative. No significant incremental effect on young striped bass survival is foreseen due to changes in May, June, and July exports and outflows. Reduced exports in June and July would be offset by reduced outflows in July. Salinities during spawning would not change significantly.

Entrainment of striped bass juveniles, eggs, and larvae at the Delta Complex would decrease relative to the no-project alternative.

Other Alternatives. Conditions under the no-project alternative also apply to Alternatives 2-6.4 and 4-6.4. Conditions under the preferred alternative also apply to Alternatives 2-7.3(Corps) and 2-8.5(Corps) because of similar monthly export and outflow changes.

Under Alternatives 2-8.5, 4-8.5, and 4-10.3, salinities during spawning would not change significantly. These alternatives might result in a slight increase in abundance of young bass in many years, because average exports during May through July would be lowest. Entrainment of striped bass juveniles, eggs, and larvae at the Delta Complex would be lower than for the preferred alternative.

General Impacts on American Shad

American shad are a popular sport fish in the Sacramento River and its major tributaries. Adults migrate from the ocean through the Delta to upstream spawning areas from February through May (see Figure 8). They feed primarily on *Neomysis*, but also eat small zooplankton. Spawning occurs from April to July, peaking in late May and early June. Many shad die after spawning. The fertilized eggs drift slowly along the bottom of the stream and hatch in 4 to 6 days. The young shad grow to 2 to 3 inches before migrating. Outmigration occurs over a long period, but the young are most numerous in the Delta from July through November. They feed mainly on small zooplankton (copepods and cladocerans), which are most numerous in Delta channels having low velocities.

State Water Project and Central Valley Project pumping and associated cross-Delta flows can affect young shad in three ways:

- By reducing their food supply through an overall net increase in channel velocities resulting from Sacramento River water being drawn across the Delta. (The pumping increases velocities in some channels and decreases velocities in others.)

- By drawing them away from the Sacramento River, their normal migration route, resulting in their being more susceptible to predation, disorientation by reverse flows, and unscreened agricultural diversions.

- By drawing them to the fish screens at the State and Federal pumps.

No-Project Alternative. Delta shad populations have remained high under conditions of present Central Valley Project, State Water Project, and local agricultural and municipal diversions. State and Federal operations in the Delta are not known to adversely affect the migration of adult shad, but can reduce the amounts and types of invertebrates in their food supply. Mathematical correlations needed to quantify the impact on adult survival or spawning success have not been determined.

An average of 800,000 young shad have been salvaged annually at the State fish screens since operations began in 1968. Considering the efficiency of the screens, the number of shad reaching the screens is at least 25 percent higher than the salvage records. The majority are salvaged during the peak migration period, July through November. Mortalities associated with the screening process are particularly high for young shad. Also, many young shad are probably eaten by predators in Clifton Court Forebay.

Table 5-12 shows average flow ratios (cross-Delta to Sacramento River) in the months of high shad abundance, July through November. These ratios were computed as for salmon and, similarly, are an indicator of the displacement of Sacramento River juveniles from normal migration routes. There are no institutional constraints on the Delta Cross Channel for shad, and flow ratios are generally higher than during months of high salmon abundance.

Table 5-12

RATIO OF CROSS-DELTA FLOWS TO SACRAMENTO RIVER FLOWS* FOR MONTHS OF HIGH AMERICAN SHAD ABUNDANCE

(Early 1990s)

Alternative	July	Aug.	Sep.	Oct.	Nov.	5-Month Average
0-6.4, 4-6.4 2-6,4	0.41	0.44	0.48	0.44	0.39	0.43
2-7.3(Corps)** 4-7.3(Corps)**	0.42	0.45	0.48	0.43	0.38	0.43
2-8.5(Corps)** 4-10.3(Corps)**	0.42	0.45	0.48	0.43	0.38	0.43
2-8.5, 4-8.5	0.41	0.44	0.48	0.44	0.39	0.43
4-10.3	0.41	0.44	0.48	0.44	0.39	0.43

* Flows are 57-year averages.
**Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

Preferred Alternative. As Table 5-12 shows, cross-Delta flow ratios would change very little during July to November. Thus, no significant incremental effect on migration of American shad is foreseen. There would be some increase in fish screen exposure of shad during winter and a decrease in summer. Quantitative information on fish screen exposure is presented in this chapter under "Direct Impacts of the Delta Complex on Other Fish Species".

Other Alternatives. None of the other alternatives would significantly increase cross-Delta flow ratios. No

C-105405

C-105405

significant incremental effects on migration of American shad are foreseen. Alternatives 2-8.5, 4-8.5, and 4-10.3 would increase fish screen exposure for shad during fall and winter, but this would be offset by reduced exposure in July, as discussed in this chapter under "Direct Impacts of the Delta Complex on Other Fish Species".

General Impacts on Sturgeon

Two species of sturgeon, white and green, inhabit the estuary. Portions of the life cycle of the white sturgeon, the more abundant of the two, have been studied. Little is known about green sturgeon, but environmental requirements of the two species are believed to be similar.

Sturgeon spawn in spring, primarily in the Sacramento River upstream from the Delta. Some may spawn in the San Joaquin River as well. After spawning, adults return to the lower estuary; the young are carried downstream with the current. In years of high riverflow, many larval sturgeon reach the Delta; in years of low runoff, they are scarce. Young sturgeon depend on Neomysis and Corophium for food.

No-Project Alternative. Small sturgeon are poor swimmers and could be susceptible to water diversions. Young sturgeon salvaged at the State Water Project fish screens average about 3,000 annually.

Populations of invertebrates eaten by young sturgeon are affected by State Water Project and Central Valley Project pumping, increasing or decreasing depending on location. Lack of knowledge concerning distribution of young sturgeon in the estuary makes it impossible to predict the overall effect of changes in export pumping.

Preliminary analyses by the Department of Fish and Game (data and analyses on file) suggest a relationship between white sturgeon year class strength, spawning stock size, and the ratio of total exports to total inflows in May. For the early 1990s, this ratio ranges from about 17 percent in wet years to about 42 percent in critical years. Sturgeon are benefited by Decision 1485 restrictions in May.

Preferred Alternative. As Table 5-2 shows, there would be little change in exports during May under the preferred alternative given the relationship discussed above concerning the importance of May exports. Therefore, no effects on sturgeon populations are expected. Screen exposure is computed to be reduced slightly, as discussed later in this chapter.

Other Alternatives. Impacts for the preferred alternative also apply to all other alternatives.

General Impacts on Resident Fish

Many species of fish inhabit the Delta year round. Five species of catfish (white and channel catfish and brown, yellow, and black bullhead) and three species of sunfish (black crappie, largemouth bass, and bluegill) are important game fish. A variety of native and introduced nongame fish are also present. Some are important forage for game fish and others prey on game fish or compete with them in a variety of ways.

Some factors controlling resident fish populations in the Delta have been investigated. Studies in the early 1960s identified general habitat requirements, food preferences, and distribution of most abundant species. More up-to-date information is not available for most species. Available information is summarized in the Final Environmental Impact Report, Agreement to Manage Fish and Wildlife Resources of the Sacramento-San Joaquin Estuary, December 1982. The most common factors are preference for quiet water, minimum movement of substrate so as not to

C—105406

C-105406

inhibit spawning (most species nest on the bottom), and salinity tolerance generally defining the geographical location of different species.

The Department of Fish and Game is studying the abundance, distribution, and habitat preferences of resident fish in the Delta. One preliminary conclusion is that many resident fish are more abundant in channels that do not transport water to the export pumps than in those channels that do. For instance, twice as many bluegill sunfish are found in non-transport channels than in transport channels. The same general relationship has been found for largemouth bass, white catfish, and several minnows, although the effect is not as pronounced.

Abundance and distribution of individual species of resident fish are determined, in part, by water management practices. Water quality and flow standards in Decision 1485 have created habitat conditions favorable to some species and less favorable to others, under the present levels and conditions of Delta export operations. Maintaining a high water quality in the Delta year round (or keeping salinity low) largely determines the species of resident fish that the Delta will support. Delta water quality variations also occur naturally due to the wide variation in Central Valley runoff.

The white catfish is of special concern because of its popularity in sport fishing and because many young-of-the-year are carried past the screens into the export canals. The abundance of white catfish at the screens is greatest from May through August.

A tagging study of white catfish, conducted by the Department of Fish and Game, shows them to be most abundant in the southern Delta, somewhat less abundant in the central and eastern Delta, and least abundant in the northern and western Delta. The white catfish population for the entire Delta is estimated at about 4.5 million. No information on abundance is available for white catfish prior to operation of the Central Valley Project and State Water Project, so project effects on their abundance are difficult to determine. The distribution of white catfish now approximates that found in the early 1960s before State Water Project exports began; therefore, changes in flow patterns induced by export operations and local diversions in recent years appear not to have affected white catfish distribution. However, white catfish tagged in the Delta have been recovered from Clifton Court Forebay and are, thus, being removed from the Delta.

No-Project Alternative. Operation of the projects has affected resident fish by:

- Altering flow patterns, which determine net channel velocities and distribution.
- Salinity control, which has influenced salinity levels and the abundance and distribution of food organisms.
- Entraining fish at export facilities.

Of these effects, only entrainment and losses can be analyzed with present knowledge. Salinity control probably has been beneficial for resident fish that prefer a freshwater environment.

Under the no-project alternative, losses of young white catfish from the Delta will increase as exports increase, as will losses of most resident fish. The relationship between screen losses and total Delta population is not known.

Preferred Alternative. There would be a reduction in summer exports under the preferred alternative, with some overall reduction in screen exposure. Some increases in entrainment of fish into Clifton Court Forebay could be expected from winter increases in export, but salvage records show very low levels of

C—105407

C-105407

entrainment during these months for most resident fish species. Overall impacts on resident fish are, therefore, expected to be less than for the no-project alternative. See section on "Direct Impacts of the Delta Complex on Other Fish Species".

Other Alternatives. Alternatives 2-8.5, 4-8.5, and 4-10.3 would result in some seasonal increases in movement of water toward and through the pumping plant. Impacts would be similar to those identified for the preferred alternative. Overall effects on resident fish are expected to be less than for the no-project alternative. See section on "Direct Impacts of the Delta Complex on Other Fish Species".

Overview of Fish Food Supply Impacts

The food web for both resident and anadromous fish consists of algae (phytoplankton), invertebrates (zooplankton, Neomysis, and zoobenthos), vertebrates (smaller fish), and detritus. A comprehensive evaluation of food supply impacts would have to consider all impacts to individual plant and animal species, as well as complex biological and physical interrelationships between individual plants and animals.

Although there is considerable information concerning the growth and reproduction of plants and animals comprising the food web, many of the interrelationships are not well understood. The food web is dynamic; one organism feeds on another, and one food source is replaced by another with change in season and the abundance and distribution of the food supply. Conditions that affect abundance and distribution of one link in the food web can, consequently, affect the entire food web. In addition, changing estuarine flows, diversions, salinity, and other water quality conditions can affect the complex interrelationships.

Estuarine changes are both project- and nonproject-related. Project and nonproject effects on the food web are discussed in the three sections that follow. These sections discuss ongoing studies of the food web and present knowledge about these effects.

General Impacts on Phytoplankton. Phytoplankton are one of several sources of food for invertebrates and fish in the Delta. The importance of phytoplankton to young striped bass was discussed in "General Impacts on Striped Bass".

Phytoplankton concentrations are affected by many interacting factors, including light penetration, residence time, water temperature, salinities, nutrients, and grazing by zooplankton. Further information on abundance, distribution, and environmental requirements of phytoplankton is available in the State Water Resources Control Board's "Environmental Impact Report for the Water Quality Control Plan and Water Right Decision Concerning Sacramento-San Joaquin Delta and Suisun Marsh" (1978).

Prior to the 1976-77 drought, two mathematical models were developed for evaluating phytoplankton levels in the Delta and Suisun Bay region. The models are:

- Central Delta model. This steady-state model calculates average summer conditions for an area extending from Sacramento and Mossdale (on the San Joaquin River), to the western limit of the Delta near Antioch.

- Western Delta-Suisun Bay model. This time-variable model calculates monthly phytoplankton variations for an area extending from Rio Vista and Jersey Point westward to Carquinez Strait.

Each model calculation utilizes input describing interrelationships among the physical, chemical, and biological

phenomena that affect phytoplankton. Some of these inputs are channel geometry, flow distribution, dispersive transport characteristics, water quality variables, waste discharges, biological kinetic parameters such as phytoplankton growth rates, and physical parameters. The models have been used in several studies, including those for the 1980 Corps of Engineers Environmental Impact Statement on the Delta Pumping Plant. The models found little effect of the existing pumps on phytoplankton abundance in the Delta and Suisun Bay.

Both models are being refined, using new information, because of the low phytoplankton abundance during and after the drought of 1976-77. The Central Delta model is being improved by a Department of Water Resources consultant by developing a time-variable model, using refined phytoplankton growth rates. The Western Delta-Suisun Bay model was updated by the Bureau of Reclamation for the San Luis Drain study.

The Phytoplankton Work Group has hypothesized that different hydraulic conditions have affected water movement and the residence time for phytoplankton. Residence time must be long enough for growth and reproduction to occur. The Phytoplankton Work Group has studied modified project operations to investigate phytoplankton residence time, as discussed under "General Impacts on Striped Bass".

Phytoplankton impacts have been classified as unknown for the operational alternatives, because of lack of information and understanding concerning the cause-and-effect relationship of export pumping, and uncertainty of the mathematical models in projecting abundance levels.

Current studies may lead to better understanding. If such studies show adverse impacts by State Water Project and Central Valley Project operations, changes may be implemented voluntarily or through changes in State Water Resources Control Board standards.

General Impacts on Neomysis and Other Aquatic Invertebrates. Numerous species of zooplankton (animals drifting in the water column) and zoobenthos (animals living on or in the substrate) inhabit the estuary. Both are important as food for many fish, including the juveniles of many game species.

High crustacean zooplankton abundance (copepods and cladocerans) is associated with low salinities, high chlorophyll *a* (phytoplankton), and low net velocities in Delta channels. Zooplankton populations are highest during summer. The opossum shrimp, *Neomysis mercedis*, an important part of the estuary's food web, is a food of young striped bass. Normally, more than 60 percent of the *Neomysis* population of the estuary is found in the Suisun Bay area, with much of the remainder found in the western Delta. Since the 1976-1977 drought, *Neomysis* populations in Suisun Bay have partially responded to increased Delta outflows that have occurred in recent wet years. However, outflows from 1978 to 1981 have had little positive effect on *Neomysis* in the San Joaquin River.

Two amphipods, *Corophium stimpsoni* and *Corophium spinicorne*, are important constituents of Delta zoobenthos. They are the principal food for sturgeon, white and channel catfish, tule perch, and small black crappie. They are the second most important food of young striped bass. Other abundant benthic organisms are the Asiatic clam, tendipedid larvae, oligochaete worms, and crayfishes. All are eaten by Delta fish, but none is as important as *Corophium*.

Zoobenthos abundance and distribution in the Delta, especially of *Corophium stimpsoni*, depend largely on the type of substrate present. Channel bottoms of shifting sand, associated with high net flows, are least productive.

C—105409

C-105409

Important elements of the Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary are: (1) to monitor the abundance of Neomysis and other zooplankton in the Delta and Suisun Bay, and (2) to analyze factors affecting the abundance. The analysis has focused on Neomysis because of its importance and because more data are available.

The abundance of other zooplankton has generally been higher since the drought. However, abundance of cladocerans and rotifers in the Delta has been low since the drought, possibly because the phytoplankton food supply has been low in spring and summer.

Department of Fish and Game biologists have developed a multiple regression for calculating a Neomysis abundance index that explains about 96 percent of the Neomysis abundance during medium and low flow years, 1972 to 1981. However, in the very high flow year of 1983, the predictions were much higher than levels observed. The environmental variables in the multiple regression and their importance are shown below:

Variable	Percent of Variance Explained
Salinities	71.3
Abundance of Eurytemora	21.4
Chlorophyll a	3.4
Water Diversions	1.5

The data used and the multiple regression cover the Delta and Suisun Bay for July through October.

Table 5-13 shows the observed Neomysis abundance indices and mean environmental variables for 1968 to 1981.

Table 5-13

HISTORICAL NEOMYSIS ABUNDANCE INDEXES AND MEAN ENVIRONMENTAL VARIABLES FOR THE SACRAMENTO-SAN JOAQUIN ESTUARY, JULY-OCTOBER 1968-1981

Year and Type*		Neomysis Abundance Index (units of 10^{10})	Conductivity at Chipps Island (mmhos/cm)	Chlorophyll a (ug/liter)	Water Diversions (m^3/second)	Eurytemora Abundance Index (units of 10^{12})
1968	BN	5.8	8.4	**	157	**
1969	W	5.8	1.4	28.7	176	**
1970	W	4.3	4.0	30.6	201	**
1971	W	6.0	0.6	16.8	238	**
1972	BN	4.8	5.4	24.0	269	3.08
1973	W	4.0	5.2	20.0	281	1.74
1974	W	4.2	1.4	12.2	298	1.80
1975	AN	4.2	0.9	9.8	298	1.34
1976	C	0.8	10.9	6.6	258	1.04
1977	C	0.7	17.5	5.6	128	0.90
1978	W	2.6	5.3	18.4	295	1.28
1979	D	1.5	8.0	11.2	261	0.72
1980	W	3.2	3.3	11.7	210	0.84
1981	D	1.0	11.4	6.8	227	0.54

* W - Wet: AN - Above Normal; BN - Below Normal; D - Dry; C - Critical
** Not sampled

Source: Factors Regulating Abundance and Distribution of Shrimp Neomysis mercedis in the Sacramento-San Joaquin Estuary for Transactions of the American Fisheries Society 112:476-485, 1983.

C-105410

C-105410

Table 5-14 shows calculated Neomysis abundance indices based on two assumed variables from Table 5-13, mean water diversions and salinities for the operation studies for the early 1990s. The assumed variables are considered representative for each year type based on the data in Table 5-13. These data are used to calculate Neomysis abundance indices for the exports and salinities computed for the alternative operational plans. Salinities are important and are generally controlling. Model studies (Appendix B) show that the pumps, with any of the alternative operational plans, do not adversely affect salinity for the multiple regression equation and, therefore, this factor does not adversely affect Neomysis. Therefore, the critical factor in the equation is diversions.

Further information on zooplankton, Neomysis, and zoobenthos is available in the State Water Resources Control Board's 1978 EIR for the Water Quality Control Plan and Water Right Decision.

Studies on the effects of spring exports on the food web for young striped bass, conducted in response to the Striped Bass Working Group recommendations, should increase understanding of the Delta's productivity dynamics. New information could lead to new water right protective standards. Any modification of Decision 1485 standards for project operation would apply to all of the alternatives and would be met by the Department of Water Resources in operating the State Water Project.

The following assessment of effects of the alternative operational plans on Neomysis and other aquatic invertebrates is based on present knowledge of their abundance and distribution, and of the effects of water project operations.

Table 5-14

CALCULATED NEOMYSIS ABUNDANCE INDICES* BY YEAR TYPES FOR ALTERNATIVE OPERATIONAL PLANS (Early 1990s)

	Assumed Variables		Calculated Neomysis Index (Y)			
Year Type	X_2 - Chlorophyll a	X_4 - Eurytemora	No-Project	Preferred	2-8.5 and 4-8.5	4-10.3
Critical	6	1.0	1.83	1.82	1.86	1.82
Below Normal	9	1.2	2.74	2.83	2.72	2.63
Wet	15	1.3	3.48	3.54	3.50	3.48
57-Year Avg.	10	1.2	2.85	2.94	2.87	2.84

*As calculated using multiple regression equation:

$Y = 5.264 - 0.264 X_1 + 0.017 X_2 - 0.009 X_3 + 1.066 X_4$

Y = Neomysis index (10^{10})

X_1 = Electrical conductivity at Chipps Island from 1990-operation studies, July-October (mmhos/cm)

X_2 = Chlorophyll a (ug/liter)

X_3 = Water diversions from 1990-operation studies (July-October mean for Banks and Tracy Pumping Plant in m^3/second)

X_4 = Eurytemora index (10^{12})

C—105411

C-105411

No-Project Alternative. State Water Project and Central Valley Project operations affect zooplankton, Neomysis, and zoobenthos by altering outflows, salinities, and tidal flows and velocities in Delta channels. Flows in Delta channels are affected by operation of the Delta Cross Channel gates. Some general effects are:

- Project operations reduce freshwater zooplankton in the reach of the San Joaquin River below the Mokelumne River by introducing Sacramento River water with low plankton densities into this area.

- Salts drawn into this reach of the San Joaquin River by pumping tend to depress freshwater plankton and increase the abundance of brackish water species, especially Eurytemora, a copepod. Neomysis graze on Eurytemora.

- Pumping entrains aquatic invertebrates. (Entrainment losses for Neomysis are discussed in the following section.)

Under the no-project alternative, the mean combined exports at the Banks and Tracy pumping plants and the Chipps Island salinities from July to October are as follows.

Year Type	Exports (Cubic Feet Per Second)	Conductivity at Chipps Island (mmhos/cm)
Critical	4,783	12.8
Below Normal	7,653	7.6
Wet	8,469	4.8
Average	7,496	7.4

The calculated Neomysis abundance indices range from 1.83 in a critical year to 3.48 in a wet year, and average 2.85, as shown in Table 5-14.

Preferred Alternative. Mean exports from July to October would be reduced in all year types on an average annual basis. The reduction would be about 1.2 percent in critical years, 4.8 percent in below normal years, 4.0 percent in wet years, and 4.7 percent on the average. The calculated Neomysis abundance indices would be improved about 3 percent on the average.

With reduced exports during the summer, incremental effects on tidal flows and velocities in Delta channels should not be adverse.

Other Alternatives. Under Alternatives 2-8.5, 4-8.5, and 4-10.3, mean exports from July to October would be changed as follows.

Year Type	2-8.5, 4-8.5	4-10.3
Critical	+6.4%	+13.9%
Below Normal	+1.1%	+ 5.6%
Wet	-3.5%	- 2.5%
Average	-1.3%	+ 0.4%

As Table 5-14 shows, the Neomysis abundance indices would be changed very little on the average.

For the same reasons as for the preferred alternative, incremental effects on tidal flows and velocities in Delta channels should not be adverse.

Direct Entrainment Impacts on Neomysis. This section reviews the direct entrainment of Neomysis into Banks Pumping Plant. This entrainment is considered in the previous section on General Impacts as one factor affecting Neomysis abundance.

The Department of Fish and Game's regression analysis found that water export diversions are the least important of four factors affecting overall Neomysis abundance. These factors were listed in the previous

C—105412

C-105412

section. This finding agrees with that of an independent consulting company, Ecological Analysts.* Present project diversions entrain Neomysis in the southern Delta and the San Joaquin River at the mouths of Old and Middle rivers. Other Delta diversions for agricultural, municipal, and industrial use also entrain Neomysis.

The Department of Water Resources has estimated historical entrainment of Neomysis in the 4 to 17 millimeter size range for Banks Pumping Plant. These estimates are based on monthly export amounts and Neomysis density. Over the period 1970 to 1980, estimated entrainment by the State Water Project ranged from about 44 million in 1977 to about 10 billion in 1972, and averaged about 3 billion. These estimates are for the 9-month period March to November, which average about 92 percent of annual estimates. Entrainment estimates are generally highest in April, May, and June.

For perspective on these entrainment estimates, the average estimates of Neomysis entrainment for July to October at Banks Pumping Plant were compared to the average total Neomysis numbers corresponding to the abundance indices for the same period, as shown in Table 5-13. This proportion averaged about 2.5 percent.

Direct entrainment losses at 1990 export levels were estimated by multiplying the average 1970 to 1980 Neomysis densities by the projected average monthly exports from March to November. The entrainment for July to October was compared to the calculated overall average Neomysis abundance corresponding to the computed indices, as shown in Table 5-14.

No-Project Alternative. Estimated average annual entrainment of Neomysis in 1990 with the present pumps is about 6 billion, of which about 69 percent occurs in April, May, and June. The July to October total represents about 4.2 percent of overall Neomysis abundance in the Delta and Suisun Bay.

Preferred Alternative. Estimated average annual entrainment of Neomysis under the preferred alternative is 5.7 billion to 5.8 billion, about a 5 percent reduction from the no-project alternative. The July to October total represents about 3 percent of overall abundance of Neomysis in the Delta and Suisun Bay.

Other Alternatives. Average annual Neomysis entrainment for the two-pump alternative under Corps constraints would be similar to that for the preferred alternative. Estimates for Alternatives 2-8.5, 4-8.5, and 4-10.3 are also similar, and the July to October totals represent about 4 percent of overall abundance of Neomysis in the Delta and Suisun Bay.

Overview of Direct Impacts of the Delta Complex on Fish

Direct impacts of the Delta Complex on fish were estimated for each of the 10 alternative operational plans. Direct impacts include fish salvaged at the screens, handling and hauling losses, predation in Clifton Court Forebay, and loss of striped bass eggs and larvae. This detailed level of direct impact assessment was derived for striped bass and chinook salmon. Direct impacts for other species used a less detailed approach, because data were limited.

Direct impacts of the Delta Complex cannot be closely correlated to overall Bay-Delta fish impacts because of a lack of information on losses that normally occur during all life cycle stages. Direct impacts are only one component of

*Ecological Analysts. 1981. Contra Costa Power Plant Cooling Water Intake Structures 316(b) Demonstration. Pacific Gas and Electric, San Francisco.

C—105413

C-105413

an overall assessment. The previous general impact assessment for overall fish impacts was made qualitatively and considered direct impacts.

Direct impacts are considered to begin when State Water Project diversions entrain fish into Clifton Court Forebay. Fish more than about 1 inch long are subject to screening from the export water at the Skinner Fish Facility and are captured, transported, and released back to the western Delta, generally beyond the influence of the project diversions. Fish too small to be screened, such as eggs and larvae of striped bass, and fish not effectively screened pass into the California Aqueduct with the export water.

Those fish not diverted by the primary louvers either die passing through the pumping plants or survive in the aqueduct system and reservoirs. A substantial fishery is supported by the aqueduct and reservoir system and is an acknowledged benefit. This fishery is a combination of stocked fish and fish exported from the Delta.

Salvage estimates for screenable fish are based on 13 years of data at the Skinner Fish Facility (1968-1980). Screening efficiencies for striped bass and chinook salmon also include improved efficiency for the recent enlargement of the facility. The estimates for unscreenable striped bass eggs and larvae are based on historical density of eggs and larvae in Delta channels supplying project exports.

Estimates for predation on small fish in Clifton Court Forebay and for handling and hauling losses associated with collecting and transporting salvaged fish to release sites in the western Delta are only available for striped bass and salmon. Striped bass losses from predation, handling, and hauling are based on general observation, rather than on field testing, and probably are underestimated at least part of the year. Salmon predation losses are based on field experiments; handling and hauling losses are based on a 4-year experiment at the Federal Tracy Fish Collecting Facility.

Details of salvage records of the Skinner Fish Facility are available in a Department of Fish and Game report, The John E. Skinner Delta Fish Protective Facility, 1968-1980, A Summary of the First Thirteen Years of Operation, October 1981. This report gives the estimated number of fish collected in the holding tanks (salvaged).

The number of fish salvaged annually at the Skinner Fish Facility between 1968 and 1980 has ranged from 2 million to 31.6 million, with an average of 12.3 million. Records show that 45 species of fish have been identified during salvage operations, with about 32 species being recorded in numbers greater than 100 for the 13 years.

During the 13 years of record, striped bass were the most abundant species from December through March and again from June through August; they were second or third in abundance during other months. Threadfin shad are the most abundant species in September and October, American shad in November, Delta smelt in May, and white catfish in April. In all months, chinook salmon were the fifth or sixth most abundant species. Striped bass, chinook salmon, American shad, and white catfish, desirable sport fish in the estuary, were salvaged in high numbers. Sturgeon and steelhead rainbow trout are also important sport fish, but are salvaged in lower numbers.

Average annual numbers of the major game fish species salvaged through 1980 are:

Striped Bass	7,381,700
American Shad	803,200
White Catfish	794,300
Chinook Salmon	65,300
Sturgeon (White and Green)	3,000
Steelhead Rainbow Trout	2,500

The average annual export during this same period was 1,437,000 acre-feet.

C—105414

C-105414

Velocities and exposure (the abundance of fish in the water) at the Skinner Fish Facility are important factors in estimating direct impacts. Exposure for salmon and striped bass is based on the average numbers of bass and salmon counted each month in the holding tanks at the Skinner Fish Facility for the first 13 years of operation, as adjusted for the following factors:

- Actual average monthly pumping quantities and estimated screening efficiencies for the 13 years.

- Projected monthly exports, off-peak and on-peak pumping schedules, and resulting monthly screening efficiencies for the 10 alternatives at the 1990 level of water demand.

Water velocities through the screens at the Skinner Fish Facility vary widely with off-peak and on-peak pumping rates, but can be adjusted, within limits, by opening or closing gates that control the flow through each bay. When the enlarged facility is operational, the capability to adjust velocities will be greater and the effectiveness of the facility will be increased. Figure 9, which shows how the enlarged fish facility will be operated, was used to determine monthly off-peak and on-peak velocities for the direct impact analysis discussed in the following two sections. Such operation is based on Decision 1485 standards for operation of the facility.

For striped bass, minimum velocities are desirable. From May 15 through October 31, when striped bass are most abundant, the facility will be operated to limit water velocities to about one foot per second. This provides the best possible screening efficiencies for striped bass. During the rest of the year, the facility will be operated to provide higher velocities and for screening efficiencies for chinook salmon. Optimum water velocity at the screens for salmon is 3.0 to 3.5 feet per second.

Direct Impacts of the Delta Complex on Striped Bass, Including Eggs and Larvae

The direct impact on striped bass was estimated in two parts: screenable sized fish, and unscreenable eggs and larvae. Estimates are shown for these two categories individually and by combined total.

The estimates for fish salvage accounted for the variable efficiency of the screens in relation to differing exports and water velocities. The number of screenable striped bass impacted directly by the Delta Complex is defined as the difference in the number of fish entering Clifton Court Forebay and the number released alive back to the Delta.

The direct loss estimates were converted to a yearling equivalent to adjust for normal mortality rates and provide a common base for comparison. This adjustment accounts for the various levels of maturity of fish exposed to the export system each month. The yearling equivalent was calculated by applying a fixed daily mortality rate for the number of days between each month of loss and the following March 1. (March 1 is the approximate date that striped bass reach a yearling level of maturity in the Delta.) In this way, very small fish lost in the summer are given the proper weight compared to larger, more mature, fish lost in the winter, which are more likely to reach yearling size under normal mortality conditions.

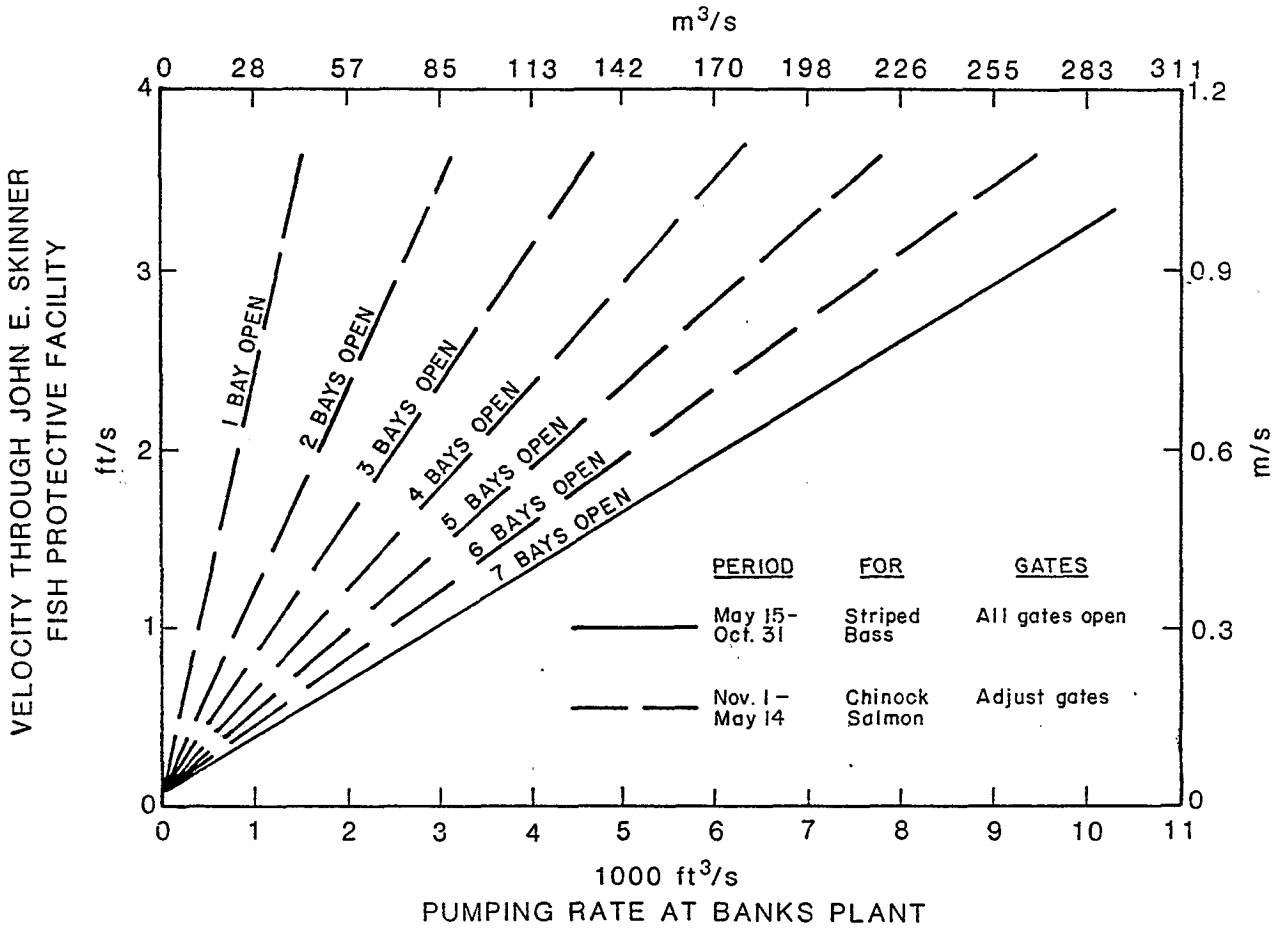
The direct impact estimates for screenable striped bass accounted for a 10 percent mortality in Clifton Court Forebay due to predation and a 20 percent mortality in handling and hauling.

The Department of Fish and Game has computed the historical annual loss of striped bass eggs and larvae, based on water export patterns and density of

C—105415

C-105415

FIGURE 9. OPERATION OF THE ENLARGED JOHN E. SKINNER FISH PROTECTIVE FACILITY



NOTES: 7 Bays each approximately 21' wide and 21' deep
Bays 1 & 2 can be operated separately or together
Bays 3A & 3B are operated together
Bays 4A & 4B are operated together
Bay 5 is operated separately

eggs and larvae in export water for 1968 through 1977 (excluding 1974, for which no data are available). (The report is reproduced in Appendix B.) During those 9 years, an estimated annual average of 437 million striped bass eggs and larvae less than 19 millimeters were entrained by the State Water Project. This corresponds to an average annual yearling equivalent of about 70,000 striped bass. The period of entrainment has varied, depending on flow patterns and time of spawning. Eggs have been entrained as early as the first week in April, and larger larvae have been entrained as late as mid-August. Peak entrainment occurs in late May and early June.

Direct entrainment losses at 1990 export levels were calculated by multiplying the average 1968-1977 density of eggs and larvae by the projected 57-year average monthly exports during the entrainment period, April through August, from each operation study. Annual yearling equivalents were obtained from these historical entrainment losses.

C—105416

C-105416

Supporting data in Appendix B show the calculations for screenable sized striped bass under the no-project and preferred alternatives. Methodology and calculations for the other alternatives, done in the same manner, are on file at the Central District, Department of Water Resources. Supporting data and a sample calculation for striped bass eggs and larvae are also in Appendix B.

The results of the combined direct impact analyses on striped bass, both screenable and eggs and larvae, under the alternative operational plans are presented in Table 5-15 on an average annual basis and in Table 5-16 by year type. For all alternatives, the losses are generally greatest in wet years and least in critical years when exports are reduced.

Following is a summary of estimated total direct impacts on striped bass, including eggs and larvae, for the alternative operational plans. This summary is discussed in conjunction with the average annual trends shown in Table 5-15, and is for the 1990 level of development.

No-Project Alternative. Striped bass eggs and larvae would continue to be entrained in proportion to their density in exported water and quantities diverted during the spring and early summer, mainly May and June. Export limitations in those months will minimize entrainment, but export (and thus entrainment) is expected to increase in May and June, compared to prior years, as water contractor demands increase. With the present pumps, the estimated annual entrainment of juveniles is 35.7 million and the annual entrainment of eggs and larvae is 870 million. The respective yearling equivalents are 1.425 million and 144,000, for a total annual loss of 1.569 million. The highest entrainment and the highest losses of juveniles occurs during May through August. The yearling equivalent loss for juveniles during these months is about 73 percent of the annual loss.

Preferred Alternative. Under the preferred alternative, striped bass direct impacts would be reduced. Under Alternative 4-7.3(Corps), the annual entrainment of juveniles would be 31.8 million and of eggs and larvae would be 856 million. The respective yearling equivalents are 1.298 million and 140,000. The total annual loss of yearling equivalents is estimated at 1.438 million, about a 9 percent decrease relative to the no-project alternative. These loss reductions are due mainly to decreased exports and entrainment during the high abundance months of June, July, and August. These would more than offset effects of increased exports and entrainment during winter, occasional increases in off-peak pumping in July, and frequent increases in October.

Under Alternative 4-10.3(Corps), the annual entrainment of juveniles is 31.2 million and of eggs and larvae is 849 million. Respective annual equivalents are 1.278 million and 139,000. The total annual loss of yearling equivalents is 1.417 million, a 10.7 percent decrease. The monthly export pattern under this upper limit of the preferred alternative is somewhat more favorable for striped bass than it is under the lower limit.

Other Alternatives. Under Alternatives 2-6.4 and 4-6.4, there would be a 0.7 percent increase in total yearling equivalent losses compared to the no-project alternative. These slight increases are due to increased off-peak pumping and reduced screening efficiencies for juveniles.

The estimated total yearling equivalent losses for Alternative 2-7.3(Corps) are similar to those for the lower limit of the preferred alternative. Losses for Alternative 2-8.5(Corps) would be about the same as for the upper limit.

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C-105417

Table 5-15

CALCULATED AVERAGE ANNUAL DIRECT ENTRAINMENT AND LOSSES* AT THE DELTA COMPLEX
FOR STRIPED BASS AND CHINOOK SALMON FOR ALTERNATIVE OPERATIONAL PLANS
(Based on 57-Year Water Supply Studies, Early 1990s)

	Alternative Operational Plan									
	0-6.4	2-6.4	4-6.4	2-7.3** (Corps)	2-8.5** (Corps)	4-7.3** (Corps)	4-10.3*** (Corps)	2-8.5	4-8.5	4-10.3
Striped Bass:										
Juveniles										
Entrainment	35.691	35.691	35.691	31.810	31.236	31.810	31.221	30.444	30.444	29.567
Released Alive	17.276	17.252	17.252	15.686	15.455	15.682	15.445	15.138	15.140	14.794
Loss	18.415	18.439	18.439	16.124	15.781	16.128	15.776	15.305	15.304	14.773
Yearling Equivalent	1.425	1.436	1.435	1.299	1.279	1.298	1.278	1.287	1.284	1.249
Eggs and Larvae										
Entrainment Loss	870	870	870	856	850	856	849	853	853	771
Yearling Equivalent	0.144	0.144	0.144	0.140	0.139	0.140	0.139	0.136	0.136	0.125
Total Yearling Equivalent	1.569	1.580	1.579	1.439	1.418	1.438	1.417	1.423	1.420	1.374
Difference	--	+0.011	+0.010	-0.130	-0.151	-0.131	-0.152	-0.146	-0.149	-0.195
Chinook Salmon:										
Entrainment	0.828	0.828	0.828	0.845	0.834	0.845	0.833	0.851	0.851	0.813
Released Alive	0.081	0.081	0.082	0.083	0.082	0.083	0.082	0.084	0.083	0.079
Loss	0.747	0.747	0.746	0.762	0.752	0.762	0.751	0.767	0.768	0.734
Yearling Equivalent	0.361	0.360	0.360	0.378	0.380	0.378	0.379	0.374	0.374	0.372
Difference	--	-0.001	-0.001	+0.017	+0.019	+0.017	+0.018	+0.013	+0.013	+0.011

* Values in million fish per year; includes loss estimates for predation in Clifton Court Forebay, screen salvage operation, and handling and hauling.
**Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

Table 5-16

CALCULATED DIRECT LOSSES AT THE DELTA COMPLEX
FOR STRIPED BASS AND CHINOOK SALMON BY YEAR TYPE
(Million Yearling Equivalents per year; Early 1990s)

	Striped Bass					Chinook Salmon				
Year Type	Study 1*	Study 2*	Study 3*	Study 4*	Study 5*	Study 1	Study 2	Study 3	Study 4	Study 5
Wet	1.861	1.756	1.733	1.595	1.562	0.391	0.412	0.413	0.407	0.371
Above Normal	1.750	1.634	1.602	1.501	1.433	0.376	0.393	0.397	0.384	0.383
Below Normal	1.713	1.476	1.458	1.445	1.570	0.378	0.395	0.393	0.380	0.374
Dry	1.494	1.427	1.435	1.567	1.469	0.345	0.369	0.368	0.364	0.366
Critical	0.558	0.555	0.557	0.647	0.664	0.270	0.275	0.275	0.267	0.255
Average	1.569	1.438	1.417	1.423	1.374	0.361	0.378	0.379	0.374	0.372

*Study 1 - Alternatives 0-6.4, 2-6.4, 4-6.4
Study 2 - Alternatives 2-7.3(Corps), 4-7.3(Corps)
Study 3 - Alternatives 2-8.5(Corps) and 4-10.3(Corps)
Study 4 - Alternatives 2-8.5 and 4-8.5
Study 5 - Alternative 4-10.3

(Corps) = Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

C-105418

C-105418

For Alternatives 2-8.5, 4-8.5 and 4-10.3, estimated total striped bass losses are 1.423 million, 1.420 million, and 1.374 million yearling equivalents, respectively. These are less than for the no-project alternative, mainly because the average export patterns during the high abundance months are more favorable. Total losses for Alternative 4-10.3 would be 12.5 percent lower than the no-project alternative.

Perspective. While direct impacts cannot be correlated directly with overall fish impacts, for perspective, the total yearling loss estimates are compared to a yearling population, as a whole, of about 10 million annually (estimated by the Department of Fish and Game in the early 1970s). The range of direct loss estimates for all the alternatives represents about 14 to 16 percent of the total population.

Direct Impacts of the Delta Complex on Chinook Salmon

Direct impact estimates for chinook salmon were calculated in the same way as for screenable striped bass. The estimates for fish salvage accounted for variable efficiency of the screens in relation to differing exports and water velocities. The number of chinook salmon impacted directly by the Delta Complex is computed as the difference in the number of fish entering Clifton Court Forebay and the number released alive back to the Delta.

Direct loss estimates were converted to a yearling equivalent for chinook salmon to adjust for normal mortality rates and provide a common base for comparison. This adjustment accounts for the levels of maturity of fish exposed to the export system each month. Chinook salmon lost in April, May, June, and July (which are smaller than salmon lost in other months) were converted to yearlings at a rate of 6 to 1.

Supporting data in Appendix B show the calculations for chinook salmon under the no-project and preferred alternatives. Methodology and calculations for the other alternatives are on file at the Central District, Department of Water Resources.

Direct impact estimates for chinook salmon accounted for a 75 percent mortality in Clifton Court Forebay and a 47 percent mortality in handling and hauling. They do not include density adjustments for seasonal flow ratios for the Sacramento and San Joaquin rivers, which are indicators of displacement of juveniles from normal migration routes. These seasonal ratios, shown in Tables 5-7, 5-8, and 5-9, do not change significantly for the alternative operational plans.

Results of the direct impact analysis on chinook salmon under the alternative operational plans at the 1990 level of development are presented in Table 5-15 on an average annual basis and in Table 5-16 by year type. For all alternatives, the total and incremental losses are least in critical years when export reductions are greatest.

The following summary of estimated direct impacts on chinook salmon for the alternative operational plans is discussed in conjunction with the average annual trends in Table 5-15. For all alternatives, direct impacts relate mainly to salmon of San Joaquin River origin, based on the previously discussed tagging studies.

No-Project Alternative. With the present pumps, the estimated annual entrainment of juveniles is 828,000, and the estimated annual losses are 361,000 yearling equivalents. Most of these losses would occur between October and May and are spread fairly evenly among those months.

Preferred Alternative. Under the preferred alternative, estimated annual entrainment is 845,000. The annual losses are estimated at about 379,000 yearling equivalents, about a 5 percent increase compared to the no-project

C—105419

C-105419

alternative. This increased loss would be due mainly to increased entrainment in December, January, and February; this would be partially offset by reduced entrainment from April through August.

Other Alternatives. Alternatives 2-6.4 and 4-6.4 would not significantly change the entrainment and loss estimates from those of the no-project alternative.

For the two-pump option under the Corps constraints, the annual loss estimates are similar to those for the preferred alternative.

For Alternatives 2-8.5 and 4-8.5, the estimated average annual loss is 374,000 yearlings, a 3.6 percent increase over the no-project alternative. For Alternative 4-10.3, the annual loss would be 372,000, a 3.0 percent increase. This alternative is somewhat more favorable for salmon than the preferred alternative because of lower entrainment in April and June.

Perspective. The average annual number of juvenile salmon migrants at the western Delta would range from about 20 million to about 50 million, mostly from the Sacramento River. Based on this range, the loss estimates (without the yearling equivalent conversion) at the Delta Complex represent about 1.5 to 3.7 percent. Data are insufficient to assess the salmon resource in the San Joaquin River, but the percentage would be higher.

Direct Impacts of the Delta Complex on Other Fish Species

Direct impact estimates for other species were based on historical salvage data. There are not sufficient data for the other species to enable detailed estimates as for striped bass and chinook salmon. However, for comparison purposes, average annual salvage numbers were estimated by multiplying projected average monthly exports by historical average monthly salvage densities for 30 species. Such estimates account for monthly abundance, but not for the numerous other factors considered in the striped bass and chinook salmon analyses, such as losses from predation, fish screen efficiency, and handling and hauling losses.

Calculated salvage numbers of other fish species are shown in Table 5-17. As salvage estimates increase, total direct losses would also increase, since the salvage process is less than 100 percent efficient. As salvage estimates decrease, total direct losses would also decrease.

No-Project Alternative. Under the no-project alternative, the total computed salvage for anadromous fish other than striped bass and salmon is 1,458,700, of which 99 percent are American shad. The total for resident game fish is 1,419,800, of which about 94 percent are white catfish and 2.5 percent are channel catfish. The total for resident nongame fish is 4,598,100, of which about 68 percent are threadfin shad, 18.5 percent are Delta smelt, 2.7 percent are prickly sculpins, and 2.5 percent are yellowfin goby.

The 1990-level seasonal distribution of the annual salvage estimates for some species is shown below:

Species	Sep-Dec	Jan-Apr	May-Aug
American shad	49%	7%	44%
Sturgeon (white and green)	38%	10%	52%
White catfish	23%	14%	63%
Channel catfish	29%	19%	52%
Threadfin shad	37%	15%	48%
Delta smelt	7%	23%	70%
Prickly sculpin	1%	13%	86%
Yellowfin goby	67%	14%	19%

Preferred Alternative. Under the preferred alternative, exports would be shifted from the months of high abundance to winter months of low abundance, and the annual salvage estimates would be reduced for 22 of the 30 species, not including striped bass or salmon. The

C—105420

C-105420

estimates are not changed for 3 species, and they are increased for 5 species, excluding the miscellaneous listing. The total salvage would be reduced by about 7 percent for anadromous fish, 9 percent for resident game fish, and 8 percent for resident nongame fish. Species of greatest salvage reduction are:

	Percent Reduction
American shad	6.8 to 7.5
White catfish	8.0 to 9.5
Threadfin shad	9.8 to 10.4
Delta smelt	4.9 to 6.1

Species that are more abundant during winter and for which salvage estimates increase are:

	Percent Increase
Steelhead rainbow trout	2.6 to 3.9
Goldfish	9.5 to 16.2
Yellowfin goby	3.1 to 4.0
Inland silverside	4.3 to 6.7
Pacific lamprey	2.2 to 4.4

Other Alternatives. For the 2-6.4 and 4-6.4 alternatives, comments for the no-project alternative apply. For the 2-7.3(Corps) and 2-8.5(Corps) alternatives, the comment for the preferred alternative applies.

For the 2-8.5 and 4-8.5 alternatives, the total salvage estimates decreased about 4 percent for anadromous fish, 5 percent for resident game fish, and 3 percent for resident nongame fish. Salvage estimates were reduced for 15 species. For Alternative 4-10.3, the reductions would be 2 percent, 6 percent, and 3 percent, respectively. Salvage estimates were reduced for 21 species.

Perspective. It is difficult to equate salvage and loss estimates to impacts on the population as a whole for any of these species. This is because of normal losses occurring during the life cycle from other causes or possible compensatory mechanisms that allow these losses to be negated. Also, there are virtually no data available on juvenile populations for these species.

Some species, such as sturgeon, Pacific lamprey, and tule perch, are salvaged rather infrequently, although they are present in fair numbers in the Delta. Others, such as starry flounder and brown bullhead, are salvaged infrequently because the southern Delta is not their preferred habitat. Species such as American shad, white catfish, and threadfin shad maintain high populations in the Delta even though they experience significant annual entrainment.

Salvage and loss estimates for five species increase with the preferred alternative. Impact evaluation on these species was coordinated with the Department of Fish and Game, and impacts were determined to be minimal on overall abundance, as discussed below:

- Steelhead rainbow trout -- Popular sport fish, salvaged infrequently; loss at Delta Complex is low compared to magnitude of runs in the Sacramento River.

- Yellowfin goby -- Salvaged in moderate numbers, high overall abundance, expanded population since accidental introduction from Japan, and wide distribution in the Bay and Delta.

- Inland silverside -- Introduced into Clear Lake and not salvaged until 1976; distribution is expanding, and has become abundant in many areas; increasing in importance as a forage fish.

- Goldfish -- Wide fluctuation in annual salvage numbers, introduced species; losses probably do not affect overall abundance.

- Pacific lamprey -- Salvaged infrequently; losses probably do not affect overall abundance.

C—105421

C-105421

Table 5-17

CALCULATED DIRECT AVERAGE ANNUAL SALVAGE OF SCREENABLE SIZE FISH
OTHER THAN STRIPED BASS AND CHINOOK SALMON*
AT THE DELTA COMPLEX FOR ALTERNATIVE OPERATIONAL PLANS
(Based on 57-Year Water Supply Studies, Early 1990s)

Species	Alternative Operational Plan					
	0-6.4, 2-6.4, 4-6.4	2-7.3,4-7.3 (Corps)**	2-8.5 (Corps)**	4-10.3 (Corps)**	2-8.5, 4-8.5	4-10.3
Anadromous Fish						
American Shad	1,446,500	1,347,500	1,338,500	1,338,000	1,385,400	1,419,800
Steelhead Rainbow Trout	7,600	7,900	7,800	7,800	8,000	8,000
Green Sturgeon	1,300	1,200	1,200	1,200	1,300	1,400
White Sturgeon	3,300	2,900	2,900	2,900	3,100	3,200
Subtotal	1,458,700	1,359,500	1,350,400	1,349,900	1,397,800	1,432,400
Resident Game Fish						
White Catfish	1,331,300	1,224,200	1,206,700	1,204,700	1,257,300	1,246,600
Channel Catfish	34,800	30,500	24,500	24,500	33,700	33,500
Black Crappie	24,300	23,100	22,800	22,800	23,600	23,100
Bluegill	11,000	10,400	9,200	9,200	11,100	11,000
Green Sunfish	7,300	7,100	7,200	7,100	7,600	7,400
Largemouth Bass	6,200	6,200	6,200	6,200	6,700	5,800
Starry Flounder	4,600	4,100	4,000	4,000	4,000	3,900
Brown Bullhead	300	300	300	300	300	300
Subtotal	1,419,800	1,305,900	1,280,900	1,278,800	1,344,300	1,331,600
Resident Nongame Fish						
Threadfin Shad	3,119,500	2,812,800	2,794,400	2,793,100	3,060,800	3,116,900
Delta Smelt	855,100	813,200	803,600	803,000	823,300	781,900
Sacramento Splittail	168,600	166,500	166,300	166,700	159,000	151,700
Prickly Sculpin	123,300	120,900	119,400	119,300	122,200	111,700
Yellowfin Goby	115,600	119,200	120,000	120,200	112,000	115,300
Longfin Smelt	97,600	92,500	91,800	91,800	80,300	76,900
Carp	28,800	25,000	24,200	24,200	25,100	24,400
Inland Silverside	20,800	21,700	22,100	22,200	21,800	21,500
Hardhead	20,300	18,900	18,700	18,700	18,100	17,000
Bigscale Logperch	8,400	8,000	7,900	7,900	7,100	6,800
Goldfish	7,400	8,100	8,500	8,600	8,600	8,400
Hitch	5,100	4,700	4,700	4,700	4,200	4,000
Tule Perch	4,900	4,900	4,800	4,800	5,000	4,500
Pacific Herring	4,900	4,700	4,600	4,600	4,800	4,400
Pacific Lamprey	4,500	4,600	4,700	4,700	4,900	4,700
Golden Shiner	3,700	3,400	3,400	3,400	3,700	3,300
Sacramento Blackfish	2,400	2,300	2,300	2,300	2,400	2,300
Mosquitofish	1,000	1,000	1,000	1,000	1,000	1,000
Miscellaneous	6,200	6,400	6,400	6,400	6,100	6,100
Subtotal	4,598,100	4,238,800	4,208,800	4,207,600	4,470,400	4,462,800

* Calculations of annual fish losses changing with salvage, based on data from "The John E. Skinner Delta Fish Protective Facility, 1968-1980, A Summary of the First Thirteen Years of Operation", Department of Fish and Game, October 1981. Values are in fish per year and reflect reduced impacts in many cases.

**Constrained by Public Notice 5820A-Amended, U. S. Army Corps of Engineers.

C-105422

C-105422

Impacts on Tracy Pumping Plant Operations

The U. S. Bureau of Reclamation has expressed concern that increased diversions with additional pumps could affect operation of its Tracy Pumping Plant by:

- Aggravating the water hyacinth problem.
- Increasing energy requirements for Central Valley Project pumping due to increased drawdowns.

Water hyacinths have been a major nuisance in the southern Delta. They hamper boating and clog irrigation diversions. Many were drawn to the State Water Project and Central Valley Project facilities and ultimately to the trash racks for the fish screens at the Tracy Pumping Plant. A floating boom with vertical screens around the control gates at Clifton Court Forebay prevents the hyacinths from entering the State works.

In recent years, the Bureau of Reclamation spent about $400,000 annually to remove some 22,000 truckloads of hyacinths from the Tracy Pumping Plant trashracks.

In 1981 the State initiated a control and eradication program. Both chemical and biological measures have been used. Expenditures of $150,000 by the California Department of Boating and Waterways seems to have cleared up the problem. After two years of spraying, mainly with the herbicide 2,4-D, about 99 percent of the navigable channels in the Delta have been cleared of the aquatic weed. The spraying covered 150 acres over the two years, but was reduced to 100 acres in 1984.

The biological measures consist of planting weevils and moths that feed on the hyacinths. These insects are expected to play a significant role in the program when they become established.

Because of the apparent success of the program, future operations with the existing or additional pumps should not aggravate the hyacinth problem at the Tracy Pumping Plant or elsewhere in the Delta.

Evaluation of the effects of the alternatives on energy requirements for the Tracy Pumping Plant was based on the Bureau of Reclamation's estimate of increased requirements of 1.25 kilowatt-hours per foot of drawdown.

No-Project Alternative. Energy requirements for the Tracy Pumping Plant will increase as Central Valley Project exports increase. The incremental requirements because of drawdown effects of State and Federal exports combined could also increase slightly.

Preferred Alternative. Because there would be no significant incremental effects on tidal fluctuations at Clifton Court Forebay with increased mid-December to mid-March exports during high San Joaquin River flows, there would be no significant incremental effects on energy requirements for the Tracy Pumping Plant. (See "Impacts on Delta Agricultural Uses and Water Levels" in this chapter.)

Other Alternatives. On the average, energy requirements for the Tracy Pumping Plant should not be significantly changed for the other alternatives relative to the no-project alternative. As discussed under "Impacts on Delta Agricultural Uses and Water Levels", modifications in the southern Delta would tend to reduce drawdowns due to State Water Project pumping.

Impacts on Suisun Marsh

Department planning includes protective measures for Suisun Marsh to mitigate project development, including the additional pumps. With or without the additional pumps, the Department will

C—105423

C-105423

protect Suisun Marsh habitat with Delta outflow, physical facilities, a monitoring program, and a management program. The most important protective facility, the Montezuma Slough Control Structure, is scheduled to be operational by 1988. This is before initial operation of the additional pumps.

Chapter 4 presented information on Suisun Marsh physical characteristics, environmental importance, planned protection facilities, environmental impact report, and the multiagency "Suisun Marsh Preservation Agreement". This section discusses future marsh conditions if protective measures are not implemented and the effects of relaxing standards during critical water supply conditions. Protection for the marsh was designed to compensate for future projects, such as the additional pumps. Evaluation of this protection was shown in the environmental document for the plan of protection.

State Water Project and Central Valley Project operation and other upstream use of water have adversely affected Suisun Marsh during dry and critical years. The reduction in outflow caused by upstream use and by export during October through May has increased channel salinities within the marsh, which affects the composition and productivity of plant communities that are important food sources for waterfowl. Soil salinities in pond areas must remain within certain limits or habitat quality will deteriorate. If no action is taken, the duration of salinity intrusion into the marsh channels will increase as greater amounts of water are diverted upstream and within the Delta. Seed production in the marsh will decrease, and less food will be available for waterfowl. Vegetation dependent on brackish water will decline and will be replaced by vegetation more typical of saltwater marshes. The natural productivity of the marsh will decline. This no-action alternative was addressed in the Environmental Impact Report and Plan of Protection for Suisun Marsh, which was described in Chapter 4.

Proposed relaxation of the post-1984 Decision 1485 standards during deficiency periods is included in the final environmental report for the marsh plan of protection and in the "Suisun Marsh Preservation Agreement". The proposed relaxation standards, which would apply about 12 percent of the time (80 months of a 57-year study period), are designed to provide the quality of water necessary to keep the important waterfowl food plants alive. Criteria in the Suisun Marsh Preservation Agreement that are different from Decision 1485 protective standards are being considered by the State Water Resources Control Board.

A marsh model was operated to assess the impact of the proposed relaxed standards on alkali bulrush in the marsh. Present Decision 1485 standards are set to provide 90 percent production and 60 percent germination. The model operation indicated that compliance with the deficiency criteria would reduce production and germination below expected Decision 1485 levels in about one-third of the marsh. Model operations showed that about 9,500 acres, or 17 percent of the marsh, would experience 62 percent seed production and 44 percent germination. An additional 17 percent of the marsh, or about 9,500 acres, would receive water with a salinity resulting in 23 percent seed production and 16 percent germination. While reduced levels of production and germination would occur in parts of the marsh in deficiency periods, salinities are not expected to be high enough to result in alkali bulrush tuber mortality.

Operation studies used for impact analysis of the additional pumps assumed protective facilities for Suisun Marsh that will provide for any changes in flows attributable to the pumps. The Montezuma Slough Control Structure, scheduled to be completed by 1988, will undergo operational tests and monitoring

C—105424

C-105424

to determine effectiveness. If needed, additional protective facilities may be constructed after 1990. For this report, it is assumed that testing of installed facilities and construction of new facilities will provide protection for the marsh under any future water resources development.

Salinities at Collinsville for the alternative operational plans are shown in Appendix B. Decision 1485 standards were met, with minor salinity changes between the operational alternatives.

The operation studies for this report did not assume the proposed relaxation standards. Other operation studies that do include the proposed relaxation standards are discussed in the February 1984 report on the Plan of Protection for Suisun Marsh.

In summary, the additional pumps will have no significant impact on Suisun Marsh, because it is to be protected with Delta outflow, physical facilities, and a monitoring program.

Summary Tables of General and Direct Impacts on Bay-Delta Fish, Early 1990 Conditions

This summary of impacts on fish presents information on general impacts for each alternative operational plan compared to the no-project alternative. These impacts represent incremental qualitative assessments for the early 1990s. Direct impacts are quantified total and incremental impacts for alternative operational plans, including the no-project alternative. This summary is based on information and data in previous sections of this chapter.

Table 5-15 presented calculated direct entrainment and impact losses at the Delta Complex for striped bass and chinook salmon. The estimates include losses due to predation in Clifton Court Forebay, screen salvage operation, handling and hauling, and entrainment of striped bass eggs and larvae. The direct loss estimates were converted to a yearling equivalent, which adjusts for normal mortality rate.

Table 5-17 presented calculated direct salvage of screenable size fish other than striped bass and chinook salmon. Data are based on 13 years of salvage records at the Skinner Fish Facility. Sufficient data are not available to calculate total direct impact of the Delta Complex on these fish species.

Table 5-18 summarizes the general incremental impacts on the major needs for anadromous and resident fish. The impacts are based on monthly average project operational changes. All changes are considered to be small in relation to total fish needs.

Table 5-19 summarizes the general incremental impacts on life stages of striped bass and chinook salmon, considering various critical factors: salinity, outflow and exports, food supply, entrainment, and migration.

Table 5-20 summarizes the general incremental impacts on 32 species of fish. These impacts consider the needs identified in Table 5-18; however, the ratings for many species are weighted toward the impacts that are quantified in Table 5-17, because entrainment was assumed to be one of the most important factors for many resident fish.

C—105425

C-105425

Table 5-18

SUMMARY OF GENERAL INCREMENTAL IMPACTS ON FISH NEEDS
FOR ALTERNATIVE OPERATIONAL PLANS
(Early 1990s)

Needs of Anadromous and Resident Fish	Incremental Impacts when Compared to 0-6.4 No-Project, for Each Alternative Operational Plan		
	2-6.4 and 4-6.4	Preferred*	2-8.5, 4-8.5 and 4-10.3
° Salinity gradient requirements for migratory fish.	No change	No change	No change
° Loss from water diversions for:			
Striped bass	Unfavorable	Favorable	Favorable
Chinook salmon	No change	Unfavorable	Unfavorable
Other species	No change	Favorable	Favorable
° Food chain for fish	No change	Insufficient Information	Insufficient Information
° Low water velocities to promote good benthic invertebrate populations (important to bottom-feeding fish).	No change	No change	No change
° Maintenance of tidal currents in Delta channels.	No change	No change	No change
° Adequate levels of dissolved oxygen in Delta channels and desirable temperature.	No change	No change	No change
° Provision of fresh water flows for migratory fish and maintenance of nursery areas, including net downstream flow of "home stream" water.	No change	No change	No change
° Water operation constraints to limit diversions and closure of Delta Cross Channel to minimize cross-Delta movement.	No change	No change	No change
° Effective project operations shifting diversions toward winter periods of lower fish abundance, and away from summer months of higher abundance.	No change	Favorable	Favorable

Note: Impacts based on monthly average project operational changes. All changes are considered to be small in relation to total fish needs. No change represents no significant change.

* Preferred = 4-7.3(Corps) to 4-10.3(Corps); constrained by Public Notice 5820A-Amended, U. S. Army Corps of Engineers.

C—105426

C-105426

Table 5-19

SUMMARY OF GENERAL QUALITATIVE INCREMENTAL IMPACTS
ON CRITICAL FACTORS THAT AFFECT STRIPED BASS AND CHINOOK SALMON LIFE STAGES
(Based on 57-Year Water Supply Studies, Early 1990s)

Species	Life Stage	Critical Factor	Location**	Months	Incremental Impacts for Operational Plans Compared to 0-6.4 No-Project Plan*			
					2-6.4 4-6.4	Preferred	2-8.5 4-8.5	4-10.3
Striped Bass	Spawning (Egg Viability)	Salinities, Critical Year	WD	Apr-May	0	0	0	0
	Young of Year	Abundance, based on outflows and exports	D,SB	May-Jul	0	0	0	0
	Larvae	Food Supply (Small zoo-plankton)	D	Apr-Jun	0	Un	Un	Un
	Juveniles	Food Supply (Neomysis)	D,SB	Mar-Nov	0	+1	+1	+1
	Juveniles	Entrainment Loss	DC	Avg Annual	-1	+1	+1	+1
	Eggs and Larvae	Entrainment Loss	DC	Apr-Aug	0	+1	+1	+1
Chinook Salmon	Adult	Migration (Reverse flows)	LSJ,	Aug-Nov	0	0	-1	-1
	Juveniles	Migration (Flow ratios)	SR,SJR	Oct-Jun	0	0	0	0
	Juveniles	Entrainment Loss	DC	Avg Annual	0	-2	-2	-2

* Legend: 0 = Base condition (No-project) -2 = Significant unfavorable effect
+1 = Small favorable effect Un = Unknown or insufficient information.
-1 = Small unfavorable effect

Preferred = 4-7.3(Corps) to 4-10.3(Corps); constrained by Public Notice 5820A-Amended, U. S. Army Corps of Engineers.

** Location:
WD - Western Delta
D - Delta
SR - Sacramento River at Delta Cross Channel
SB - Suisun Bay
LSJ - Lower San Joaquin River at Antioch
SJR - San Joaquin River at Old River
DC - Delta Complex

C-105427

C-105427

Table 5-20

SUMMARY OF GENERAL INCREMENTAL IMPACTS ON FISH SALVAGED AT DELTA COMPLEX (Early 1990s)

Species	Incremental Impacts Compared to 0-6.4, No-Project, for Each Alternative Operational Plan (Corps)*		
	2-6.4, 4-6.4	2-8.5,4-10.3 2-7.3, 4-7.3	2-8.5, 4-8.5, 4-10.3
Channel catfish	0	+1	0
Mosquito fish	0	0	0
Inland silverside	0	0	0
Striped bass	-1	+1	+1
Bluegill	0	+1	0
Green sunfish	0	+1	-1
Sacramento splittail	0	+1	+1
Hardhead	0	+1	+1
Golden shiner	0	0	0
Goldfish	0	0	0
Carp	0	+1	+1
Brown bullhead	0	0	0
White catfish	0	+1	+1
Pacific lamprey	0	0	0
White sturgeon	0	+1	0
Green sturgeon	0	+1	0
Threadfin shad	0	+1	+1
American shad	0	+1	+1
Chinook salmon	0	-2	-2
Steelhead	0	0	0
Delta smelt	0	+1	+1
Longfin smelt	0	+1	+1
Hitch	0	+1	+1
Sacramento blackfish	0	+1	+1
Black crappie	0	+1	+1
Largemouth bass	0	0	0
Bigscale log perch	0	+1	+1
Tule perch	0	0	0
Yellowfin goby	0	0	0
Prickly sculpin	0	+1	+1
Pacific herring	0	+1	+1
Starry flounder	0	+1	+1

0 = No change. Available information is sufficient to determine no impact.
+1 = Small favorable effect
-1 = Small unfavorable effect
-2 = Significant unfavorable effect

This summary is based on (1) information in this report, (2) Department of Fish and Game experience, and (3) quantitative calculations on fish salvage.

*Constrained by Public Notice 5820-A Amended, U. S. Army Corps of Engineers.

Operational Impacts, Late-1990 Conditions

The evaluation of operational impacts was extended to cover higher project demands during the late 1990s. This evaluation of potential impacts from operation of existing and additional pumps under maximum export conditions expected for this period includes gradually increasing project demands. The evaluation used the median year power operation studies described in the introduction to this chapter and in Appendix B. These studies operate under normal and above normal water supply conditions, allowing exports under these study assumptions to meet full contractor entitlement requests. Under varying hydrologic conditions, these export levels at full request are expected to occur 25 to 30 percent of the time. Such an analysis produces the greatest impacts for both the no-project alternative and the preferred alternative.

The studies were completed for alternative operational plans 0-6.4, 2-6.4, 4-6.4, 2-7.3(Corps), and 4-7.3(Corps). No Delta transfer improvements were assumed. State Water Project planning envisions Delta transfer improvements in about 10 to 15 years; the timing for such a facility has not yet been determined. The late-1990s evaluation covers future operations with five alternative operational plans. Conditions beyond the year 2000 are discussed in conjunction with potential Delta improvements and added project storage capabilities in Chapter 6, "General Impacts of Additional Pumps with Potential Related Projects". If State Water Project development is sooner than year 2000, then the cumulative impact discussion in Chapter 6 would apply to an earlier date. In case development is delayed beyond 2000, operations with the no-project and the preferred alternative to meet post-2000 demands are also discussed in Chapter 6.

C—105428

C-105428

The preferred mitigation for the additional pumps considers future demand increases by coupling mitigation to future export operations. Use of Banks Pumping Plant with the additional pumps to meet increasing demands will increase fish losses and require increasing mitigation. Also, added mitigation will be investigated in future environmental documents for operations without the Corps of Engineers operating restrictions or with the construction of an improved Delta transfer system.

For this late-1990s impact evaluation, outages were investigated in greater detail. Operations during normal and above normal water supply years will require continuous operation of the existing units for longer durations than during drier years. Also, future increases in demands will increase the need for pump reliability. Under these conditions, impacts to project operations from elimination of outages are likely. To estimate such effects, a 10 percent outage factor was applied to the existing plant. This factor is higher than historical forced outage estimates and tends to increase the incremental impacts of the additional pumps.

The operational impacts evaluated for the late 1990s focused on: (1) monthly and annual export and outflow changes, (2) water level drawdowns, and (3) direct fish impacts at the Delta Complex. These parameters are key to determining trends of changes caused by the continuing operation of existing or additional pumps to meet increasing demands.

Seasonal and Annual Exports at Banks Pumping Plant

The following tabulation summarizes the seasonal and annual exports at the Banks Pumping Plant from the power operation studies.

	State Water Project Exports in 1,000 acre-feet		
Season*	0-6.4**	2/4-6.4	2-7.3, 4-7.3(Corps)
Early 1990s			
Winter	1,369	1,390	1,475
Summer	929	920	866
Fall	979	958	918
Annual	3,277	3,268	3,259
Late 1990s			
Winter	1,375	1,420	1,583
Summer	951	940	923
Fall	1,095	1,088	942
Annual	3,421	3,448	3,448

* Winter = December-March
Summer = April-July
Fall = August-November
** 10 percent outage factor

The annual exports differ because of outages and storage changes. Winter exports increase with export capability, being greatest for alternatives 2-7.3 (Corps) and 4-7.3(Corps). Summer and fall exports decrease with export capability, and are least for the same two alternatives.

Delta Outflow Changes

Table 5-21 summarizes seasonal and annual export and outflow changes during the 1990s for above normal year conditions. The exports are combined total exports for the Banks and Tracy pumping plants. Outflows and exports from May to June are considered an important factor for striped bass young-of-year abundance. Outflow volumes from February through April are a factor being studied in connection with the biological resources of San Francisco Bay.

The late-1990s changes under the preferred alternative, relative to the no-project alternative, are:

C—105429

C-105429

Period	Outflow	Total Exports
February-April	-3.7%	--
May-July	-0.4%	-4.8%
Annual	-1.8%	+3.6%

Impacts on the bay's biological resources associated with such outflow changes are unknown. The changes in outflows and exports from May to July appear to be slightly favorable for striped bass young-of-year abundance.

Water Levels Near Clifton Court Forebay

Table 5-6 showed representative 1990-level effects on high-high tides near Clifton Court Forebay during the irrigation season. These were total drawdown amounts for the seven alternative operational plans, including effects attributable to Tracy Pumping Plant. The higher drawdown figures were for the peak diversion rates on Sundays.

Monthly export rates from the power studies were reviewed to assess changes in the peak drawdowns during the 1990s. The results are shown below for the five alternatives evaluated with the power studies. Values shown are peak drawdowns, in feet; the top values are for the early 1990s and the lower values are for the late 1990s.

Alternative	Apr	May	Jun	Jul	Aug	Sep
0-6.4	1.2	0.8	0.7	1.0	1.0	0.9
	1.2	0.8	0.8	1.1	1.0	1.0
2-6.4	1.3	0.8	0.7	1.0	1.0	0.9
	1.4	0.9	0.8	1.1	1.1	1.1
4-6.4	1.5	0.8	0.7	1.0	1.0	0.9
	1.6	0.9	0.8	1.2	1.2	1.2
2-7.3	1.3	0.8	0.7	0.9	0.9	0.9
(Corps)	1.3	0.9	0.8	1.1	0.9	1.0
4-7.3	1.3	0.8	0.7	0.9	0.9	0.9
(Corps)	1.3	0.9	0.8	1.1	0.9	1.0

Table 5-21

ESTIMATED STATE WATER PROJECT AND CENTRAL VALLEY PROJECT EXPORT AND OUTFLOW CHANGES PRE-2000, ABOVE NORMAL YEAR TYPE

(Volumes in 1,000 acre-feet)

		Feb-April	May-July		Annual	
Period	Alternatives	Total Outflows	Total Exports	Total Outflows	Total Exports	Total Outflows
Early 1990s*	0-6.4, 2-6.4, 4-6.4	5,810	1,200	2,350	6,340	11,410
	2-7.3(Corps), 4-7.3(Corps)	5,750	1,160	2,330	6,330	11,360
Late 1990s**	0-6.4	5,870	1,260	2,320	6,430	11,390
	2-6.4, 4-6.4	5,760	1,260	2,320	6,680	11,260
	2-7.3(Corps), 4-7.3(Corps)	5,650	1,200	2,310	6,660	11,190

* Values for early 1990s are averaged from water supply studies for above normal years. Outages were not included for alternative 0-6.4.

**Values for late 1990s are from power operation studies under median water supply conditions. A 10 percent outage is included for alternative 0-6.4. Values for alternatives 2-6.4 and 4-6.4 include adjustments for outages.

C-105430

C-105430

These changes in peak drawdowns reflect changes over time for both monthly export rates and for off-peak/on-peak pumping schedules at Banks Pumping Plant. The greatest change over time between the early and late 1990s is an increase of 0.3 foot for alternative 4-6.4 in September. The greatest change with the preferred alternative, relative to the no-project alternative, is an increase of 0.1 foot in April. This is due to increased off-peak pumping. The late-1990s impact is no greater than that in the early-1990s analysis, and is considered insignificant for the same reasons.

Direct Fish Impacts

The late-1990s direct fish impact assessments were calculated similarly to previous assessments in this chapter. Table 5-22 shows the early-1990s average annual estimates and the late-1990s estimates for six species. Of these, striped bass, chinook salmon, American shad, and white catfish are desirable sports fish that have been salvaged frequently at the Skinner Fish Facility. Threadfin shad are a nongame fish that have been salvaged in high numbers. Delta smelt have also been salvaged frequently.

Table 5-22

ESTIMATED DIRECT LOSSES AT THE DELTA COMPLEX FOR SELECTED FISH SPECIES, EARLY AND LATE 1990s

(Values in million fish per year)

		Species 1/					
Level	Alternative	Striped Bass	Chinook Salmon	American Shad	White Catfish	Threadfin Shad	Delta Smelt
Early 1990s 2/	0-6.4	1.569	0.361	1.447	1.331	3.120	0.855
	2-6.4	1.580	0.360	1.447	1.331	3.120	0.855
	4-6.4	1.579	0.360	1.447	1.331	3.120	0.855
	2-7.3(Corps)	1.439	0.378	1.347	1.224	2.813	0.813
	4-7.3(Corps)	1.438	0.378	1.347	1.224	2.813	0.813
Late 1990s 3/	0-6.4*	1.931	0.358	1.708	1.670	3.880	1.034
	2-6.4**	2.079	0.373	1.781	1.723	4.054	1.065
	4-6.4**	2.080	0.373	1.781	1.723	4.054	1.065
	2-7.3(Corps)	1.890	0.402	1.528	1.487	3.269	0.981
	4-7.3(Corps)	1.878	0.402	1.528	1.487	3,269	0.981

1/ Values for striped bass are yearling equivalents, including eggs and larvae. Values for chinook salmon are yearling equivalents. Values for other species are salvage estimates; losses increase or decrease with salvage estimates.

2/ Values for 1990 are average annual, based on 57-year water supply studies. Outages were not included for alternative 0-6.4

3/ Values for pre-2000 are based on power operation studies of the California Aqueduct under median water supply conditions. *A 10 percent outage is included for alternative 0-6.4. **Values for alternatives 2-6.4 and 4-6.4 include adjustments for outages.

C-105431

C-105431

The late-1990s estimates are generally higher than early-1990s estimates due primarily to demand increase, which will occur without the additional pumps. This is because annual exports under above normal conditions will be about the same with or without the added pumps. With the preferred alternative, monthly export changes will occur so that there is less export during summer (see Table 5-21). Comparison of alternatives at the late-1990s level shows similar trends, but the estimate for chinook salmon under alternative 0-6.4 is depressed because of the assumed outages during the winter months when salmon are abundant. Estimated chinook salmon losses increase by 4 percent under alternatives 2-6.4 and 4-6.4 compared to the no-project alternative and by 12 percent under the preferred alternative and alternative 2-7.3(Corps). For species other than chinook salmon, estimated losses decrease under the preferred alternative because of the more favorable export pattern. As for the early 1990s, there is a significant direct impact on chinook salmon.

Impacts on State Water Project Service Areas

Incremental socioeconomic, growth-inducing, and environmental impacts in the State Water Project service areas were evaluated for the alternatives that would increase project yield. This yield includes State Water Project firm yield and potential additional yield from enhanced operations of ground water basins in Southern California. In this section, procedures involved in the evaluation are first described briefly, with results following in summary form. Appendix D describes in more detail the assumptions and methodology used to evaluate service area impacts.

The rationale for the service area impact analysis is similar to that for the firm yield analysis described in Chapter 3 (Economic Analysis), i.e. the economic activity supported by the State Water Project is directly proportional to firm yield.

Evaluation of Socioeconomic Impacts

The varying firm yields of the operational alternative plans range from 57,000 to 188,000 acre-feet and were allocated to the affected service areas in proportion to each area's overall maximum entitlement. A further allocation was made for the type of use. Resulting allocations of the firm yield developed from the alternatives are:

Service Area	% of Firm Yield	Allocation by Use (in Percent) M&I*	Agriculture
North Bay	2	100	0
South Bay	4	100	0
Central Coastal	2	100	0
San Joaquin	32	10	90
So. California	60	100	0

*Municipal and Industrial

Ground water yields of the alternatives range from 9,000 to 43,000 acre-feet and were allocated 70 percent to Southern California and 30 percent to the San Joaquin service area. The other service areas were assumed not to receive significant supplies from the ground water programs.

For the municipal and industrial firm yield component, direct income impacts were estimated by using the Department's input/output model. This model describes the relationship between industries in the State's economy and ingredients, including water, necessary for the products of those industries. Because some industries are relatively large water users (and therefore water dependent) while others are not, the model automatically provides an

C—105432

C-105432

indication of that portion of the economy that is directly responsive to additional water supplies.

The income impacts include economic profit to the firm owners; employee compensation; and allowances for net interest, indirect business taxes, and capital consumption allowances. The agricultural direct income resulting from the firm yield deliveries includes economic profit accruing to landowners, returns to management, and returns to labor (wages). For the ground water yield amounts (municipal, industrial, and agricultural), the income values were adjusted to account for the extra costs of storing and recovering the water from ground water basins.

Municipal and industrial employment impacts were estimated from relationships of employment and income. Agricultural employment impacts were estimated from area irrigated and crop labor requirements.

Direct economic (income and employment) impacts will cause repercussions on local and State economics. Indirect and induced income and employment impacts were also estimated with the input/output model.

Population impacts were derived from the employment impacts, and then used to assess land use, including housing and environmental changes.

Socioeconomic impacts in the Southern California service area were adjusted to account for the loss of Colorado River supplies. Metropolitan Water District's entitlements to Colorado River water will be reduced from 1,200,000 to 550,000 acre-feet in the late 1980s as a result of a 1964 Supreme Court decision. In addition, the Court awarded certain water rights to Indian tribes in the lower Colorado River area, which by the late 1980s could reduce Metropolitan Water District's entitlement to 450,000 acre-feet, and possibly to only 400,000 acre-feet.

Assuming that all existing and planned State Water Project facilities serve all the service areas collectively, then it could also be assumed that all of the individual project facilities contribute equally to reducing deficits in other water supplies in the service areas. For Southern California, an average of 33 percent of State Water Project deliveries between 1990 and 2035 will be needed to replace water diverted to the Central Arizona Project. Therefore, it was assumed that 33 percent of the impact associated with the water supply from the additional pumps would be a continuation of current conditions.

Socioeconomic impacts in the San Joaquin service area were adjusted to account for replacement of State Water Project surplus agricultural supplies. From 1973 to 1980, substantial amounts of agricultural surplus water have been delivered to the San Joaquin service area, averaging about 407,700 acre-feet per year, excluding the drought year of 1977. Future State Water Project agricultural entitlement deliveries of about 1,244,400 acre-feet per year will displace these surplus deliveries, which are about 33 percent of projected agricultural entitlements. Thus, 33 percent of future entitlement deliveries will be replacing these past agricultural surplus deliveries. Municipal and industrial deliveries to this service area will not be affected by this surplus replacement.

Evaluation of Growth-Inducing Impacts

According to California Environmental Quality Act definitions, a growth-inducing action is one that "could foster economic or population growth, either directly or indirectly, in the surrounding environment. Included in this are projects which would remove obstacles to population growth ... (and) which may encourage and facilitate other activities that could significantly

C—105433

C-105433

affect the environment, either individually or cumulatively."

Water supplies are planned to meet the needs of people, industry, and farms with projected economic and population growth.

A water supply, by itself, is not considered to cause growth; however it is possible that the lack of water (if severe enough) can hinder economic growth and subsequent population growth. In light of Department projections of impending water shortages in the State Water Project service areas (1990 and beyond), it is necessary to evaluate the growth-inducing impacts of proposed project development. This evaluation is required for individual proposed facilities, as well as for the cumulative effect of the State Water Project as a complete water importation system.

The growth-inducing nature of a project is evaluated by comparing the population impact of the proposed facility (or State Water Project as a whole) in the service areas with forecasted total population in the counties encompassing the service areas. Because the State Water Project has been in operation for several years, the analysis compares the estimated population impact of the facility (or the State Water Project) with the forecasted population increase in the service area from 1985 to 2020.

Population impacts were derived from the effect of the State Water Project on income and employment in the service areas. In effect, the extent to which additional water will contribute to growth in an area depends on the industrial mix. By applying employment/population relationships, it is possible to derive the population associated with additional water.

Summary of Socioeconomic and Growth-Inducing Impacts

Table 5-23 shows the average annual socioeconomic impacts in all five service areas for two alternative operational plans: preferred and 4-10.3. Values shown are for income, employment, population, and housing units.

Table 5-23

SUMMARY OF INCREMENTAL SOCIOECONOMIC IMPACTS OF ADDITIONAL PUMPS ON PROJECT SERVICE AREAS FOR PREFERRED* AND 4-10.3 ALTERNATIVES

	Income (Million 1982 Dollars)				Employment (1,000 Jobs)				Population (1,000 People)		Housing Units (1,000)	
	Direct		Direct, Indirect, and Induced		Direct		Direct, Indirect, and Induced					
Service Area	Preferred*	4-10.3	Preferred*	4-10.3	Preferred*	4-10.3	Preferred*	4-10.3	Preferred*	4-10.3	Preferred*	4-10.3
So. California	233	747	793	2,541	6.3	20.2	37.6	120.6	66.2	212.3	28.6	94.4
South Bay	33	96	110	322	0.9	2.6	3.5	10.4	0.4	1.1	0.2	0.5
San Joaquin	4	14	16	52	0.4	1.4	2.5	8.3	0.5	1.5	0.2	0.6
North Bay	7	20	28	80	0.1	0.4	1.1	3.3	0.1	0.4	0.1	0.2
Central Coastal	5	16	21	63	0.2	0.7	1.4	4.3	0.7	2.1	0.3	0.9
Total with Replacement Adjustments	282	893	968	3,058	7.9	25.3	46.1	146.9	67.9	217.4	29.4	96.6

*Preferred upper limit of 4-10.3(Corps); constrained by Public Notice 5820A-Amended, U. S. Army Corps of Engineers.

C—105434

C-105434

The total estimated income impact, as a percent of the projected 1990 level for California ($565.8 billion) is about 0.2 percent for the preferred alternative and about 0.5 percent for Alternative 4-10.3.

The total estimated employment impact, as a percent of the projected 1990 level for California of about 13 million employees, is about 0.4 percent for the preferred alternative and about 1.1 percent for the 4-10.3 alternative.

The total estimated population impact, as a percent of the projected 1990 level for California of about 26.5 million, is about 0.3 percent for the preferred alternative and about 0.8 percent for the 4-10.3 alternative.

Table 5-24 summarizes growth-inducing impacts of the additional pumps on the five service areas for the preferred and 4-10.3 alternatives. The table also compares this growth-inducing impact with the projected total increase in population from 1985 to 2020 in the counties encompassing the service areas. The annual impact of the preferred alternative would represent about 0.9 percent and the 4-10.3 alternative about 2.9 percent of the total population increase in the service areas between 1985 and 2020.

Table 5-24

GROWTH-INDUCING IMPACTS IN STATE WATER PROJECT SERVICE AREAS FOR PREFERRED* AND 4-10.3 ALTERNATIVES

Service Area	Projected Service Area Population** (thousands)			Annual Banks Pumping Plant Impacts (thousands)		Banks Pumping Plant as % of Total Increase	
	1985	2020	Increase	Preferred	4-10.3	Preferred	4-10.3
Southern California	14,570.5	20,603.4	6,032.9	66.2***	212.3***	1.1	3.5
San Joaquin	535.0	851.8	316.8	0.5	1.5	0.2	0.5
Central Coastal	496.0	671.2	175.2	0.7	2.1	0.4	1.2
South Bay	2,526.7	3,243.1	716.4	0.4	1.1	0.1	0.2
North Bay	396.3	723.2	326.9	0.1	0.4	0.0	0.1
TOTAL	18,524.5	26,092.7	7,568.2	67.9	217.4	0.9	2.9

* Preferred upper limit of 4-10.3(Corps); constrained by Public Notice 5820A-Amended, U. S. Army Corps of Engineers.

** For the counties encompassing the service areas.

***Net impact after allowing for replacement of Metropolitan Water District Colorado River entitlement being diverted to the Central Arizona Project in the late 1980s.

C—105435

C-105435

Environmental Impacts and Mitigation Measures for Service Area Impacts

Potential environmental effects were considered for each service area and are discussed below.

Because adverse air quality is an existing rather than potential problem, any growth within the State Water Project service areas could possibly impair air quality or make it more difficult for State and Federal air standards to be met. Most regions will probably show slight increases of particulates, sulphur dioxide, and oxides of nitrogen. However, more stringent automobile emission standards will reduce present levels of oxidants and carbon monoxide emissions. The more stringent standards would tend to offset the effects of growth attributable to the additional pumps. Considering the growth impacts in relationship to projected emissions in each service area, the overall air quality effects of the project would be minimal.

Hydrologic conditions and water quality should be improved somewhat in the Southern California, South Bay, and Central Coastal areas. In the San Joaquin service area, salt management problems may be somewhat aggravated because of increased deliveries in years of agricultural water deficiencies. San Joaquin Valley drainage and salt management studies were discussed in Chapter 4, "San Joaquin Valley".

Based on the operation studies, average annual agricultural deliveries would be increased by 1.7 percent with additional pumps operated under the Corps constraints and by 3.8 percent under alternative 4-10.3. These increased deliveries would offset ground water pumping. However, there would be increases in the volume of dissolved salts carried in the applied irrigation water. About 24 percent of applied irrigation water must be allowed to percolate through the root zone to leach away accumulated salts. Thus, there would also be corresponding increases in the volume of subsurface drainage water that is too saline for reuse for conventional irrigation and requires disposal.

Evaporation ponds are a commonly used method for disposal of saline drainage water. To the small extent that additional or larger evaporation ponds would be required with the additional pumps, there could be associated impacts. The general impacts of evaporation ponds are:

- Other land uses are precluded.
- Initial wildlife habitat values diminish as salinities increase beyond the tolerance of most plants.
- Accumulated salts must eventually be transported to a permanent disposal site.

The public benefits from use of chemicals in agriculture to control pests and diseases and to increase productivity. However, pesticide use can affect the ecosystem and people exposed to the chemicals. The pesticide registration process of the Environmental Protection Agency, in conjunction with the Department of Food and Agriculture, is designed to protect the applicator, surrounding farms, the soil and water, and the consumer.

The amount of applied irrigation water is a major factor affecting use of pesticides. Thus, the impacts of the additional pumps on pesticide use could be proportional to the increase in average annual agricultural deliveries, as given in the discussion of salt management. Further information on pesticide use and associated problems is presented in Appendix D.

In view of regulations on pesticides and the small area involved, potential

C—105436

C-105436

pesticide problems associated with increased dry year deliveries with the additional pumps are considered minimal.

Urbanization and agricultural expansion would be stimulated somewhat by the project, resulting in further loss of wildlife habitat. Also, wildlife could be affected by increased recreational use associated with growth induced by the project.

Rare and endangered species in the service areas that could be affected are:

South Bay -
Alameda striped racer (snake)

San Joaquin -
San Joaquin kit fox
San Joaquin antelope squirrel
Blunt-nosed leopard lizard
Giant kangaroo rat
Bald eagle

Central Coastal -
Morro Bay kangaroo rat

In the San Joaquin service area, impacts to rare and endangered wildlife would be minimal in the districts that have already been extensively cultivated. In the remaining districts, increasing water supplies could allow existing habitat to be converted to cropland, potentially affecting the rare and endangered species. These impacts could be significant in such districts as Belridge, Berrenda Mesa, Lost Hills, and Cawelo, because these districts have the greatest potential for bringing new lands under cultivation. The potential cultivation would be 4,500 acres for the preferred alternative and 13,200 acres for the 4-10.3 alternative. This represents about 1 to 2 percent of the irrigated acreage within the service area.

The extent and specific location of potential agricultural expansion in these districts cannot be predicted accurately at this time. Specific decisions on expansion generally are made by the farm operators and the various districts, based mainly on engineering, economic, and financial considerations. Thus, it is difficult to correlate the potential conflicts of such expansion with the recovery plans for the blunt-nosed leopard lizard and the San Joaquin kit fox, described in Chapter 4, under "San Joaquin Valley Service Area". The specific priority habitat areas should be considered in any specific plan for expansion.

Service area impacts for this project would be secondary. The extent, type, or manner of development that may be caused by this project are beyond the control of the Department of Water Resources. Potential impacts discussed in this section could be significant, depending mainly upon where development occurs. To the extent that they are significant, they should be mitigated by local agencies or other interested entities implementing measures such as:

- Acquiring land for habitat protection.
- Developing environmental plans for local management.
- Implementing water management plans.

Funding environmental studies to advance knowledge of environmental needs will be important. Also the Department is advancing water management planning to help reduce entitlement buildup schedules and thereby reduce service area impacts.

General plans prepared by local governmental agencies in the urban service areas identify areas suitable for further development, as well as those to be reserved for open space. Local planning agencies have responsibilities for evaluating each proposed development to ensure compliance with these plans.

C—105437

C-105437

Relationship of the Proposed Action to Land Use Plans

Operation of the Delta complex with additional pumps under Corps constraints would not conflict with any known land use plans in the five Delta counties of Solano, Sacramento, San Joaquin, Alameda, and Contra Costa, nor with the Delta Master Recreation Plan. The additional pumps would be installed in the existing plant building in space provided during original construction. No new building, enlargement, or modification of Clifton Court Forebay would be needed. Banks Pumping Plant has been in operation since 1967, and land use plans formulated since that time have taken into account the existing facilities, water deliveries, and water supply contracts.

Operating the Delta complex with the additional pumps not constrained by Corps criteria would require southern Delta modifications. It is assumed that modifications would consist of 6 miles of channel dredging and berm removal in Victoria Canal and Middle River, 1 mile of rock riprapping in Old River, and a new intake structure on the northeast corner of Clifton Court Forebay. These modifications would not conflict with any known land use plans in the Delta counties of San Joaquin and Contra Costa, nor with the Delta Master Recreation Plan.

Energy and Capacity Impacts

The energy and capacity impacts of the additional pumps were reviewed in recognition of the following:

- The points of analysis for energy conservation set forth in Appendix F of the California Environmental Quality Act guidelines.
- The purposes of the additional pumps, which include electrical load management.
- The Department's long-range energy program. (As described in Chapter 1, "State Water Project Power Operations", total project energy requirements for year 2000 are projected at 10.86 billion kilowatt-hours.)
- Gradually increasing State Water Project demands.
- Operation studies and economic analyses (see Chapter 3, "Physical and Operational Comparison of Alternative Operational Plans" and "Economic Analysis").

To the extent that water deliveries are increased with the additional pumps, State Water Project energy requirements will also increase. However, inefficient, wasteful, or unnecessary energy consumption will be avoided by measures such as water conservation, energy recovery along the system, and minimal use of on-peak energy. Such measures are included in the Department's energy program, and were incorporated in the economic analysis, which also considered the high costs of energy and capacity.

Estimated average annual increases in energy requirements for firm yield and ground water yield increases from the additional pumps are shown below (values in million kilowatt-hours):

Alternative	State Water Project Net	Local*	Total
2-7.3(Corps) 4-7.3(Corps)	240	29	269
2-8.5, 4-8.5	426	50	476
4-10.3	686	86	772

* Local requirements for distribution and treatment.

The energy requirements for firm yield deliveries with the additional pumps would be about 60 percent of those for median year deliveries with the existing pumps.

C—105438

C-105438

Such increased energy requirements would be met from several energy sources. One possible source is the Reid Gardner Unit 4 (an addition to three existing coal-fired generating units about 45 miles northwest of Las Vegas, Nevada). The increased energy requirements of the alternative operational plans for the additional pumps would be less than the energy produced by the Unit 4 facility. The proportion of energy needed for the additional pumps in relation to the energy produced by Unit 4 are:

Alternative	Percent
2-7.3(Corps), 4-7.3(Corps)	17
2-8.5(Corps), 4-10.3(Corps)	19
2-8.5, 4-8.5	53
4-10.3	56

Mitigation measures employed in constructing and operating Unit 4 include:

- A sulfur dioxide scrubber to remove at least 85 percent of the sulfur dioxide in the flue gas.
- An electrostatic precipitator to remove virtually all of the fly ash from the flue gas.
- Boiler design to limit nitrous oxide emissions to a maximum of 0.6 lbs/10^6 BTU.
- Dust abatement provisions for the coal handling and storage systems.

Maximum air quality predictions for Unit 4 were judged not significant in the Department's environmental impact report for that project. Estimated pollutant concentrations under worst-case airflows in the area of Unit 4 are shown below (values in micrograms per cubic meter):

Pollutant	Time Period	Background and Existing Units	With Unit 4*	Standard
Sulfur dioxide	24 hour	123	126	260
	Annual	24	24.3	60
Total suspended particulates	24 hour	420**	420.3	150
	Annual	36.5	36.6	60
Nitrogen dioxide	Annual	18.0	18.6	100

* These estimated pollutant concentrations represent full operation, which would provide more increments of State Water Project energy supplies than needed by the additional pumps.

** Very high background total suspended particlate levels associated with dust storms.

The preferred alternative will help meet increasing State Water Project demands while displacing a need for supplemental energy and capacity. Specifically, four additional pumps would delay State Water Project needs for additional capacity and any plant construction needed to provide such capacity. This is a beneficial economic and environmental impact. The overall energy and capacity impact is not judged to be significant.

C—105439

C-105439

Summary of Impacts Under the Preferred Alternative

This section summarizes incremental impacts of the preferred alternative according to three categories: insignificant, unknown yet potentially significant, and significant. Data and analyses supporting these conclusions are discussed in other sections of this chapter. Cumulative impacts of pump operation are discussed in Chapter 6.

The determination of significant impacts was based on review of Appendix G in the California Environmental Quality Act guidelines (Table 5-25).

Impacts Found to be Insignificant and Factors That Are Favorable

Following is a list of subjects for which incremental impacts were evaluated and determined not to be significant or to be slightly favorable.

- Construction impacts
- Monthly and annual Delta outflows
- Delta outflow surges
- Delta municipal and industrial uses
- Delta agricultural uses and tidal fluctuations at Clifton Court Ferry
- Channel velocities, scour, and siltation
- Cross-Delta flows and levees
- Salmon and steelhead migration
- Striped bass
  - Spawning
  - Young-of-year abundance
  - Entrainment of juveniles, eggs, and larvae
- American shad migration and entrainment losses
- Sturgeon migration and entrainment losses
- Entrainment losses for steelhead rainbow trout and resident fish
- *Neomysis* abundance and entrainment
- Suisun Marsh
- Recreation and wildlife at Clifton Court Forebay
- Operation of Tracy Pumping Plant
- Energy

Environmental categories listed in the California Environmental Quality Act Guidelines, Appendix I, that are not directly affected by this project are:

- Earth
- Light and Glare
- Risk of Upset
- Public Services
- Human Health
- Esthetics
- Cultural Resources
- Plant Life
- Noise
- Utilities
- Recreation

It is possible that some of these categories may be affected by secondary service area impacts, as discussed in the section "Impacts on State Water Project Service Areas" in this chapter.

Impacts Evaluated with Insufficient Information to Determine Significance

There are two important environmental concerns for which not enough information is available to assess either absolute or incremental impacts of the additional pumps. These are:

- Overall food supply for young striped bass and other fish.

- Biological resources of San Francisco Bay.

Data upon which to base assessments are several years away. Therefore, environmental impacts are not known, yet are recognized to be potentially significantly. Studies may result in modification of Decision 1485 standards, and any valid future standards would be met by the Department with or without the additional pumps. The two unknown impacts are discussed below, along with considerations about proceeding with the additional pumps and related studies, which can advance knowledge of potential impacts.

Overall Food Supply for Fish. The overall interrelationship between the factors affecting fish food supply is not well understood. A particularly important unknown aspect pertains to the food supply for young striped bass, which was discussed in the sections "General Impacts on Striped Bass" and "Overview of Fish Food Supply Impacts". Impacts of export operations on the plankton food supply for larval striped bass cannot yet be analyzed. Results of proposed studies under the Interagency Work Plan are expected to provide the basis for a decision on modifying Decision 1485 standards, particularly in regard to spring export operations. Such a decision would likely be made before the additional pumps are operational.

Several comments on the Draft Environmental Impact Report on the Proposed Additional Pumping Units stated that increased diversions during winter might affect phytoplankton levels later in the spring and, thus, the food supply for larval bass. There is no evidence that increased winter diversions might affect spring phytoplankton development. If the relationship found by the Striped Bass Working Group between 7-day average exports prior to the phytoplankton blooms and peak levels during the blooms is valid, the additional pumps should have no incremental effect on spring development.

Activities by the Department regarding unknown environmental impacts, such as food supply for young striped bass and other fish, consist of funding and active participation in several ecological studies. Over $20 million has been spent by the Department for such investigations, and budgets project millions to be spent annually to continue this work. Studies include:

- Phytoplankton Work Group and Export Management Experiments
- Interagency Ecological Study of the Sacramento-San Joaquin Estuary
- Decision 1485 Monitoring

Biological Resources of San Francisco Bay. It is not known how differences in Delta outflows under the various alternatives (see Tables 5-4 and 5-21) will affect biological resources in San Francisco Bay. The important relationship between Delta outflows and fish and wildlife resources in the bay is the subject of ongoing studies and monitoring that the Department of Water Resources helps fund.

Environmental concerns for the bay are recognized by the State Water Resources Control Board, as discussed in "Environmental Setting" (San Francisco Bay Area) in Chapter 4. A related study, the Interagency Ecological Study Program, is discussed in Chapter 1 under "Ecological Studies". Outflow surges, a consideration for the bay environment, are discussed earlier in this chapter.

The life cycles of several fish in San Francisco Bay depend on freshwater flows into the bay. Changes in both salinity and currents from these flows are associated with the timing of spawning and environmental conditions suitable as a nursery area for larval and juvenile fish. Life cycles of four of these species (English sole, northern anchovy, longfin smelt, and Pacific herring) are described in the July 1983 interagency report, Effects of Freshwater Outflow on San Francisco Bay Biological Resources. Longfin smelt and Pacific herring have been salvaged at the Skinner Fish Facility, but losses at the facility probably do not influence the overall abundance of either species. (See Table 5-17 for salvage estimates for these species.)

Impacts on San Francisco Bay biological resources are unknown because of lack of information. The Department is funding various studies to advance knowledge of biological resources and needs in the bay complex, but no conclusions have yet been reached. However, if bay fish resource levels are related to the amounts of freshwater inflows, then the incremental effects of the additional

C—105441

C-105441

Table 5-25

GUIDELINES FOR DETERMINING SIGNIFICANT EFFECTS

A project will normally have a significant effect on the environment if it will:

(a) Conflict with adopted environmental plans and goals of the community where it is located;

(b) Have a substantial, demonstrable negative aesthetic effect;

(c) Substantially affect a rare or endangered species of animal or plant or the habitat of the species;

(d) Interfere substantially with the movement of any resident or migratory fish or wildlife species;

(e) Breach published national, state, or local standards relating to solid waste or litter control;

(f) Substantially degrade water quality;

(g) Contaminate a public water supply;

(h) Substantially degrade or deplete ground water resources;

(i) Interfere substantially with ground water recharge;

(j) Disrupt or adversely affect a prehistoric or historic archeological site or a property of historic or cultural significance to a community or ethnic or social group; or a paleontological site except as a part of a scientific study;

(k) Induce substantial growth or concentration of population;

(l) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system;

(m) Displace a large number of people;

(n) Encourage activities which result in the use of large amounts of fuel, water, or energy;

(o) Use fuel, water, or energy in a wasteful manner;

(p) Increase substantially the ambient noise levels for adjoining areas;

(q) Cause substantial flooding, erosion, or siltation;

(r) Expose people or structures to major geologic hazards;

(s) Extend a sewer trunk line with capacity to serve new development;

(t) Substantially diminish habitat for fish, wildlife, or plants;

(u) Disrupt or divide the physical arrangement of an established community;

(v) Create a potential public health hazard or involve the use, production or disposal of materials which pose a hazard to people or animal or plant populations in the area affected;

(w) Conflict with established recreational, educational, religious or scientific uses of the area;

(x) Violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations.

(y) Convert prime agricultural land to non-agricultural use or impair the agricultural productivity of prime agricultural land.

(z) Interfere with emergency response plans or emergency evacuation plans.

Source: California Environmental Qualicy Act Guidelines, Appendix G.

pumps can also be expected to be minimal, since outflow changes for the preferred alternative would be minor.

Further considerations in proceeding with the additional pumps are in the response to General Issue 11 in Chapter 7.

Significant Environmental Effects

In reviewing incremental environmental effects of the preferred alternative, one was found to be significant: increased entrainment losses for juvenile chinook salmon, mainly those from the San Joaquin River. This impact would be mitigated by provisions incorporated into the preferred mitigation.

Service area impacts for this project are secondary. Some of these, such as wildlife habitat loss, could be significant. Mitigation measures that could be carried out by local agencies that control local development were described in "Impacts on State Water Project Service Area" in this chapter.

Mitigation for Impacts on Fish

Four mitigation options were developed for significant fish impacts in the Bay-Delta estuary in connection with the Banks Pumping Plant and the additional pumps. These options provide a wide range of mitigation possibilities for all alternative operational plans, consisting of an agreement for preservation of fish, a reduction in off-peak power use, a further reduction in project exports during critical fish abundance periods, a fish stocking commitment, and a potential reduction in export buildup rates with further water conservation. The discussion of these options expands on that found in the draft report because of:

- The fact that preferred mitigation in the draft, the December 1982 proposed Agreement to Manage Fish and Wildlife Resources of the Sacramento-San Joaquin Estuary, was not executed.
- Publication of preliminary water management plans for various State Water Project contractors and enactment of the Urban Water Management Planning Act.
- Written and verbal comments on the draft environmental impact report.
- Improvements by the Department of Fish and Game in the assessment of impacts on fish for existing and additional State Water Project pumps.
- Completion of statewide operation studies for the additional pumps using more efficient operating methods and updated assumptions on water resources development.

All mitigation measures assume continued compliance with Decision 1485, which provides protection in four areas:

- Flow and water quality standards.
- Operational constraints for monthly export limits and operation of the Delta Cross Channel.
- Operational standards for fish protective facilities.
- An estuary water quality monitoring program.

In some cases, the mitigation measures are more stringent than Decision 1485.

Evidence in recent years has shown a major decline in striped bass, even with the protections of Decision 1485. Although the decline may be due to toxic pollution, it could be related to the water projects. If it is, the State Water Resources Control Board may modify the standards or constraints. The Department would comply with any valid changes, with or without the additional pumps.

C—105443

C-105443

Mitigation Option 1, Modified Agreement for Preservation of Fish in Relation to Banks Pumping Plant. This mitigation option is preferred. Both the Department of Water Resources and Department of Fish and Game believe an agreement on operation of the State Water Project is needed to protect fish. Past efforts in this area have been extensive and include negotiations that produced draft agreements in 1976 and again in December 1982.

The 1976 agreement, negotiated between the Department of Water Resources, Department of Fish and Game, U. S. Fish and Wildlife Service, and U. S. Bureau of Reclamation, was never formally adopted. Its provisions, however, formed the basis for fish and wildlife protective provisions of Water Right Decision 1485.

The December 1982 agreement between the Department of Water Resources and Department of Fish and Game was the subject of an environmental impact report, which provides important supplemental material to this report on the additional pumping units. It was not signed, and negotiations were resumed to develop a new agreement.

The preferred mitigation in this final report for the additional pumps is a new fish preservation agreement between the Department of Water Resources and the Department of Fish and Game. This agreement to mitigate for the direct losses of fish at the intake to the California Aqueduct is being negotiated with the assistance of representatives from groups concerned with fish resources affected by the State Water Project, as well as representatives of State Water Project contractors.

The basic principles of the agreement have been established. Most important of the principles is that the agreement will mitigate for all direct impacts on fish caused by the pumping plant. This means the State Water Project will pay for mitigation projects that will compensate for direct losses of chinook salmon, striped bass, and steelhead trout caused by the existing pumps as well as the four additional pumps. A second principle is that projects funded as a result of this agreement will stress nonhatchery measures designed to restore the fishery by means of habitat improvement and to preserve the genetic integrity of fishery stocks.

Unresolved items primarily relate to details of fish loss calculations, the cost of replacing fish, and how to address impacts not covered by the agreement. While these are important, they are technical items not likely to affect the basic principles upon which the agreement is based.

Principles of the proposed agreement and issues to be resolved are discussed below.

Mitigation would be provided for fish that would have remained in the estuary if Banks Pumping Plant had not been in operation during 1968-1984. Fish lost during this period are estimated at 5 million to 10 million striped bass, salmon, and steelhead; cost to replace these fish would average $2.00 to $2.50 per fish. In addition, the State Water Project would mitigate for annual losses of chinook salmon, steelhead trout, and striped bass for future export of water by all the pumps. The mitigation responsibility will be calculated each year based on pumping rates during the preceeding year and average salvage losses in the previous five years.

Fishery restoration projects would be selected by the Department of Water Resources and Department of Fish and Game with guidance from an advisory committee represented by groups concerned with fish resources and by State Water Project contractors. Projects would be chosen based on economic, technical, and environmental factors. Although hatchery operation can be an integral feature of any restoration program, priority would be given to habitat restoration and other

C—105444

C-105444

nonhatchery projects that help to preserve the genetic integrity of the stock. When hatcheries are chosen, wild brood stock will be issued. Potential projects identified in the draft agreement are:

- Improvement of upstream habitat, including flows, to benefit salmon and steelhead;
- Barriers and other control structures to provide channel flows favorable to fish;
- Screens for some major Delta agricultural diversions; and
- Facilities at Clifton Court Forebay where striped bass collected at the Skinner Fish Protective Facility will be raised to a size that will improve their ability to survive when returned to the Delta.

U. S. Army Corps of Engineers constraints for Banks Pumping Plant operations, described on page 19, would be part of the agreement.

During regulated flow periods in May and June, limitation on Banks Pumping Plant exports will be more restrictive than the current Decision 1485 limits when water is released from storage for exports. This will result in fewer fish being lost during such times.

Department of Fish and Game will evaluate striped bass stocking strategies to determine the contribution of stocked fish to the fishery.

There is insufficient information to determine the impact of Banks Pumping Plant on species other than striped bass, salmon, and steelhead or to determine appropriate mitigation measures. Some of the mitigation measures described for these species may benefit others. If current studies develop enough information to identify other effective mitigation measures, such measures will be included in the agreement.

The agreement provides for review of its success in mitigating the effects of the pumping plant on fisheries dependent on the Delta and renegotiation, if appropriate, to fulfill State Water Project mitigation responsibilities relating to Banks Pumping Plant.

Efforts will be made to involve the Federal Government in developing programs that would mitigate for similar effects of the Central Valley Project.

A provision will be included regarding impacts of the State Water Project not covered by the agreement. Issues to be resolved include the type, timing, and scope of discussions to take place.

Entrainment loss estimates for striped bass and chinook salmon incorporate certain assumptions about mortality rates in Clifton Court Forebay and during handling and hauling. The losses are especially high for chinook salmon, mainly because of the 75 percent mortality assumed in the forebay. Predation control programs in the forebay are under study and could result in a reduction of mortality. Any reduction would provide mitigation for the existing pumps or the additional pumps.

Table 5-26 shows how the predation rate assumption for the forebay affects the average annual losses for chinook salmon under two cases.

Table 5-26

EFFECTS OF CLIFTON COURT FOREBAY PREDATION RATES ON AVERAGE ANNUAL LOSSES OF CHINOOK SALMON (Values in 1,000 Yearling Equivalents)

Predation Rates	Case 1* Alternative No-Project	Case 1* Alternative Preferred	Case 2* Alternative No-Project	Case 2* Alternative Preferred
75%**	361	378	361	378
60%	211	221	338	354
50%	161	169	323	337
40%	128	134	307	321
25%	95	99	284	296

* Case 1 investigates the sensitivity of computed salmon direct losses to the accuracy of the 75 percent predation estimate used to evaluate the impacts of the additional pumps. Case 2 investigates the potential for reduced salmon mortality rates that predation control programs could provide when compared to an estimated predation of 75 percent.
**Current estimate.

C—105445

C-105445

The certainty of raising large numbers of striped bass is well documented; however, the Department of Water Resources recognizes the uncertainty of survival of these yearling fish once they are stocked in the Delta. Within the limits of present knowledge, it is the judgment of the Department of Water Resources and the Department of Fish and Game that stocking can be an effective part of the mitigation package. The new agreement is considering many fish improvement measures with priority given to nonstocking measures.

Mitigation Option 2, Restricted Operational Modes with the Additional Pumps. In response to comments received on the draft report, two restricted operational modes were investigated to demonstrate the potential of the additional pumps to reduce entrainment impacts. The associated loss of State Water Project benefits for the restricted modes was also investigated.. The restrictions investigated are:

- An off-peak pumping curtailment to increase screening efficiencies during summer months of peak striped bass abundance. Off-peak curtailments were offset by increased on-peak pumping, with no reduction of average monthly pumping volume. This restriction would result in a loss of on-peak energy savings during summer and reduced daily velocity extremes at the screens.

- Reducing export limits below those in Decision 1485 for May, June, and July proportionally to increased diversions the previous winter. This restriction would reduce annual deliveries and firm yield.

Curtailment of Off-Peak Pumping: The off-peak pumping restriction investigated was to limit the off-peak daily maximum pumping to 3,000 cubic feet per second in June and 6,400 cubic feet per second (the present capacity) in July. Under the export limits of Decision 1485, this restriction would represent continuous pumping during June and July. Such off-peak restrictions would be more stringent than present restrictions with the existing pumps. This restriction would reduce average annual striped bass losses by 43,700 yearling equivalents, or 3 percent. There would be no significant effect on chinook salmon. The tradeoffs involved in this restriction are shown in Table 5-27. Estimated cost of the restriction is $176,000, or $4.00 per fish.

Table 5-27

SUMMARY OF POSSIBLE STRIPED BASS AND CHINOOK SALMON IMPACT REDUCTION, BENEFITS LOST, AND UNIT COSTS USING OPERATIONAL FLEXIBILITY OF THE BANKS PUMPING PLANT (57-Year Average; Early 1990s)

Alternative****	Operational Restriction	Estimated Annual Losses, Yearlings: Striped Bass*	Estimated Annual Losses, Yearlings: Chinook Salmon	Impact Reduction: Striped Bass	Impact Reduction: Chinook Salmon	Impact Reduction: Total	Benefits Lost ($)	Unit Cost ($)
0-6.4	None	1,569,000	360,000	--	--	--	--	--
4-7.3(Corps)	None	1,438,000	378,000	--	--	--	--	--
4-7.3 (Corps)	Off-Peak Curtailment**	1,394,000	378,000	44,000	--	44,000	176,000	4
4-7.3 (Corps)	Reduced Exports (May, June, July)***	1,369,000	373,000	69,000	5,000	74,000	3 million-6 million	40-80

* Includes eggs and larvae.
** Off-Peak daily pumping limited to 3,000 cubic feet per second in June and 4,600 cubic feet per second in July.
*** Decision 1485 limits in May, June, and July reduced by 50 percent of increased exports occurring with the additional pumps from December through March.
****Alternatives designated (Corps) are constrained by Public Notice 5820A Amended, U. S. Army Corps of Engineers.

C—105446

C-105446

Reduction of Exports in May, June, and July: An analysis was made of the effects of offsetting the increased winter diversions possible under the preferred alternative by reduced diversions during May, June, and July. This analysis assumed that the increased export volume from December through March would enable export limits less than those of Decision 1485 during the following May through July. As an example, a 50 percent reduction factor was assumed. If winter exports were increased by 150,000 acre-feet, then the Decision 1485 limits would be reduced by 75,000 acre-feet, 25,000 acre-feet in each of the three months. For each of the 57 years in the operation study, the winter increases and the May, June, and July reductions were determined. The total reductions ranged from none in 14 dry years to 81,000 acre-feet, and averaged 33,000 acre-feet, of which 17,000 acre-feet was in May, 14,000 acre-feet was in June, and 2,000 acre-feet was in July. The July reductions were least because the July exports in the original operation study were most frequently less than the export limit determined, and therefore no reduction was applied.

Table 5-27 shows the results of this analysis. Striped bass losses would be further reduced by an estimated 69,000 yearling equivalents, or 5 percent. Chinook salmon losses would be reduced by an estimated 5,100 yearling equivalents. Losses would also be further reduced for many other fish species.

Average annual deliveries would be reduced by 33,000 acre-feet. The incremental firm yield of the additional pumps would be reduced by 11,500 acre-feet, or 20 percent. Average annual cost of this restriction ranges from $3 million to $6 million, or $40 to $80 per fish.

Mitigation Option 3, Fish Stocking Commitment by the Department of Water Resources. The Department could fund a fish stocking program for striped bass and chinook salmon without a specific agreement with the Department of Fish and Game. This program would focus on offsetting impacts corresponding to operations under the preferred alternative.

Water conservation of about 250,000 acre-feet for 1990 has already been included in determining need for State Water Project supplies. The Department determined this amount was reasonable based on draft management plans prepared for agricultural and urban contractors. The amount is consistent with water conservation estimated by the contractors. All contractors (or subcontractors) of the State Water Project that provide urban supplies must adopt water management plans pursuant to the Urban Water Management Planning Act (see Chapter 1, "Water Conservation and Water Management Plans). This final report also discusses several "extraordinary" water conservation measures that could be considered alternatives to the pumps. As discussed in Chapter 3, these were not included in determination of need because they were more costly, had some institutional problems, and were considered to be at a lower level of acceptance. Under the study assumptions, however, if feasible water supply alternatives in addition to the pumps are not found, such extraordinary measures could likely be implemented to help offset shortages.

One additional mitigation option discussed in the draft report is a commitment to water conservation goals by some or all of the water contractors in contracts between the Department and the contractors. Such contracts would be based on estimates made in the Department's draft water management plans. These estimates were included in determination of need for State Water Project supplies. Thus there is already considerable incentive for contractors to try to save that amount of water. To the extent that such contracts might reduce State Water Project demands beyond the levels adopted by local suppliers in

C—105447

C-105447

their water management plans, there could be a further reduction of fish losses in years when deficiencies are not being imposed. There are no studies that identify to what extent, if any, such contracts could reduce demands.

Other Mitigation Possibilities

Three other fishery mitigation possibilities were investigated but found not feasible. These possibilities and the reasons for elimination from further consideration are listed below.

Possibility	Reason
Screening small agricultural diversions	Found infeasible; numerous institutional problems. (Screening large diversions is being considered as part of the proposed fish agreement.)
Salvage system south of Delta Complex	Expensive when measured by number of fish returned to the Delta; would impact the existing sport fishery.
Moving fish screens to a location near Clifton Court intake gates	High capital cost (about $100 million); probably ineffective because of continued dead-end flow situation. Continued predation and handling and hauling losses.

Unavoidable Significant Effects

There is no substantial evidence that the preferred alternative will create any unavoidable significant environmental effects.

The only potential significant impacts identified were additional losses of salmon and possible service area impacts. The preferred alternative with the mitigation option of the proposed fish agreement would mitigate for impacts of the preferred alternative and for impacts of the existing pumps. If the project includes such an agreement or its equivalent, there would be no significant impact on salmon.

With mitigation provided by the proposed fish agreement and protective measures, it is estimated that salmon populations will remain at recent levels. For San Joaquin River salmon, that means a population of about one-fifth to one-tenth the population 30 years ago, due mainly to conditions outside the responsibility of the State Water Project. Sacramento River salmon will be maintained at a level sustained recently and will be controlled by conditions outside the estuary. Salmon runs in the American and Feather rivers, for instance, are being maintained, through a combination of wild and hatchery production, at levels above those occurring before construction of Folsom and Oroville dams.

Effects on the service area could be significant, depending on where additional development, if any, took place. Measures are available to local government and other entities that can mitigate such impacts.

It was not possible to assess the impact, if any, of the proposed project on several areas, including overall fish food needs and San Francisco Bay biological resources. The Department will continue to fund and participate in ecological studies to better determine the effect of the State Water Project on these resources.

C—105448

C-105448

Chapter 6. CUMULATIVE IMPACTS

This chapter discusses cumulative impacts on the Bay-Delta estuary including the additional pumps at the Harvey O. Banks Delta Pumping Plant; cumulative impacts of State Water Project deliveries in the service areas; and potential mitigation measures for cumulative impacts. Delta and State Water Project planning and related projects are also discussed.

Cumulative impacts refers, in general, to two or more individual effects that are considerable when considered together, or that compound or increase other environmental impacts. Cumulative impacts from several projects are changes in the environment that result from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over time.

General Impacts of Past and Present Development

Many forces affect the complex Bay-Delta estuary environment. Changes have occurred in five general areas:

- Bay and Delta land changes, reclamation, and flooding;
- Population and recreational use;
- Pollution;
- Delta inflow and outflow to the bay (and flow patterns); and
- Fish and wildlife populations.

Installation and operation of the additional pumps would be associated primarily with cumulative effects on the last two areas; all five areas are discussed, since relationships between the areas are complex and interwoven.

Reclamation

Reclamation has been extensive in the estuary. In 1850 there were about 300 square miles of marshland in the bay area. Due to reclamation, little more than 75 square miles of marshland remains. More than 250 square miles of tidal and submerged lands existed in the bay area. In San Francisco Bay itself, about 100 square miles of tidal, marsh, and submerged lands have been reclaimed. Of this, almost half, mostly along the southern sections of the bay, was originally reclaimed for salt ponds. Large areas in the northern part of the bay have been reclaimed for airports. Reclamation has cumulatively reduced valuable riparian and wetland habitat for many Bay-Delta species.

The Delta was originally a freshwater tidal marsh. During the mid-1800s to early 1900s, the Delta was reclaimed for agriculture. This reclamation has traded wetland riparian habitat for habitat provided by agricultural land, which is less diverse and of different value ecologically.

Delta Flooding

The fertile Delta islands are defined by more than 1,000 miles of levees. Nearly 500,000 acres of productive farmland is protected by these levees. Maintaining this fragile levee system has been a continual problem since the original reclamation in the 1890s; over 100 levee failures have occurred since then. Even with today's construction equipment and improved governmental assistance, there have been 15 levee failures since 1980. Reclamation of inundated islands has become so expensive that in some cases they have been left flooded (Franks Tract, lower Sherman, and Mildred

C—105449

C-105449

Islands). To date, Federal disaster assistance has provided $65 million to repair levee breaks. Some adverse effects of levee failures include:

- Loss of agricultural production;
- Major disaster fund expenditures;
- Loss of wildlife habitat and effects on fish;
- Urban damage; and
- Disruption of utilities, gas well production, and highway traffic.

Population

Population of the Bay-Delta area has increased dramatically in the last 25 years, and increases are expected to continue. Because of waste discharge and use, population increases will affect the quality and quantity of water, plus air quality, plant and animal life, noise, land use, housing, esthetics, etc. Water-oriented recreation has increased with the population, resulting in increased fishing pressure and increased boat wave action.

Pollution

The major inflow source to the Delta is the Sacramento River, which drains the Sacramento Valley. This includes rice field drainage containing herbicides. During the rice-growing season, up to one-third of the Sacramento River inflow can consist of rice field drain water, and during very wet years, valley drainage can enter the Delta and Cache Slough via the Yolo Bypass system.

The San Joaquin River is the second major tributary providing Delta inflow. This river carries considerable amounts of salt from irrigation drainage in the San Joaquin Valley.

The San Joaquin River has been the subject of concern recently with regard to its effect on Delta water supplies. Data collected by the Department of Water Resources and from other sources indicate that San Joaquin River water is not higher in pesticide concentrations than that of other streams tributary to the Delta, such as the Sacramento River. Pesticide levels in water samples from all streams measured were far below established drinking water limits. Selenium data collected by the Department of Water Resources and reinforced by data collected by the U. S. Geological Survey demonstrate that the San Joaquin River is not now a significant source of selenium to Delta water supplies, although the possibility of future impacts cannot be dismissed.

In the Delta vicinity, over 50 municipal and industrial waste dischargers release about 453,000 acre-feet of waste water into the Delta annually. In addition, drainage from Delta agriculture totals over a million acre-feet annually.

According to a 1983 report by Citizens For a Better Environment, point discharges into San Francisco Bay annually contribute about 11 million pounds of oil and grease and about 876,000 pounds of toxic pollutants, including heavy metals, petroleum products, industrial solvents, and other toxic organic chemicals.

The contribution of outflows to estuarine pollution is a complex topic, and only a superficial discussion of the outflow/pollution relationship is presented here. Toxicants transported in outflow can affect the abundance of organisms in estuaries; however, outflow probably affects toxicants by influencing dilution rates. In south San Francisco Bay, the rate of freshwater discharge was studied in relation to its effect on contamination buildup in clams. Concentrations of silver and copper in clam tissue were found to react to high quantities of fresh water from the Delta entering South Bay in winter and spring, even though the source of the metals was local runoff.

Additional discussion of toxics and pollution is presented in the Fish and Wildlife section of this chapter.

C—105450

C-105450

Delta Hydrology

Natural features of the Bay-Delta estuary that affect the environment are ocean tides and salinities, inflows of fresh water, and interior Delta flow patterns. Ocean salinity intrusion varies with inflow rates. Tidal fluctuations occur in regular cycles throughout the year. Natural tributary inflow to the Delta is controlled by the climate and varies greatly from season to season and from year to year. Before major upstream regulation, low dry season inflow often allowed ocean salt water to intrude far into the estuary. In 1924, 1926, 1934, and 1939, chloride concentrations in nearly all Delta channels exceeded 1,000 milligrams per liter.

Control and development of Central Valley streams to reclaim land and to produce the power and water needed for California's farms, homes, and industries have altered the seasonal pattern of riverflows and reduced the amount of water reaching the ocean by way of the Delta. Wet season flows are reduced principally by storage in upstream reservoirs and by exporting Delta inflows. Dry season flows are reduced by upstream uses, but releases from project reservoirs maintain Delta outflows at or above minimum protective levels specified by the State Water Resources Control Board. In the Central Valley, local water uses and exports for use elsewhere reduce the natural unimpaired runoff from a 57-year historical annual average of 27.7 million acre-feet to an annual Delta outflow of 11.2 million acre-feet, a reduction of 16.5 million acre-feet per year. Natural unimpaired runoff represents the natural water production of a river basin, unaltered by upstream diversions, storage and exports, or imports.

Delta outflow in an average year is the sum of:

- 4.3 million acre-feet required to meet Decision 1485 requirements and to protect water quality at project export pumps, and
- 6.9 million acre-feet of unregulated Delta outflow in excess of minimum requirements.

The 16.5 million acre-foot per year reduction in natural runoff includes:

- 1.6 million acre-feet of local Delta uses.
- 7.4 million acre-feet of combined State Water Project and Central Valley Project water exported directly from the Delta for use both within and outside the Central Valley. The additional pumps incremental exports represent less than 1 percent of this total.
- 7.5 million acre-feet of upstream uses including exports from the Central Valley via the Hetch Hetchy Aqueduct, Mokelumne River Aqueduct, Friant-Kern Canal, and other local projects.

Bay Hydrology and Circulation

San Francisco Bay is often referred to as an "urbanized estuary" because of its proximity to such a large population center. Water circulation in the bay is of major importance for many human uses of the bay. Water movements disperse and eventually remove unwanted materials from the system.

Bay circulation is driven by three main factors: tides, estuarine circulation, and wind-induced mixing. Most water motion in the bay is the result of tides. Filling and diking along the bay over the years have decreased the volume of the tidal prism (volume of water entering the bay between low and high tide), which in turn has decreased tidal flushing of the bay. The average volume of water passing the Golden Gate during a single flood or ebb tide is about 1.1 million acre-feet, about 20 percent of the total volume of the bay. About

C—105451

C-105451

24 percent of this tidal prism (about 5 percent of the bay volume) is replaced by new ocean water during each tidal cycle.

Estuarine circulation created by freshwater inflow from the Sacramento River system is also being studied as a factor affecting net transport into and out of the bay. Estuarine circulation is driven by the difference in density between fresh water and salt water, which is related to Delta outflow. The importance of estuarine circulation and its association with winter storm's affect on salinity distribution in the southern reaches of the bay is being investigated in connection with flushing the South Bay and controlling long-term buildup of toxic materials. Freshwater inflow to the bay also provides large amounts of suspended sediments and nutrients, which contribute to the ecological balance of the bay.

The timing of previous flow conditions can affect the type and magnitude of biological responses to outflow-related effects. These considerations make it difficult to establish statistically sound and predictable cause and effect relationships between outflow and biological parameters.

Other Factors

Many factors contribute to change in the Bay-Delta estuary system. Some of these will continue to affect the estuary with or without installation of the additional pumps. Others will be cumulatively impacted by incremental changes caused by the additional pumps. Some incremental changes may be beneficial, such as reduced striped bass impacts at the Banks Pumping Plant. Past and present factors impacting the estuary include:

- Land reclamation.
- Sediment load from early gold mining activities.
- Waste water effluent and surface runoff from local and upstream urban development.
- Oil spills.
- Drainage and leaching water discharge from Delta and upstream agricultural water use.
- Commercial, sport, and illegal fishing.
- Construction and maintenance of deep water channels.
- Use of natural inflows by agricultural and urban development.
- Upstream storage and regulation of natural inflows by the Central Valley Project, State Water Project, Hetch Hetchy Aqueduct project, Mokelumne Aqueduct project, and local projects.
- Delta diversions by the Central Valley Project, State Water Project, local municipal and industrial water users, and Delta agricultural water users.
- Levee failures in the Delta.

Of these factors, four additional pumps will add cumulatively only to Delta diversions by the State Water Project; however, they can add cumulatively to the environmental stress caused by other factors.

Fish and Wildlife

During the past century, the estuary has undergone some dramatic changes. Land reclamation, dredging, water development projects, water pollution, and overfishing have resulted in a decline of some resources. Many of the commercial fisheries began to decline before the turn of the century.

Several species have shown an increase in their resource levels, three of them introduced: the Korean shrimp, an important forage species; the Japanese littleneck clam, important in the diet of some sport fish; and the yellowfin goby, one of the most common species in the Bay-Delta system.

In response to a mandate outlined in the State Water Resources Control Board's Water Quality Control Plan for the

C—105452

C-105452

Sacramento-San Joaquin Delta and Suisun Marsh, as well as mandates listed in Decision 1485, the 4-Agency program developed a study plan to determine fresh water needs of San Francisco Bay. While no definitive relationships have yet been established, a report published in July 1983 analyzed the available literature on Delta outflow and its relationship to estuarine hydrology and biology. The following discussion presents some highlights of that report, Effects of Freshwater Outflow on San Francisco Bay Biological Resources.

Primary resources on the decline in the bay are the dungeness crab, striped bass, and white sturgeon. The crab decline was closely correlated with persistent changes in ocean conditions that began three years before the initial decline. No single factor has surfaced as the major cause of the striped bass decline. Declining phytoplankton production, Delta water diversion projects, toxicants, and reduced egg production have all been implicated as possible causes, either singly or cumulatively. Fluctuating population levels of white sturgeon have been attributed to poor recruitment during the mid-1950s. Three causes of poor recruitment have been offered: degradation of habitat for juveniles due to reduced freshwater flows, toxicant contaminants, and declines in spawning stock size.

Some resources are contaminated. Until recently, the Department of Health Services has not allowed any bay shellfish to be harvested for human consumption due to shoreline contamination by sewage and other inputs. Recent improvements have allowed selected shellfish beds to be opened on a temporary basis.

The report concluded that reductions in freshwater outflow cause significant biological changes in estuaries of all types. Changes result, in most cases, from responses by organisms to physical conditions such as altered circulation patterns, increases salinities and reduced nutrient input. The ecological significance of these changes is not completely defined in most systems. In some cases, the same flow change favors some organisms while negatively affecting others. Biological responses to flow are difficult to document because the cause and effect relationship between flows and organism abundances generally operates through a chain of events rather than direct effects of flow alterations on abundance. Some abundance-related changes are continuous functions of flow reductions, while others involve threshold responses. Threshold-type responses are of special concern in that small changes cause large biological responses. Abundance responses of striped bass, salmon, American shad, and longfin smelt in the Bay-Delta system, however, appear to be continuous functions of flow. Survival of these species increases or decreases incrementally with flow variation.

Relationship to Pumps

Evaluation of impacts for the additional pumps included evaluation of conditions if Banks Pumping Plant had not been constructed, existing conditions, and future conditions if additional pumps are installed. Because of the small increase in export pumping caused by the preferred alternative (less than 1 percent of total outflow), it appears that the preferred alternative would not have a significant cumulative effect on the environment. The preferred mitigation compensates for fish that would have been in the estuary if Banks Pumping Plant had not been constructed and, therefore, considers cumulative effects. Cumulative yearling equivalents that would have been in the estuary if the pumping plant were not constructed amount to about 5 million to 10 million striped bass, salmon, and steelhead. The existing pumping plant accounts for annual losses of about 1.5 million yearling equivalent striped bass and 0.3 million salmon. The preferred

alternative would increase yearling equivalent losses for salmon by 17,000, but would decrease yearling equivalent losses for striped bass by about 130,000 for conditions of the early 1990s. Under the preferred mitigation, the State Water Project would be responsible for replacing fish lost on an annual basis after 1986 and all or most of the fish that would have been in the estuary if Banks Pumping Plant had not been constructed.

State Water Project Planning and Related Projects

Department of Water Resources planning programs for the Delta and related projects are discussed in this section, including protection efforts. Planning for power resources was discussed in Chapter 1 under "State Water Project Power Operations".

Operation of the additional pumps can be changed substantially in the future with added State Water Project facilities. The Department does not now have a specific plan for future facilities, but any future facilities would benefit from the additional pumps. The added pumps without any facilities show a favorable benefit/cost ratio, reduced impacts for striped bass, and more efficient use of energy.

Protection Efforts

Planning activities for protecting the Delta environment, discussed in previous chapters, include:

- Two-agency agreement for preservation of fish in relation to Banks Pumping Plant (Department of Water Resources and Department of Fish and Game).
- San Francisco Bay and Sacramento-San Joaquin Delta estuary monitoring in accordance with Decision 1485.
- Interagency Ecological Study Program.
- Striped Bass Working Group studies.
- Suisun Marsh Overall Facilities and Plan of Protection.
- Investigation of predation control for Clifton Court Forebay.
- Testing and improvement of the enlargement of John E. Skinner Fish Protective Facility.
- Installation of additional fish screens at Suisun Marsh facilities.
- Seasonal placement of a rock barrier in Old River to facilitate salmon migration in the San Joaquin River if requested by the Department of Fish and Game.
- National Environmental Policy Act.
- California Environmental Quality Act.
- Discharge permits required by the Federal Water Pollution Control Act and the Porter-Cologne Act.
- Water management plans to reduce the increase of water exports.
- San Francisco Bay Conservation and Development Commission.
- Negotiations for a Coordinated Operation Agreement between the Bureau of Reclamation and the Department of Water Resources.
- Water Right Decision 1485.
- Local coordination for construction.

Water Management

Water management plans for State Water Project contractors, which address both water and environmental needs, were discussed in Chapter 1 (Water Conservation and Water Management Plans). These plans benefit both project operations and contractors by reducing demand buildup schedules, thereby stretching

C—105454

C-105454

available supplies and reducing risks of water shortages. The reduced demand buildup schedule would minimize potential Delta export impacts.

Department planning has developed recommended water management plans for State Water Project contractors. Work toward these plans included investigation of feasible water supply and demand reduction programs for future local development. These programs include water conservation, water reclamation and improved water management practices, conjunctive use of ground water and surface water, watershed management, banking of water supplies for use in water-deficient years, interbasin and intrabasin transfers of developed water supplies, and development of conventional in-basin water supplies. Programs such as conservation will reduce or delay the buildup of water demands by stretching available supplies. Reclamation will augment present water supplies. Conservation measures would require less energy than would importing water from other sources.

Other planning programs for water management include local projects and desalting investigations. As discussed in Chapter 3 (Water Supply and Demand Reduction Alternatives), water management plans are considered to be independent of the availability of State Water Project supplies from the additional pumps or other additions to the State Water Project. Additionally, the Urban Water Management Planning Act of 1983, which requires certain local water agencies to adopt water conservation plans, will add to the Department's efforts on conservation. The act is described in Chapter 1 under "Water Conservation and Water Management Plans". There are current legislative efforts to establish a program for agricultural conservation.

It is Department of Water Resources policy to fund local water supply projects within State Water Project service areas as units of the State Water Project if they are engineeringly feasible, economically and environmentally sound, and financially feasible. Such projects can include supplies from surface water, ground water, or reclaimed water resources. While the amounts of water from such projects are usually relatively small, they do represent a potential supply for the project that could be developed in lieu of importing water from the Delta. When requested by a contracting agency, the Department will evaluate the feasibility of including such projects in the State Water Project. The Department has issued guidelines on funding local water supply projects for inclusion in the State Water Project.

The Los Banos Demonstration Desalting Facility is a key feature of the Department's feasibility study of reverse-osmosis desalination of agricultural drainage water in the San Joaquin Valley. The principal elements of the feasibility study are to:

- Assist in solving immediate and long-range agricultural drainage problems.
- Operate a demonstration desalting facility to obtain information for estimating design and cost of large-capacity plants.
- Determine possible sites for desalting facilities.
- Evaluate desalting facilities, delivery of brackish agricultural drainage water to desalters, conveyance of desalted water to places of use, and disposal of brine. Costs for disposal are expected to be a controlling factor in the economic feasibility of reverse osmosis systems in the valley. Environmental concerns center around brine/waste disposal.
- Determine a schedule of demand for desalted water and availability of proposed desalting facilities.

C—105455

C-105455

- Develop a coordinated plan of operation for desalting facilities.

- Determine the feasibility of using brine from the desalter for salt-gradient solar ponds that could provide energy for operating the desalter.

Some of these planning programs and facilities also benefit State Water Project operations by reducing demand buildup schedules and increasing the efficiency of project operations.

Delta Levees

The description in the Delta Region section of Chapter 4 includes discussions of Delta levee problems, recent State and Federal studies, and the effect of levee failures on State Water Project and Central Valley Project operations. Other adverse effects of levee failures include:

- Loss of agricultural production
- Major disaster fund expenditures
- Loss of wildlife habitat and effects on fish
- Urban damage
- Disruption of utilities, gas well production, and highway traffic.

There seems to be a consensus that some form of levee rehabilitation effort should be undertaken. There is much less agreement on what the scope of the effort should be.

The State Administration believes that the many economic interests involved in the Delta warrant a substantial rehabilitation effort. Last year the Administration proposed, as part of the water program, that $10 million a year of State funds be devoted to this program. The intent was that the State contribution, combined with other funding sources such as a Corps of Engineers flood control project, local Reclamation District expenditures, and the water transfer work by the State Water Project would significantly advance rehabilitation of Delta levees. Although the program was defeated, the State is continuing its $2 million a year levee maintenance subventions program. It is probable that most water interests in the State would support a rehabilitation program in conjunction with improvements in the water transfer system.

Alternatives for Delta Water Transfer

The Department has long recognized that a Delta water transfer facility could provide an economical increment of State Water Project yield as well as help overcome problems in the Delta. In November 1983, the Department released Alternatives for Delta Water Transfer, a report on the most promising alternatives to the Peripheral Canal. The report was essentially a technical review of information gained through many years of Delta investigations. The report made no recommendation, nor did it draw any conclusions about a preferred plan.

The most serious water transfer problem in the Delta is the reverse flow in the lower San Joaquin River. In essence, during summer months, and in dry periods during late spring and early fall, the flow past Antioch moves east toward the export pumps rather than west toward the bay. The reverse flow brings salt from the bay to the pumps and causes problems for fish, including striped bass and salmon. Although concentrations of salts at the pumps are kept within drinking water standards, they are still high enough to control project pumping and to cause higher than desirable levels of trihalomethanes (THMs).

The reverse flows occur because the channels across the northern Delta that connect the Sacramento River with the Mokelumne and San Joaquin river systems

C—105456

C-105456

are not large enough to carry the water being exported at the pumps. Consequently, the extra water has to travel around Sherman Island and back up the lower San Joaquin River channel.

The way to eliminate the reverse flow and its related problems is to develop more channel capacity in the northern Delta. Some of the alternatives are to widen and deepen the South Fork Mokelumne River and possibly to build the New Hope Cross Channel. Other alternatives such as building entirely new cross channels have also been considered.

On April 10, 1984, the Department of Water Resources presented the Administration's proposed plan for Delta water transfer facilities to the Senate Committee on Agriculture and Water Resources. Senate Bill 1369 (Ayala) was amended to provide for the facilities (see "Governor's Water Legislation Package" later in this chapter).

The recommended plan would have involved staged construction in the northern and southern Delta. The initial stage in the northern Delta would have been to enlarge the South Fork Mokelumne River between the Delta Cross Channel and Little Potato Slough. The second stage would have included construction of a new channel between the Sacramento River and Mokelumne River if experience gained from operation of the initial stage indicated it to be necessary to meet environmental and water supply objectives.

Other Delta Facilities

The 1983 Delta alternatives report also stated the Department's intention to construct an overland agricultural water supply for Sherman Island in the western Delta, to continue to evaluate the need for facilities to solve local water supply problems in the southeastern Delta, and to evaluate relocation of the Contra Costa Canal intake.

Overland facilities would provide long-term protection for western Delta agriculture.

Portions of the southern Delta area suffer from one or more of the following problems: poor water quality, inadequate water supply, poor water circulation, and low water levels at certain times and locations. Several alternative physical solutions have been proposed in the past, including building control structures or new distribution channels and dredging existing channels.

The Department is discussing with South Delta Water Agency options for correcting the problems. Agreement is needed on a specific physical plan and financing from a combination of contributions from appropriate local, State, and Federal agencies.

On September 4, 1985, the Department and South Delta Water Agency signed a letter of intent to establish a program for ameliorating water level and water circulation problems in the southern Delta. The letter is the first step toward a binding agreement between the two agencies. The most important part of the letter of intent establishes a cooperative planning program, which envisions probable construction of facilities in some channels, an additional inlet gate to Clifton Court Forebay, and widening and deepening of some channels. It also provides procedures for working cooperatively to prevent or minimize irrigation pumping draft problems before the new plan can be put into effect.

The possibility of relocating the intake of Contra Costa Canal from Rock Slough to the vicinity of Clifton Court Forebay has been under consideration for a long time as a means of improving the water quality and reliability of that supply. At this time, it is not clear that the local interest desire such a plan. The Department is prepared to work with Contra Costa Water District if interest in the relocation is revived.

C—105457

C-105457

Coordinated Operation Agreement

Background and status of the Coordinated Operation Agreement was discussed in Chapter 1 under "State Water Project Operation". This agreement will provide the basis for negotiating a wheeling and purchase agreement between the two projects that would provide for:

- Central Valley Project use of extra conveyance capacity in the California Aqueduct.
- State Water Project purchase of interim water available from the Central Valley Project.

A draft environmental impact report/statement for the Coordinated Operation Agreement was released in July 1985. A final report is now being prepared by the Department and the Bureau of Reclamation. The proposed action of signing and implementing the draft Coordinated Operation Agreement obligates the Central Valley Project and State Water Project to meet water quality and outflow standards extracted from State Water Resources Control Board Decision 1485, designed to protect beneficial uses of the Delta water supply. Without this agreement, the Central Valley Project's participation in meeting these standards would not be assured in critical years. As compared to no action, the agreement would have beneficial environmental impacts in the Delta. It could have adverse impacts on salmon spawning and rearing in the upper Sacramento and Trinity rivers, depending on how the two water projects would be operated in no action, but similar problems would be likely to exist without the agreement.

Offstream Storage South of the Delta

Installation of the additional pumps at Banks Pumping Plant and construction of an improved Delta water transfer system would provide considerably more operational flexibility for the State Water Project. San Luis Reservoir could be filled even earlier and more frequently. It would be possible to divert additional excess winter flows through the California Aqueduct and store them in new offstream reservoirs for use during subsequent drier periods, either that same year or in later years. In addition to the benefits from increased water delivery capability, winter diversions are more compatible with Delta fish needs than are late spring and early summer diversions.

The Department has evaluated alternative offstream storage sites, ranging from 35,000 to 2,300,000 acre-feet, in the Coastal Range near the California Aqueduct. The progress report, Alternative Plans for Offstream Storage South of the Delta (May 1984), recommends that studies focus on feasibility of constructing Los Banos Grandes Reservoir south of San Luis Reservoir. The report also suggests further consideration of a Federal-State-local development at Los Vaqueros or Kellogg Reservoir, immediately south of the Delta.

The Los Banos Grandes Reservoir Bill (AB 3792, Isenberg), approved by the Legislature and the Governor, authorized construction of the reservoir, which could be developed in stages as part of the State Water Project. It also required a study of selenium in drain waters in adjacent farm areas. The Department is conducting feasibility studies of this project. The Bureau of Reclamation may participate.

Ground Water Storage Programs

The Department of Water Resources, in conjunction with other agencies, has conducted numerous investigations and published reports on ground water basins throughout the State. Basic objectives of the investigations are protection

C—105458

C-105458

through improved management. The investigations include studies of potential ground water storage programs to be managed by State Water Project contractors whose service areas overlie the ground water basins. This type of program could be operated by the involved contractors, using entitlements and any surplus water that may be available. Such programs could be entirely to the benefit of the individual contractor or, if all contractors should agree, some programs could be fully integrated into the State Water Project by operating available ground water storage space conjunctively with the project, including new offstream storage reservoirs south of the Delta. Through conjunctive use, greater amounts of water could be made available for ground water storage, and all contractors would benefit from the increased State Water Project water deliveries under this option.

Operation studies show that substantial amounts of additional water could be made available through conjunctive use of surface facilities and a ground water storage program. Cooperating contractors could also realize reduced costs through reallocation of part of the aqueduct costs from transportation to conservation. To develop specific, workable programs, the Department of Water Resources and the contractors are working together on programs of mutual benefit to the State Water Project and local agencies.

The Chino study was completed during the past year. Ground water studies of North Santa Clara Valley and the San Bernardino Valley and San Gorgonio Pass area are continuing. Progress on these investigations during the past year is discussed in Bulletin 132-84.

Conjunctive use programs are operating in many of the State's ground water basins. New conjunctive use programs have recently been initiated that involve exchange agreements and use of available supplies from the Colorado River or the State Water Project.

Other ground water programs to conjunctively use State Water Project supply, either directly or by exchange, are being organized by local agencies in a number of areas, including Kern County, the Chino basin in Southern California, and Alameda and Santa Clara counties. The common objective in all these efforts is to more fully use the potential of the basins for long-term carryover storage.

Onstream Storage North of the Delta

Most of the economical dam sites in California have already been developed. With a few exceptions, the remaining storage sites north of the Delta are less favorable. However, several projects are being considered in the Sacramento River basin.

The status of studies of surface storage facilities and other potential supplies north of the Delta is discussed in the following paragraphs.

Enlarged Shasta Reservoir. This project, evaluated under a joint study by the Department of Water Resources and the Bureau of Reclamation, could provide up to 10 million acre-feet of additional storage capacity and 1.5 million acre-feet of new yield from Central Valley streams.

Major issues concerning enlarged Shasta are timing and total cost. While the unit cost of water appears to be favorable, total capital cost would be several billion dollars. The Department and the Bureau have, therefore, decided to complete the existing investigation and defer the project. Need for the project can be evaluated from time to time in the course of long-range studies and, when appropriate, more intensive investigation can resume.

C—105459

C-105459

Enlarged Shasta could produce water for under $200 per acre-foot, but construction would take until the next century. Therefore, the Department is considering smaller projects that could be developed earlier.

Cottonwood Creek Project. Cottonwood Creek is the largest uncontrolled tributary of the Sacramento River. In 1970, the U. S. Army Corps of Engineers received congressional authorization for construction of two large multi-purpose reservoirs on the main forks of Cottonwood Creek.

Since authorization, the Corps of Engineers has been proceeding with the planning and design studies for the project. These efforts were based on representations by the Department of Water Resources that it would purchase water developed by the project. However, last year the Department found it necessary to withdraw its support from the project, at least temporarily, because the costs allocated to water supply were higher than expected.

For the last year, the Department and the Corps of Engineers have been reevaluating the range of options for development and flood control on Cottonwood Creek. The Corps has concentrated on refining its designs for the two large reservoirs; recent estimates show about a 25 percent reduction in project costs.

The Department has been updating evaluations of several smaller reservoirs in the upper tributaries of Cottonwood Creek, which it studied in the 1960s. These new studies have been completed, and the Corps and the Department are reviewing all the studies.

A June 1985 Department of Water Resources memorandum report, Cottonwood Creek Alternatives, recommends a study of constructing a combination diversion and storage dam at the lower Dippingvat site, a storage dam at the Schoenfield site, and a conveyance system connecting the two reservoirs. The Dippingvat-Schoenfield studies would be conducted in cooperation with the Bureau of Reclamation, Department of Fish and Game, Fish and Wildlife Service, and Corps of Engineers to include fishery and flood control elements.

The major factor that will influence the decision on Cottonwood Creek will be the willingness and ability of State Water Project contractors to underwrite the costs of the projects. The larger two projects can develop more water, but they require much more capital and have somewhat higher unit costs. The smaller reservoirs do not develop as much water or provide the same degree of flood control, but they would require less investment and would be more easily staged. A decision on a Cottonwood Creek project is expected soon.

Central Sierra Streams. In 1983, the Department of Water Resources began an investigation to determine if possible water supply projects on the Yuba, Bear, Cosumnes, and American rivers, identified by other agencies, warrant more detailed study. In analyzing potential projects, consideration is given to meeting area-of-origin and other local needs along with development of State Water Project supply.

A State/Federal Task Force was established by former Secretary of the Interior Clark and Governor Deukmejian to consider Auburn Dam and Reservoir on the North Fork American River. Substantial expenditures have been made at the site. The project would provide needed flood control, hydroelectric power, and water supply, but cost estimates for completion exceed $1.5 billion. Funding of the project is uncertain. In a renewed effort to examine all alternatives, an independent consultant has been retained.

Other developments that may be included if local sponsors demonstrate them to be viable for State participation are: Garden Bar Dam and Reservoir on the Bear

C—105460

C-105460

River, being studied by South Sutter Water District, and a multiple-reservoir development proposed by the Cosumnes River Water and Power Authority.

North Coast Rivers. The 1972 California Wild and Scenic Rivers Act prohibits the State from building dams and reservoirs on major segments of certain rivers: Klamath, Trinity, Smith, Eel, and lower American. The river segments are also included in the National Wild and Scenic Rivers Act. Legislation would be required before these streams could be considered as sources for the State Water Project. However, the State Act directed the Department of Water Resources to report to the Legislature after March 1985 on the need for water supply and flood control projects on the Eel River to provide a basis for legislative consideration as to whether the Eel should be removed from the Wild and Scenic Rivers System.

In August 1985, the Director of Water Resources sent a letter to the Legislature stating that he did not foresee any near-term need to develop the Eel River.

Local Water Purchases and Transfers

It may be possible to increase the State Water Project supply on a temporary basis during drought years by buying water from farmers, water districts, and others in the Sacramento Valley. Local interest has been expressed in such an arrangement. Before such a program could be implemented, however, contractual arrangements would have to be made to establish specific criteria as to amounts of water to be purchased, advance notice and timing of water deliveries, and payment provisions. Negotiations and analysis are needed to determine appropriate arrangements and the practical potential of increasing the project water supply by this means. Delta water transfer improvements would make such purchases more effective.

State Water Project Conveyance Facilities

The Department of Water Resources is pursuing the following additions to State Water Project conveyance facilities:

- North Bay Aqueduct, Phase II
- San Luis Canal Enlargement
- East Branch Enlargement
- East Branch Extension
- Coastal Branch, Phase II

Mid-Valley Canal

The Bureau of Reclamation has studied and proposed the Mid-Valley Canal as an addition to the Central Valley Project. This canal would transport water from the San Luis Reservoir complex south and east to alleviate ground water overdraft from Merced to Kern County. A substantial portion of the Central Valley Projects' remaining uncontracted supply would be devoted to this service area. The Mid-Valley Canal would probably tie into the California Aqueduct near Dos Amigos Pumping Plant.

Timing of the Mid-Valley Canal is uncertain. The Bureau of Reclamation and local agencies are studying alternatives and staging possibilities.

Sacramento River Deep Water Ship Channel

The Corps of Engineers has prepared feasibility reports and environmental impact statements for deepening the navigation channel between Pittsburg and the port of Sacramento. One major concern has been the possibility of increased salinity intrusion into the Delta and resulting effects on Central Valley Project and State Water Project water supplies. Feasibility studies have included salinity effects and mitigation possibilities for any significant increase, but the impact is not definable at this time. If a monitoring

C—105461

C-105461

program identifies increased salinity due to channel deepening, mitigation possibilities will be considered further. Mitigation alternatives could consist of a submerged sill, barriers in the Sacramento River, or release of Central Valley Project water.

Barrier Studies

Barriers in the San Francisco Bay system to physically separate saline water of the bay from the fresh water of the Delta have been proposed and studied many times since the late 1800s. The numerous barrier sites studied have ranged from a few miles upstream of the Golden Gate to many miles upstream as far as Chipps Island. Bay barriers have repeatedly been rejected because of environmental, financial, and other reasons. The Department has contracted with a consultant for further feasibility studies of the barrier concept.

Governor's Water Legislation Package

On April 5, 1984, Governor Deukmejian introduced specific legislation proposals related to water resources. Principal elements of the proposed legislation were:

- A water facility bill that (1) required construction of specified water transfer facilities in the Delta, including fish and wildlife mitigation measures, (2) included offstream storage facilities south of the Delta, ground water storage facilities, southern Delta protection facilities, and interconnections to other water supply systems such as the Contra Costa Canal, (3) permitted use of State Water Project facilities to deliver Central Valley Project water for the Mid-Valley Canal service area, (4) provided protection for Suisun Marsh and San Francisco Bay, and (5) expressed legislative intent that the State Water Project and Central Valley Project be operated in coordination (SB 1369, Ayala).

- A bill to authorize an expanded subventions program for Delta levee construction and maintenance (SB 2196, Boatwright).

- A bill to authorize the Department of Water Resources to establish and administer a loan program for local water agencies to construct ground water recharge facilities (AB 3626, Areias).

- A bill to allocate part of State Water Project costs to mitigate effects of upstream diversions by other than State and Federal projects on the Delta, Suisun Marsh, and San Francisco Bay (AB 3542, Katz).

- A bill to require the Department of Water Resources to conduct investigations in the Sacramento Valley related to inventory of local water supplies and needs, flood control, water quality, seepage, and erosion control (AB 3758, Herger).

- A bill to appropriate Tideland Oil revenues from the California Water Fund for the preceding four items and other purposes as follows (AB 3907, Costa):

Millions	Purpose
$10.0	Delta levees
7.0	Ground water recharge program
3.0	Mitigation for past upstream diversions
1.3	Sacramento Valley planning
2.6	Los Banos Desalter operations and drainage studies
0.5	Acquisition of riparian vegetation sites
0.6	Miscellaneous investigations
$25.0	

C—105462

C-105462

- A bill to authorize general obligation bonds, primarily to fund existing subventions programs under which the State pays part of the costs of Corps of Engineers flood control projects (SB 1648, Nielson).

- A bill to clarify flood fighting authority of the Department of Water Resources (SB 2145, Doolittle).

Related bills would have provided funding for the Department of Fish and Game to propose streamflow requirements for certain streams (AB 3271) and reallocated $5 million per year of Tideland Oil revenues to restore fishery resources reduced by water projects (SB 1500, Keene). A related constitutional amendment would have required a two-thirds vote of the Legislature to amend the area-of-origin statutes or the Delta Protection Act (SCA 16, Johnson). SCA 16, SB 1500, and all the Administration bills except SB 1648 and SB 2145 were joined so that none would have any force or effect unless all were enacted and SCA 16 was approved by the voters.

The only bills in the package approved by the Legislature and the Governor were AB 3535, for the current Delta levee subvention, and AB 3636, for a ground water recharge program. AB 3792, authorizing Los Banos Grandes Reservoir, was separate from the package, but was approved.

The Governor has invited the Legislature to reconsider his plan or develop its own water program.

Water-related bills that provide direct mitigation for adverse impacts of development on fish or that could help reduce demands on Delta water supplies signed by the Governor for the 1985 legislative session include:

- AB 723 (Campbell) requiring the Department of Fish and Game to set streamflow requirements for certain streams.

- AB 1029 (Kelly) providing financial assistance for local water conservation or reclamation projects.

- AB 1156 (Areias) providing financial assistance for Ground Water Recharge Facilities Act.

- SB 400 (Keene) for the Fisheries Restoration Act of 1985, providing annual funding of $5 million in 1985-86 and 1986-87 to restore fish.

- SB 674 (Nielson) requiring studies of the Sacramento River, Feather River, and tributaries north of Sacramento.

General Impacts of Additional Pumps with Potential Related Projects

Future actions in upstream areas by holders of prior water rights will further reduce flows into the Delta. Such actions include increased water use, additional diversion facilities for irrigation and domestic purposes, and major projects such as a proposed water and power development on the South Fork American River and proposed enlargement of the Hetch Hetchy Project.

Table 6-1 summarizes potential cumulative effects of the additional pumps and potential related projects on Delta inflows, outflows, exports, and fish.

Post-2000 Operation of Banks Pumping Plant Without Added Storage or Improved Delta Water Transfer

Many uncertainties are involved in water resources planning; to predict what will happen after the year 2000 is speculative. Added storage and improved Delta water transfer is expected to be implemented by then.

Various other factors will affect future State Water Project operations and deliveries independent of added storage or improved Delta water transfer.

Development upstream of the Delta will decrease supplies available to the project. By the year 2000, supplies will be reduced several hundred thousand acre-feet. Also, California is nearing the time when a portion of the Colorado River water used in Southern California for many years will instead be diverted to Arizona. This process will be well in place by 2000, and it will be necessary to replace these supplies.

In addition to decreasing supplies available to the project and its service area, urban water use in conjunction with conservation in the State will probably increase by about 1.1 million acre-feet by the year 2000. A major portion of this increase is expected in project service areas. Without additional project capabilities, the frequency and severity of shortages will increase.

If no additional facilities such as those described in Table 6-1 are built, then annual State Water Project exports will gradually decrease in drier years when Delta inflow is being regulated by the projects. This is because water supplies will gradually decrease from upstream area of origin use. With additional pumps, this decrease will be less.

In above normal years of unregulated flow conditions, with the additional pumps operated under the preferred alternative, there would be some additional capability to increase annual State Water Project exports to respond to increasing entitlement buildup schedules. This capability would come from increased winter export and elimination of outages. Direct fish impacts at Banks Pumping Plant would increase with these increased exports. Average annual impacts would be incrementally less for most fish species with the four additional pumps under the preferred alternative when compared to the no-project alternative. These impacts would be mitigated by the preferred mitigation agreement for the preservation of fish at Banks Pumping Plant, which requires increased mitigation for increased exports.

In addition, continued use of existing Delta channels for exports would continue to aggravate the serious transfer problems of reverse flow in the lower San Joaquin River, which causes problems for striped bass and salmon, as well as the water quality of drinking supplies.

C—105464

C-105464

Table 6-1

POTENTIAL CUMULATIVE EFFECTS OF ADDITIONAL PUMPS AND POTENTIAL RELATED PROJECTS ON DELTA FLOWS AND FISHERIES (COMPARED TO 1990-LEVEL CONDITIONS)

Related Project Location	Project Type	Delta Inflow Changes	Delta Export Changes		Delta Outflow Changes		Potential Fisheries Impact
			Seasonal	Annual	Seasonal	Annual	
North of Delta	Additional Storage Regulation*	Winter and Spring Reductions, Summer and Fall Increases	Summer and Fall Increases	Drier Year Increases	Winter and Spring Reductions	Drier Year Increases	Screening Losses Increased
North of Delta	Purchase of Surplus Supplies*	Summer and Fall Increases	Summer and Fall Increases	Drier Year Increases	Summer and Fall Increases	Drier Year Increases	Screening Losses Increased
Delta	Coordinated Operation Agreement for Additional Purchase and Wheeling	Increase During Regulated Flow	Depends on Terms of Agreement	Increased	Depends on Terms of Agreement	Increase in Regulated Outflow With Purchase, Decrease with Wheeling	Screening Losses Increase if Summer Exports Increase
Delta	Western Delta Overland* Facilities	Summer and Fall Reductions of Carriage Water Releases	Potential Summer and Fall Increases	Potential Drier Year Increases	Potential Summer and Fall Reductions	Potential Drier Year Reductions	Potential Screening Losses Increase
Delta	Improved Delta Transfer System	Summer and Fall Reductions	Summer and Fall Increases	Drier Year Increases	Summer and Fall Reductions	Drier Year Reductions	Fish migration improved with Reduction of Reverse Flows; Potential Reduction of Screening Losses
South of Delta	Additional Ground and Surface Water Storage*	No Significant Change	Winter and Spring Increases	Wetter Year Increases; Minimum Change in Drier Years	Winter and Spring Reductions; Maximum Summer and Fall Potential	Wetter Year Reductions	Provides Operational Flexibility to Minimize Incremental Screening Losses
South of Delta	Desalting**	Potential Reduction of Carriage Water Releases	Minimizes Exports	Minimizes Exports	Potential Reduction of Carriage Water Portion of Summer and Fall Outflows	Maximizes Outflow	Minimizes Screening Losses
SWP Service Areas	Additional Demand Reduction Projects, Conservation and Recycling**	Potential Reduction of Carriage Water Releases	Minimizes Exports	Minimizes Exports	Potential Reduction of Carriage Water Portion of Summer and Fall Outflows	Maximizes Outflow	Minimizes Screening Losses
Combination of Above Projects, also Mid-Valley Canal		Winter and Spring Reductions, Less Summer and Fall Reductions	Year-round Increase, Mainly Winter and Spring	Increased All Years	Year-round Reductions, Mainly Winter and Spring	Reduction All Years	Fish Migration Improved with Reduction of Reverse Flows; Potential Reduction of Screening Losses

* Full efficiency of use not achieved without Improved Delta Transfer System; effects shown assume no Improved Delta Transfer System.

** Effects shown apply only in years when project deficiencies are not imposed.

C—105465

C-105465

Cumulative Impacts on Service Areas of State Water Project Deliveries

The average annual cumulative impacts of State Water Project deliveries on the service areas (excluding Feather River) were estimated for 1980-1989, 1990-1999, 2000-2009, and beyond 2020, based on projected deliveries presented in Bulletin 132-81. In the 1980s, about 1.9 million acre-feet of water would be delivered annually, of which about 40 percent (0.8 million acre-feet) would be for agriculture. Beyond 2020, projected deliveries would be about 4.2 million acre-feet, of which 29 percent (1.2 million acre-feet) would be for agriculture. The ability to deliver such amounts would require implementation of some of the previously discussed projects.

Cumulative impacts on income, employment, population, and housing were estimated in about the same way as they were for Banks Pumping Plant impacts, discussed in Chapter 5 under "Impacts on State Water Project Service Area". Table 6-2 summarizes cumulative impacts, by service area, for 1980-1989 and beyond 2020. Details, including other time periods, are in Appendix D.

At the 1990 level, the cumulative direct, indirect, and induced net income impact would be about 5.5 percent of the State total; cumulative employment impacts would be about 11.4 percent; and cumulative population impacts would be about 8.0 percent.

The scheduled State Water Project deliveries could support significant economic activity in the service areas. Such increases in socioeconomic activities would cause additional physical impacts such as on air quality, water quality, hydrology, and land use. Service area impacts are considered to be secondary in connection with the pumps. Most mitigation measures for potential significant impacts would have to be implemented by local agencies.

Growth-Inducing Impacts of the State Water Project

A water supply, by itself, is not considered to cause growth; however it is possible that a lack of water (if severe enough) can hinder economic growth and subsequent population growth. In light of projected water shortages in

Table 6-2

SUMMARY OF CUMULATIVE SOCIOECONOMIC IMPACTS OF STATE WATER PROJECT DELIVERIES, BY SERVICE AREA

	Net Income (Billion 1981 Dollars)				Employment (1,000 Jobs)				Population (1,000 People)		Housing Units (1,000)	
	Direct		Direct, Indirect, and Induced		Direct		Direct, Indirect, and Induced					
Service Area	1980-89	2020+	1980-89	2020+	1980-89	2020+	1980-89	2020+	1980-89	2020+	1980-89	2020+
So. California	8.6	13.7	29.3	46.4	248.1	391.7	1,482.8	2,340.9	2,668.1	4,119.9	1,006.4	1,681.2
San Joaquin	0.2	0.2	0.7	0.7	14.5	19.8	88.6	119.6	18.8	24.6	8.5	11.1
Central Coastal	0	0.3	0	1.2	0	12.8	0	84.7	0	41.6	0	18.3
South Bay	1.5	2.0	4.9	6.7	41.6	58.3	163.9	229.7	17.5	24.4	6.7	11.3
North Bay	0.1	0.4	0.4	1.6	1.3	8.5	10.7	69.9	1.2	8.0	0.5	3.4
Total with Replacement Adjustments	10.4	16.6	35.3	56.6	305.5	491.1	1,746.0	2,844.8	2,705.6	4,218.5	1,022.1	1,725.3

C—105466

C-105466

the State Water Project service areas (1990 and beyond), growth-inducing impacts of the State Water Project must be evaluated as a complete water importation system.

Total population in the service areas was examined with State Water Project population impacts. Table 6-3 shows annual cumulative project population impact for 1985 and 2020, as well as the increase between these two years. The 1985 population impacts are considered "base year" impacts -- population now being supported by the project. By 2020, average annual population supported by the State Water Project for all the service areas would increase from about 2.7 million to 5.7 million. However, in the Southern California service area, about 650,000 acre-feet of Metropolitan Water District's Colorado River entitlement will be diverted to the Central Arizona Project beginning in the late 1980s. Thus, net population increase for the State Water Project would be about 1.5 million, assuming State Water Project supplies replace this lost entitlement.

For comparison purposes, the total projected population for the counties encompassing the service areas is also shown in Table 6-3. Between 1985 and 2020, total annual population increases by about 7.6 million. Thus, the increase in the net cumulative State Water Project population impact would be about 20 percent of the total population increase from 1985 to 2020. Thus, the State Water Project, as a whole, would support about 20 percent of the projected population growth in the service areas over this time frame.

Other cumulative impacts in the service area include:

- Air pollution,
- Increased agricultural drainage water,
- Increased pesticide use,
- Changes in land use,
- Increased stress on utilities and services, and
- Increased stress on the biological environment.

Table 6-3

SUMMARY OF CUMULATIVE GROWTH-INDUCING IMPACTS, BY SERVICE AREA
(In Thousands)

Service Area	Cumulative Population Impact Supported by SWP Deliveries			Total Projected Population*			SWP Increase as a Percentage of Total Population Increase
	1985	2020	Increase	1985	2020	Increase	
Southern California							
Total	2,668.1	5,569.4	2,901.3	14,570.5	20,603.4	6,032.9	48.1
Replacement	0	1,449.5	1,449.5	--	--	--	--
Net	2,668.1	4,119.9	1,451.8	14,570.5	20,603.4	6,032.9	24.1
San Joaquin	18.8	24.6	5.8	535.0	851.8	316.8	1.8
Central Coastal	0	41.6	41.6	496.0	671.2	175.2	23.7
South Bay	17.5	24.4	6.9	2,526.7	3,243.1	716.4	1.0
North Bay	1.2	8.0	6.8	396.3	723.2	326.9	2.1
TOTAL (Without Replacement)	2,705.6	5,668.0	2,962.4	18,524.5	26,092.7	7,568.2	39.1
TOTAL (With Replacement)	2,705.6	4,218.5	1,512.9	18,524.5	26,092.7	7,568.2	20.0

*Total population projection based on total county estimates.

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Other Cumulative Impacts

Other cumulative effects associated with potential water development above the Delta probably would be similar to and would add to impacts of past surface water development. Past projects on the Sacramento, San Joaquin, and Trinity river systems have had a variety of beneficial and adverse effects, including:

- Development of water supplies for local and statewide needs.
- Development of hydroelectric power.
- Increased power requirements.
- Improved navigation on the Sacramento River.
- Creation of reservoir recreation areas and fisheries.
- Increased flood control.
- Creation of jobs.
- Displacement of people and wildlife.
- Inundation of lands, archeological sites, and live streams.
- Blockage of anadromous fish runs.
- Changed flow regimes, sediment regimes, water quality, and seepage conditions along affected streams.

Cumulative effects of offstream storage south of the Delta would include:

- New recreation opportunities and reservoir fisheries.
- Creation of jobs.
- Displacement of people and wildlife.
- Inundation of lands and archeological sites.
- Improvement in quality of water delivered to service areas.
- A net increase in power requirements.

Ground water programs south of the Delta would involve construction of wells and distribution systems. Ground water programs would have local water quality and hydrologic impacts and increased power requirements.

Mitigation Measures for Cumulative Impacts

Potential mitigation measures for cumulative impacts due to future State, Federal, and local water development generally include:

- Safeguards by laws, regulations, and water rights standards.
- Contracts and agreements.
- Physical measures.
- Studies and water management programs.
- Energy programs.

Safeguards

Some State and Federal laws that provide safeguards include:

- Area of Origin Law
- County of Origin Law
- Davis-Dolwig Act
- Delta Protection Act
- Burns-Porter Act
- Porter Cologne Act
- California Environmental Quality Act
- National Environmental Policy Act
- National Fish and Wildlife Coordination Act
- National Clean Water Act
- Public Trust Doctrine
- State Water Resources Control Board Decision 1485 or other valid water right decision.

These laws can lead to requirements that various operational and physical measures and/or studies be carried out.

State and Federal regulatory agencies administering the laws include the State Water Resources Control Board, Regional Water Quality Control Boards, Environmental Protection Agency, U. S. Fish and Wildlife Service, and U. S. Army Corps of Engineers.

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Contracts and Agreements

Binding contracts are negotiated between project operators and various interests. The Department of Water Resources has executed contracts with several Delta water agencies that commit the Department to providing reliable water supplies and qualities under the Delta Protection Act. These contracts are with North Delta Water Agency, Contra Costa Water District, City of Antioch, and East Contra Costa Irrigation District. These contracts provide further safeguards for Delta protection. The Department is continuing negotiations with other Delta interests.

Contracts for management of fish and wildlife resources in the Bay and Delta estuary can be broadened as to scope and the participating agencies. Such contracts would specify mitigation measures identified by studies and negotiations.

The preferred mitigation for preserving fish at Banks Pumping Plant with the additional pumps would also continue to provide mitigation for cumulative impacts, since it requires increased mitigation for increased exports. It also contains measures to mitigate for fish that would have been in the estuary if Banks Pumping Plant had not been constructed.

The Suisun Marsh Preservation Agreement provides protection for cumulative impacts of full development of State and Federal water projects on the marsh.

The proposed agreement for coordinated operation of the State Water Project and Central Valley Project would allocate available supplies and shortages between the projects after meeting in-basin obligations, including Delta water quality objectives. Contracts for additional wheeling and purchase would include additional measures to protect fisheries.

Physical Measures

Potential physical mitigation measures for identified significant impacts are listed below. Specific measures could be incorporated in contracts or permits.

- Fish -- Hatchery construction, multiple-level intake structures for water temperature control, adjustment of reservoir releases, habitat modification, establishment of reservoir fishery, fish screens and return systems, export curtailments, and fish stocking programs.
- Wildlife -- Purchase of replacement lands, capture and removal of species, control fencing, escape devices; mitigation in Suisun Marsh as specified in the Environmental Impact Report and Plan of Protection.
- Socioeconomic -- Payment of increased public services caused by project workforce.
- Cultural -- Avoidance or removal of identified cultural resources where possible; purchase of private property where necessary.
- Recreation -- Construction of recreational facilities.
- Soils and Vegetation -- Reestablishment of native vegetation, erosion control techniques, replacement of soil where possible.
- Transportation -- Relocation of roads and railroads.
- Utilities -- Relocation of utilities.

Studies and Water Management Program

Many of the specific needs for mitigation are uncertain. Potential impacts requiring mitigation can be identified during studies. Objectives of the Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, funded in part by the State Water Project, are to:

- Improve understanding of the requirements of fish and wildlife in the estuary.
- Develop design and operating criteria for the State Water Project and Central Valley Project for protection and enhancement of fish and wildlife.
- Monitor and evaluate project operations.

These studies provide a sound basis for mitigation measures. For example, the predation control studies in Clifton Court Forebay may reduce losses of chinook salmon.

The U. S. Army Corps of Engineers is obligated to monitor Delta channels to determine whether operation of the additional pumps under Corps constraints results in impacts on navigation, thus requiring activation of the Corps permit process. Mitigation for Delta agricultural needs will be identified through the studies of the salt tolerance of corn. Continuation of programs to improve water management would provide mitigation by reducing the buildup rate of future upstream diversions and Delta exports.

Water management studies are an integral part of State planning for efficient use of water supplies. This was discussed in Chapter 1 under "Available Water Supply, State Water Project Demands and Delivery Capabilities" and "Water Conservation and Water Management Plans". Water management efforts such as urban and agricultural water conservation, waste water reclamation, conjunctive use of surface and ground water, and water exchanges and transfers are expected to reduce State Water Project entitlement buildup rates. This reduction follows planning measures such as recommended water management plans prepared for all contractors and the Urban Water Management Planning Act passed by the Legislature. Further reductions are expected from negotiations between Metropolitan Water District and Imperial Irrigation District for a water exchange.

Energy Programs

Overall mitigation for increased power requirements is incorporated into: (1) environmental impact reports and design features for specific water and power facilities, (2) coordination of power sources and uses between utilities, (3) efficient use of water supplies, and (4) best use of off-peak power supplies to delay construction of new generating facilities. The long-range energy program for the State Water Project incorporates such mitigation measures.

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Chapter 7. COMMENTS AND RESPONSES

The Draft Environmental Impact Report on the Proposed Additional Pumping Units was distributed on November 30, 1982, with a 45-day comment period ending January 15, 1983. In response to several requests, the comment period was extended to February 15, 1983. A public hearing was held on February 4, 1983, in Sacramento.

Comment letters were received from 30 Federal, State, and local agencies, 8 environmental groups, and 3 individuals. At the February 4 hearing, 11 individuals testified, representing the same or similar groups. Table 7-1 lists those that commented on the draft report.

In addition, 75 letters from individuals and 81 signed form statements from members of two fishing clubs were received, all protesting the additional pumps. Most of these letters and forms were apparently generated by a request to write the Department, by columnist Tom Stienstra in the January 30, 1983, issue of the San Francisco Examiner and Chronicle. The Stienstra article and a representative protest letter are reproduced in Figure 10, along with the names of those sending letters and postcards in response to the article.

The comment letters and the transcript of the public hearing are reproduced in this chapter (beginning on page 197), followed by the Department's responses to each comment of each letter. Responses to the comments were coordinated with the Department of Fish and Game.

All comments received have been considered in preparing this final environmental impact report, which has been expanded or modified, where appropriate, in response to the comments.

General Issues and Responses

Many of the comments received on the Draft Environmental Impact Report for the Proposed Additional Pumping Units at the Harvey O. Banks Delta Pumping Plant focus on the future operation of the additional pumps, the impact analysis, the mitigation measures, and the economic analysis. These comments, categorized into 11 general issues for discussion, are presented below, with a listing of the commenting entities. Each general issue is a summary of comments received, and is not necessarily representative of the Department of Water Resources' position or information presented in the draft report. A response, prepared by the Department, is included for each general issue.

General Issue 1

It is unwise for the Department of Water Resources to proceed with additional pumping units until the Delta fisheries problem is resolved.

Comment by: Delta Environmental Advisory Committee, U. S. Fish and Wildlife Service, Contra Costa County Water Agency, San Francisco Bay Conservation and Development Commission, Tom Stienstra and protest letters, California Fisheries Restoration Foundation, National Audubon Society

Response

The Department of Water Resources recognizes the importance of the Delta fish problem and has spent over $20 million in advancing knowledge to better understand the needs of this important resource.

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Table 7-1

ENTITIES COMMENTING ON
DRAFT ENVIRONMENTAL IMPACT REPORT, PROPOSED ADDITIONAL PUMPING UNITS

Commenting Letter Number		Written Comments	Testimony at 2/4/83 Hearing
	Federal Agencies		
1	National Marine Fisheries Service	x	x
2	U. S. Bureau of Reclamation (2/23)	x	
3	U. S. Fish and Wildlife Service	x	
	State Agencies		
4	Office of Planning and Research (2 letters)	x	
4A	Department of Fish and Game	x	x
4B	Department of Parks and Recreation	x	
5A	California Regional Water Quality Control Board	x	
6	Public Utilities Commission	x	
7	State Water Resources Control Board (2/17)	x	x
	Local Agencies		
8	Alameda County Water District (2/16)	x	
9	Antelope Valley-East Kern Water Agency	x	
10	Casitas Municipal Water District	x	
11	Coachella Valley Water District (2/16)	x	
12	Contra Costa County Water Agency (2/16)	x	
13	Crestline-Lake Arrowhead Water Agency (2/18)	x	
14	Desert Water Agency (2/16)	x	
15	Devil's Den Water District (2/22)	x	
16	Dudley Ridge Water District (2/16)	x	
17	Kern County Water Agency (2/18)	x	
18	The Metropolitan Water District of Southern California (2/16)	x	x
19	Palmdale Water District	x	
20	San Francisco Bay Conservation and Development Commission	x	
21	San Gabriel Valley Municipal Water District	x	
22	Santa Barbara County Flood Control and Water Conservation District and Santa Barbara County Water Agency (2/17)	x	
23	Santa Clara Valley Water District (2/16)	x	
24	Solano County Flood Control and Water Conservation District (2/16)	x	
25	Tulare Lake Basin Water Storage District	x	
26	State Water Contractors, Inc.	x	x
27	State Water Contractors Audit Committee	x	x
	Private Entities		
28	The California Fisheries Restoration Foundation	x	
29	California Waterfowl Association	x	
30	Delta Environmental Advisory Committee	x	x
31	Environmental Defense Fund	x	x
32	D. W. Kelley and Associates	x	
33	H. S. Pete Fowler, PE	x	
34	National Audubon Society	x	
35	G. Rosekilly	x	
36	Sierra Club	x	x
	Suisun Resource Conservation District		x
37	Tehama Fly Fishers	x	
38	United Anglers of California	x	x

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FIGURE 10. PROTEST LETTERS RECEIVED IN RESPONSE TO TOM STIENSTRA ARTICLE.

PROTEST LETTERS

A newspaper article by Tom Stienstra, right, generated many letters to the Department protesting the installation of additional pumps at the Harvey O. Banks Delta Pumping Plant.

Letters similar to the one shown at the far right were received from the following:

Jan. 30, 1983 S.F. Sunday Examiner & Chronicle

Tom Stienstra / Outdoors

For 20 cents you can help save the striped bass fishery. Write a brief letter protesting the proposed addition of giant pumps at the California Aqueduct near Tracy. The present pumps already swallow 80 million bass per year. Mail to: Robert G. Potter, Central District, Department of Water Resources, P.O. Box 160088, Sacramento, CA 95816.

Mr. Ralph Merola
378 Cascade Drive
Fairfax, CA 94930

Mr. Lloyd Willis
2801 Eastgate Avenue
Concord, CA 94519

Ms. Joyce R. Hodge
202 Linden Lane
San Rafael, CA 94901

Mr. Joe R. Badger
339 Catamaran
Foster City, CA 94404

Mr. Richard Anderson
8 Hawke Ridge Court
Novato, CA 94947

Mr. Richard M. Gonzales
1990 No. California Blvd.
P. O. Box 3189
Walnut Creek, CA 94598

Mr. R. V. Thomas
Box 3176 Bowman Branch
Auburn, CA 95604

Mr. Anthony Arnold
19 Hayes Street
Novato, CA 94947

Mr. R. J. Lyons
1082 Innsbrock Street
Livermore, CA 94550

Ms. Maryhope Jacks
218 C Brush Street
Alameda, CA 94501

Mr. Vincent Lawton
1228 Delaware
Berkeley, CA 94702

Mr. Tom Brehney
San Jose, CA 95127

Mr. Ben Imprescia
125 Cuesta Drive
South San Francisco, CA 94080

Mr. Stan Nathrop
1622 - 26th Street
San Francisco, CA 94122

Mr. Michael Garrett
4706 Canyon Road
El Sobrante, CA 94803

Mr. Harold A. Keelen
P. O. Box 229
Lagunitas, CA 94938

Mr. Larry Donlin
1445 Kerley Drive #2
San Jose, CA 95112

Mr. Vernon L. Breuillot
2603 San Antonio Drive
Walnut Creek, CA 94598

Ms. Leilani Thompson
1733 Calaveras Drive
Santa Rosa, CA 95405

Mr. Joseph Thomas and
Ms. Christine Seronello
139 Mabry Way
San Rafael, CA 94903

Mr. Rick Wester
1877 Riverbank Avenue
Castro Valley, CA 94546

Mr. H. R. Anaguon
1326 Devonsinas Drive
El Cerrito, CA 94530

Mr. George Goldmark
171 Santa Rosa Avenue
Oakland, CA 94610

Mr. Bill Harp
Route 4, Box 427Y (Bridle)
Chico, CA 95926

Mr. Joe Yarosevich
21 Amber Way
Chico, CA 95926

Mr. Howard R. Stevens
3349 Cypress Way
Santa Rosa, CA 95405

Mr. Jack Weiler
1543 Irving Drive
San Francisco, CA 94109

Robert G. Brown, M.D.
992 Durlston Road
Redwood City, CA 94062

Mr. John Burgess
113 Dwight Road
Burlingame, CA 94010

Mr. Tony Tadin
1518 Tadin Lane
Woodside, CA 94062

Mr. A. W. Wedgward
P. O. Box 3706
Clearlake, CA 95422

Mr. R. J. Hendricks
285 A Grand View Avenue
San Francisco, CA 94117

Mr. Mike Geranio
2560 Webster Street
Oakland, CA 94612

Mr. William G. Wilson
9 Heritage Court
Belmont, CA 94002

Mr. Jim Cummins
1414 Mallard Lane
Roseville, CA 95678

Mr. James Ellison
19341 Loretta Drive
Sonoma, CA 95476

Ralph and Bernice Lewis
P. O. Box 431
Bethel Island, CA 94511

Mr. Paul E. Minor
3028 Octavia
San Francisco, CA 94123

Mr. Robert S. Nichols, D.P.M.
534 Oregon Street
Vallejo, CA 94590

John Moylan, D.D.S.
2920 Broadway, Suite A
Redwood City, CA 94062

Mr. Gregg Freeman
1740 Terrace Drive
Belmont, CA 94002

Mr. Jerry Perkins
24 Bayview Court
Millbrae, CA 94030

Mr. John A. Gustafson
921 South Norfolk Street
San Mateo, CA 94401

Mr. Ken G. Murray
2125 Rivera Drive
San Francisco, CA 94116

Mr. Tom Kearcher
417 Lincoln Way
San Francisco, CA 94122

Mr. John R. Gutierrez
18 Gardner Avenue 2
South San Francisco, CA 94080

Mr. and Mrs. G. F. Shuster, III
87 Behr Avenue
San Francisco, CA 94131

Mr. James Baker
19255 Twin Oak Lane
Sonoma, CA 95476

James and Doreen Peterson
436 Lomita Avenue
Millbrae, CA 94030

Colonel R. Dana Fish
17800 Redberry Lane
Jackson, CA 95642

Mr. Vernon Mazzali
816 West Oregon Avenue
South San Francisco, CA 94080

Michael Smith, M.D.
2519 Milvia Street
Berkeley, CA 94704

Mr. Teman Johnson
845 Brookdale
Merced, CA 95340

Mr. Jack Hollenbeck
3166 Bryant Street
Palo Alto, CA 94306

Mr. J. P. Hartog, N.A.
3510 Geary Boulevard
San Francisco, CA 94118

Mr. R. L. Wright
20200 Lucille Avenue #100
Cupertino, CA 95014

Mr. Leon Frayssé
381 Granada Drive
South San Francisco, CA 94080

Peninsula Wine Company
P. O. Box 1123
San Carlos, CA 94070

Wells Fargo Realty Finance
Attention: George A. Tillotson
600 Montgomery Street
San Francisco, CA 94111

Dr. & Mrs. Arthur Jampolsky
61 Peninsula Road
Belvedere, CA 94920

Mr. Albert Ghiringhelli
36 Los Robles Drive
San Rafael, CA 94901

Mr. James E. Zoph
519 Fremont Avenue
Pacifica, CA 94022

Mr. Richard W. Thomas
1825 Humboldt Street
Santa Rosa, CA 95404

Mr. Bill Bush
232 Sierra Drive
Walnut Creek, CA 94596

Mr. Francis C. Szoras
45 Mendosa Avenue
San Francisco, CA 94116

Mr. Michael Evert
105 Cabro Court
Novato, CA 94947

Mr. Jack Kelleher
2121 - 19th Avenue
San Francisco, CA 94116

Mr. Eugene M. Morrow
South Broadview Terrace
Orinda, CA 94563

Mr. Nicholas K. Lowe
1171 Locust Ravine
Bakersfield, CA 93306

V. T. Miyake
Hayward, CA

Mr. Garland K. Kelley
3174 Valley Green Lane
Napa, CA 94558

Mr. James L. Zopb
271 Marina
Pacifica, CA 94044

Mr. Angelo Cuanang
849 Newman Drive
So. San Francisco, CA 94080

Mr. Abe Cuanang
849 Newman Drive
So. San Francisco, CA 94080

Mr. Richard Walton
1604 Francisco Boulevard
Pacifica, CA 94044

TYPICAL SAMPLE

Robert G. Potter
Central District
Dept. of Water Resources
P.O. Box 160088
Sacramento, Ca.

Dear Sir:

I am writing this letter to protest the proposed addition of giant pumps at the California Aqueduct near Tracy. The present pumps are doing much too much damage to our striped bass fishery as is.

Sincerely,

Robert G. Porter
Central District, Department of Water Resources
P.O. Box 160088
Sacramento, California 95816

Please save the striped bass from being sucked away by the giant pumps. We urge you not to build additional pumps at the California Aqueduct near Tracy. Not only will you be destroying our great sport of fishing, but they are also greatly desired table fish.

Thank you very much for your considerate attention.

We remain,

Fishfinder Fishing Club Member
Sacramento, California

Same note as above received from the following:

Midori Sunahara
George Matsumoto
Amy Ohara
Joan Hisamoto
Ted Kamizaki
Alex Slevoth
Kan Sanui
Fred S. Matsumoto
Fred Toomey
Mollie Toomey
Tom Mizuno
Katherine Miguno
Ted Kaboija
Masayoshi Ito
Shizuko Ito
Chiyoko Fuchigami
Yoshio Fuchigami
Tauneko Yamasaki
Shizue Takahashi
Akira Ichikawa
Hisae Nakayama
H. I. Kiino
Paul Tanabe
Kay Tanabe
James Kitabayaski

Margaret Kitabayaski
Harold L. Pingree
Ko Pingree
Henry M. Kajioka
Kay N. Omoto
Bernice Omoto
Tomoko Rose Kajioka
Edward M. Inaba
Y. Neltar
M. Nitta
Stanley K. Tateishi
Grace H. Tateishi
Hiroshi Takahashi
George Goto
Harry H. Nakamura
Mike Tanaka
James Okamoto
Lester N. Matsumoto
Takako Namba
Jim Namba
Roy Hatanaka
Masateru Henry Hoshimoto
Mitsue Eleanor Hashimoto
Helen F. Matsumoto
P. Matsumoto

Tom Matsumoto
Tom Yokoi
Mary Yokoi
George Morita
Flo Inaba
Christine Nishijima
Minoru Ouye
Isamu Nishimoto
Bill R. Nakayama
Jim Bently
Joe Makishima
Kazumi Tanaka
Charles K. Riffle
Joseph C. Keifer
Richard N. Furuhashi
Ken Inaba
Reiko Inaba
Emiko Masunaga
Alan Kurosawa
John Enkoji
Jeff Enkoji
Sue Inaba
Fresno Nisei Fishing Club
(9 members)

C—105473

C-105473

The Department is continuing to fund millions of dollars of studies, experiments, and monitoring to provide more information on project-related factors affecting fish, and this effort is independent of the installation of more pumps. A recent outcome of such studies was the installation of a $5 million advanced fish screen design to reduce fish losses at the Skinner Fish Protective Facility. Toxic pollution in the Bay-Delta estuary also requires further study.

Proceeding with additional pumps is not inconsistent with planning to resolve the fish problems. The proposed mitigation for the additional pumps, along with operational flexibility with the additional pumps, can actually reduce impacts for many species, including striped bass. In addition, the proposed mitigation agreement would go beyond the incremental impacts of the additional pumps and include compensation for all the pumps, including replacing fish that would have been in the Delta if the plant had not been built. It represents improvements over no action. Installation of the pumps will not include revised operations if future studies identify impacts of the project and ways to avoid adverse impacts. Any such results would be considered by the State Water Resources Control Board in its planned rehearing of Decision 1485, which may result in revised standards.

Delta protection is an important objective of the Department, along with other statewide water resources planning activities. The reliability of the State Water Project in meeting the needs of about 15 million people is decreasing, because of upstream area of origin use, reduction of California's supplies by the Central Arizona Project, and continued population increases. The Governor, Legislature, and Department have all acted to advance important conservation measures; however, the potential for shortages remains. The additional pumps can help reduce such a shortage. One way the new pumps will help is to offset outages of the existing units. Also, the Department must continue to plan for more efficient use of California's energy and implement measures to delay construction of power generating facilities. The additional pumps will allow more operational flexibility for the State Water Project to help accomplish this.

Protecting Delta fish is part of the Department of Water Resources management and functional objectives, planning programs, and project operations as well as operation of and mitigation for the additional pumps.

The management objectives that guide the Department's planning are:

- To protect the environment and economy of the Delta.
- To provide dependable water supplies to the Central Valley Project and State Water Project.
- To protect the financial integrity of the State Water Project and Central Valley Project.

The functional objectives relate to:

- Improving water management.
- Providing a water supply for Delta users.
- Controlling salinity in the Delta.
- Protecting water quality in the Delta and export service areas.
- Preserving and, when feasible, enhancing the fish and wildlife resources of the Bay-Delta estuary and Suisun Marsh.
- Preserving and enhancing recreational opportunities in the Delta.
- Transferring export water supplies safely from the Delta.

C—105474

C-105474

These objectives, coupled with environmental documentation and appropriate mitigation, will provide the basis for a decision on the pumps.

The yield, power cost savings, and standby capacity provided by the pumps help the Department to meet management objectives pertaining to dependable water supplies and protection of the financial integrity of the State Water Project. Department projections show that the existing project facilities would not provide enough water to meet delivery requests after 1985 under prolonged drought conditions. However, under median water delivery conditions, the existing project facilities could meet all requests for entitlement water until about 1989. The pumps would require 5 years to manufacture and install. The operational constraints of the preferred alternative operational plan and the preferred mitigation would provide continued protection for the Delta environment and help the Department to meet its functional objectives.

Many of the Department's overall planning and ongoing programs focus on Delta environmental protection. These programs and facilities are listed below:

- Coordinated operations of State Water Project and Central Valley Project.
- Agreement for preservation of fish under operation of the Harvey O. Banks Delta Pumping Plant.
- San Francisco Bay and Sacramento-San Joaquin Delta estuary monitoring in accordance with Decision 1485.
- Interagency Ecological Study Program, including fishery studies.
- Striped Bass Working Group studies and recommendations.
- Suisun Marsh Overall Facilities and Plan of Protection.
- Investigation of predation control for Clifton Court Forebay.
- Recommended water management plans for State Water Project contractors that define potential use of water conservation, conjunctive use of surface water and ground water, waste water reclamation, and desalting investigation programs. (These can delay Delta export buildup schedule for the project.)
- Ongoing testing and improvement of the enlargement of John E. Skinner Delta Fish Protective Facility at the Banks Pumping Plant.
- Regular placement of an Old River barrier to facilitate salmon migration in the San Joaquin River.

Delta protection in connection with present operation is incorporated by the criteria of Water Right Decision 1485. The Coordinated Operation Agreement and Suisun Marsh Preservation Agreement better define protective operations. All of these measures provide for water sources from the projects to maintain flows and qualities needed for fish and wildlife protection in the estuary.

Protection for Delta fish is also considered in operation and mitigation of the additional pumps, which will enable shifting exports from high fish abundance periods toward low fish abundance periods. This shift can reduce striped bass losses by over 100,000 yearly equivalent fish for operations during the early 1990s.

In addition to this shift, the preferred mitigation option for the pumps will include improvement projects for fish that would have been in the Delta if Banks Pumping Plant had not been constructed. Although numbers have not been finalized, current estimates are for about $15 million for projects to compensate for about 5 million to 10 million striped bass, salmon, and steelhead. This mitigation covers

cumulative impacts of the existing pumping plant, addressing impacts beyond the additional pumps. Also future pumping plant exports for the existing and additional pumps would have ongoing and increasing mitigation. Other points covered by the preferred mitigation include placing the operating constraints established by the U. S. Army Corps of Engineers into a contractual setting and further reducing summer pumping plant exports below Decision 1485 levels during regulated flow conditions.

Also see "Planning Perspective" in Chapter 1.

General Issue 2

The draft environmental impact report did not adequately disclose the Department's future intentions regarding operation of the Banks Pumping Plant with the four additional units.

Comment by: Environmental Defense Fund, Metropolitan Water District of Southern California, State Water Contractors, State Water Contractors Audit Committee, State Water Resources Control Board.

Response

The Draft Environmental Impact Report for the Proposed Additional Pumps at the Harvey O. Banks Delta Pumping Plant explained the Department's intent regarding installation and operation of additional pumping units at the Banks Pumping Plant (Chapter 3, page 22). The preferred alternative represented installation of the four additional pumping units with operation constrained by the U. S. Army Corps of Engineers operating criteria and the protective criteria contained in Water Right Decision 1485. The Corps of Engineers criteria were presented in Public Notice 5820A, Amended, which was shown as Figure 2, page 7, of the draft report.

The preferred alternative discussed in the draft report was evaluated along with other operating alternatives. Beyond this level of development, no specific plan has been established by the Department. A constrained operation for additional pumps according to the Corps criteria is the same preferred alternative in the final report; however, the description of alternative operations has been updated.

Department studies have demonstrated the problems that result from the present inefficient transfer capabilities of Delta channels. These problems include disruption of Delta fish and wildlife habitat and interference with fish mitigation.

The Governor, Legislature, and Department have made extensive efforts to gain approval of a water package that would include a defined transfer facility; however, no package has yet been approved. It is not possible to predict what type of facility may be approved (or when), so the additional pumps must make economical and environmental sense on their own merits, independent of how or when they could be used with improved Delta transfer. The final report presents information that shows economic benefits above costs for independent utility.

In November 1983, the Department of Water Resources released a report, Alternatives for Delta Water Transfer, which was not available at the time the report on the pumps was published. That report focused on possible solutions to water transfer problems in the Delta. It presented an interim technical review of the most practical water transfer alternatives, all of which would require continued use of existing State and Federal pumps and installation of four additional pumps at the Banks Pumping Plant.

At this time, the Department of Water Resources action does not require a

C—105476

C-105476

Federal permit. After more study and redirection, the Department will consider operations exceeding the Corps of Engineers constraints. If such operations are proposed, then the Federal permit process and the necessary environmental documentation will be undertaken. The action being taken in connection with this current planning and environmental documentation process should not be interpreted as eliminating the Department's options to apply for a permit.

While there is an element of uncertainty regarding the manner in which the State Water Project will be completed, the Department is committed to meeting its contractual obligations. The final report cannot specify what future facilities may be built, but it does discuss potential cumulative impacts for possible future facilities. The cumulative impact review looks at general types of changes to Delta inflow, export, outflow, and fish resources that could occur when operating the additional pumps in conjunction with future facilities.

General Issue 3

The draft environmental impact report is inadequate in assessing impacts on fish of the existing pumps and the various alternatives with additional pumps.

Comment by: Delta Environmental Advisory Committee, National Marine Fisheries Service, Environmental Defense Fund, Sierra Club, United Anglers of California, Contra Costa County Water Agency, U. S. Fish and Wildlife Service

Response

The Draft Environmental Impact Report on the Proposed Additional Pumping Units discussed and assessed both general and direct fish impacts in Chapters 4, 5, and 6. Two categories were used to assess fish impacts in Chapter 5:

- A general discussion, by species, of the effects on migration, survival, and fish screen exposure.
- An analysis and discussion of losses and salvage at the Clifton Court Forebay and Banks Pumping Plant complex.

This final report investigates these same two categories; however, it has been updated to reflect new determinations by the Department of Fish and Game, comments made on the draft report, and updated operation studies that reflect increased project operating efficiencies. No new significant adverse impact was found.

The draft report included general impacts of the additional pumps for each alternative operational plan on resident and anadromous fish in the Delta and San Francisco Bay, and on the striped bass index. In Chapter 5, pages 68 to 78 and page 83, the draft report included specific discussions of general impacts on salmon, steelhead, striped bass, American shad, sturgeon, resident fish, aquatic invertebrates, and San Francisco Bay fish. The investigation of general impacts in the draft report looked at specific fish requirements such as:

- Flow and salinity standards for maintenance of adequate food supplies.
- Flow standards to facilitate upstream and downstream migration.
- Operation of the Delta Cross Channel gates from January to June to provide for anadromous fish needs.
- Operating standards for the State Water Project and Central Valley Project fish protective facilities.

Summary tables were also presented in the draft report in connection with general impacts. Tables of seasonal State Water Project exports and Delta flow conditions that were particularly

significant to fish needs were shown on pages 71 and 72. These tables categorized important changes in State Water Project exports, lower San Joaquin River flows, and ratios of the Delta Cross Channel and Georgiana Slough to the Sacramento River for the alternative operational plans. Another table, on page 72, compared incremental impacts on adult and juvenile salmon migrants in the Delta for the alternative operational plans.

The striped bass index calculation, used in the draft report, was not used in this final report because of a determination by the Department of Fish and Game that the correlations are no longer valid for predicting young-of-the-year abundance. Use of the index in the draft report was not to predict abundance levels but to show differences in levels for comparing alternatives. In addition, the index showed the significance of these changes to the overall fishery condition. The small changes in June and July Delta outflows and exports from operation with the additional pumps, which were used for the striped bass index equation, have been considered in the general impact assessment presented in the final report.

The final report considers the general impacts that were a part of the index with other factors to provide a better qualitative overview of total Bay-Delta fish impacts associated with each alternative operational plan. This overview, in general, replaces the quantitative comparison provided by the striped bass index. The new tables (5-18, 5-19, and 5-20) review the needs of many of the fish species found at the Banks Pumping Plant, in contrast to the one indicator species used in the striped bass index. The factors that are qualitatively reviewed are:

- Gradual salinity gradient for migratory fish.
- Loss from water diversions for striped bass, chinook salmon, and other species.
- Food chain for fish.
- Low water velocities to promote good benthic invertebrate populations (important to bottom-feeding fish).
- Maintenance of tidal currents in Delta channels to protect Neomysis and striped bass survival.
- Adequate levels of dissolved oxygen in Delta channels and desirable temperature.
- Provision of fresh water flows for migratory fish and for maintenance of nursery areas, including net downstream flow of "home stream" water.
- Water operation constraints to limit diversions, and closure of the Delta Cross Channel to minimize cross-Delta movement.
- Effective project operations shifting diversions toward winter periods of lower fish abundance and away from summer months of higher abundance.

The draft report evaluated direct impacts at the Banks Pumping Plant for losses during fish salvage operations and included loss estimates for striped bass and chinook salmon only at the Skinner Fish Facility. A general discussion of other fish losses was also included. The direct loss estimates were explained in Chapter 5, pages 78 to 81, and in Appendix B, and were summarized on page S-7. The direct impact was analyzed in the draft report to provide a basis for comparing alternative operational plans. The estimates were based on quantifying losses of screenable size fish at the Skinner Fish Facility. Other components of total direct fish losses were discussed qualitatively.

C—105478

C-105478

The comment letters revealed some confusion over the application of direct losses in fish impact assessment. This analysis has been updated for total direct system salvage and loss for the Harvey O. Banks Delta Pumping Plant, John E. Skinner Delta Fish Protective Facility, and Clifton Court Forebay. Collectively, these are referred to as the Delta Complex.

The major changes in the updated analysis involve quantifying additional factors, such as losses of eggs and larvae of striped bass, losses to predation in Clifton Court Forebay, and losses due to handling and hauling for returning salvaged fish to the western Delta for salmon and striped bass and salvage of species other than striped bass and salmon now in Tables 5-15 to 5-17. The draft report discussed these factors only qualitatively. Assessment of the general and direct fish impacts has been coordinated with staff of the Department of Fish and Game. Although scientific knowledge is not sufficient to enable conclusive determination, the evaluation was judged satisfactory within the limits of present knowledge and a good-faith effort.

General Issue 4

A. The Environmental Impact Report on the Proposed Additional Pumping Units needs to account for the uncertainty regarding authorization of the December 1982 fish agreement, which was assumed to be included as mitigation for the additional pumping units in the draft report.

Comment by: State Water Contractors, State Water Resources Control Board, Metropolitan Water District of Southern California, Environmental Defense Fund, National Marine Fisheries Service.

B. The Environmental Impact Report should investigate the potential for operational flexibility of the pumping units of the Harvey O. Banks Delta Pumping Plant to mitigate direct fish impacts.

Comment by: National Marine Fisheries Service, Environmental Defense Fund, Sierra Club.

C. How can water conservation agreements provide mitigation for the additional pumping units, and what do they represent?

Comment by: State Water Contractors, State Water Resources Control Board, Metropolitan Water District of Southern California, U. S. Bureau of Reclamation.

Response

The three areas of concern in this general issue are addressed by the updated mitigation measures included in the final environmental impact report. The mitigation measures described in the draft report have been expanded to account for:

- The fact that the proposed December 1982 agreement between the Department of Water Resources and the Department of Fish and Game to manage fish and wildlife resources in the Bay-Delta estuary was not executed.
- The recent publication of preliminary water management plans for the various State Water Project contractors.
- The recently enacted Urban Water Management Planning Act.
- Written and verbal comments received on the draft report.
- New determinations by the Department of Fish and Game to update the Bay-Delta fish impacts assessment for the existing and additional pumps at the Banks Pumping Plant.

Differences between the draft and final report mitigation discussions consist of:

- Changing from a specific mitigation plan to alternative plans.
- Adding alternatives involving the operational flexibility of the additional pumps to benefit fish, with loss of power or water supply benefits.
- Adding a discussion of in-place State Water Project mitigation measures and service area cumulative impacts.
- Adding an updated discussion on a new proposed agreement between the Department of Water Resources and Department of Fish and Game for the preservation of fish at the Harvey O. Banks Delta Pumping Plant.

The new proposed agreement differs in scope from the December 1982 agreement. The proposed agreement in this report focuses on impacts at Banks Pumping Plant, whereas the 1982 proposed agreement encompassed State Water Project impacts in the entire estuary. The agreement in this report was discussed under the response to General Issue 1.

In addition to the expanded discussion of direct fish mitigation options, the final report discusses studies for potential unknown impacts, mitigation for water supply alternatives, and potential mitigation for secondary service area impacts and for cumulative impacts.

Mitigation for Fish Impacts. The fish mitigation options, discussed and evaluated in Chapter 5 of the final report, are:

1. The new proposed agreement. This mitigation option is preferred.
2. Two restricted operational modes, one involving a curtailment of off-peak pumping, and the second involving reduction of Decision 1485 export limits in May, June, and July proportionally to increased diversions during the previous winter.
3. Fish stocking commitment without a specific agreement with the Department of Fish and Game.
4. Water conservation contractual agreements. (This measure would not necessarily reduce demands expected under current operation studies, but it could provide a method to define aspects of conservation goals and methods of implementation not specified in the Urban Water Management Planning Act.)

Under Mitigation Option 2, the off-peak pumping curtailment would further reduce striped bass losses by an estimated 44,000 yearlings annually, at a unit cost of $4 per fish. Reduced exports in May, June, and July would further lessen striped bass losses by an estimated 69,000 yearlings. Chinook salmon losses would be reduced by an estimated 5,000 yearlings. The unit cost is estimated at $40 to $80 per fish.

Other fish mitigation possibilities were investigated but found not feasible. These are:

- Salvage system south of Delta.
- Moving fish screens to a location near Clifton Court intake gates.

Studies for Potential Impacts With Insufficient Information to Determine Significance. Some potential environmental impacts may occur in connection with the Bay-Delta estuary and fish food supply. These subjects of study and their complex biology make it difficult to predict if or to what extent the additional pumps may cause significant changes. No impacts have been identified for these; however, the Department has committed funding or personnel to study these potential impacts.

C—105480

C-105480

Mitigation for any impacts requires detailed knowledge of the Bay-Delta estuarine environment. It starts with funding and participating in studies specifically aimed at advancing knowledge in areas where impacts are known or suspected. The more that is understood about the Bay-Delta estuarine environment, the more effective mitigating actions may be. This is true for all factors affecting the Delta, including project and non-project development.

The Department of Water Resources is funding and participating in ecological studies to determine potential Bay-Delta impacts for the alternative operational plans, such as reduced food supply for larval striped bass and impacts to bay fish. These studies include:

- Phytoplankton Work Group and Management Experiments
- Interagency Ecological Study
- Water Right Decision 1485 Monitoring

Mitigation for Water Supply Alternatives. Potential impacts associated with the water supply alternatives are discussed in Chapter 3. For example, the Imperial Valley conservation-transfer alternative may affect the Salton Sea. Such impacts could be the subject of environmental studies and possibly could be mitigated by salinity control for impacts of conservation. Impacts associated with poor quality water (increased salt concentrations) in the service areas could possibly be mitigated by desalting.

Potential Mitigation for Secondary Service Area Impacts. Potential mitigation for service area impacts that would require action by local agencies or others includes:

- Land acquisition for wildlife preservation.
- Funding local studies to advance knowledge about environmental needs.
- Development of local environmental management plans.
- Conservation measures by local agencies.

Recovery plans for the San Joaquin kit fox and the blunt-nosed leopard lizard show how these species can be protected. Local environmental management plans should comply with these recovery plans. General plans prepared by local government agencies in these service areas identify areas suitable for further development, as well as those to be reserved for open space. Local planning agencies should evaluate each proposed development to ensure compliance with these plans.

To help solve the drainage problem, Governor Deukmejian and then-Secretary of the Interior William Clark approved a State-Federal Intergovernmental Coordination Team to start a corrective program. The objective is to protect public health, fish and wildlife, agricultural productivity, and surface and ground water resources. In addition, the Governor, State Legislature, and Department of Water Resources have advanced water management programs to reduce the buildup rate of project exports from the Delta.

Potential Mitigation for Cumulative Impacts. Mitigation for cumulative impacts due to future State, Federal, and local water development generally consists of:

- Safeguards by laws, regulations, and water quality standards.
- Contracts between project operators and various interests such as Delta agricultural and industrial users.
- Physical measures such as fish hatcheries, fish screens, and fish stocking programs.
- Studies and water management programs.

C—105481

C-105481

° Energy programs.

° Agreements such as the Coordinated Operation Agreement, which includes Delta protective measures, and the Suisun Marsh Preservation Agreement, which mitigates cumulative impacts of State and Federal projects on the marsh.

The preferred mitigation for the additional pumps does include measures to compensate for cumulative impacts. The agreement is being negotiated to include provisions to compensate for fish that would have been in the estuary if Banks Pumping Plant were not constructed and also a method to increase mitigation requirements as project entitlement requests increase.

These mitigation measures are discussed in Chapter 6 of the final report (Mitigation Measures for Cumulative Impacts).

General Issue 5

Stocking striped bass is experimental; it is uncertain if, or how well, it would supplement the striped bass population.

Comment by: Delta Environmental Advisory Committee, National Marine Fisheries Service, Environmental Defense Fund.

Response

Negotiations on the agreement for preservation of fish at Banks Pumping Plant are focusing on many nonstocking measures. These may include measures such as facilities to improve channel flow patterns and improved screening of Delta diversions. These measures are being selected with the assistance of fishery groups and State Water Project contractors.

Stocking may still be considered. Some controversy surrounds stocking; however, the controversy lies in the contribution of stocking to Bay-Delta fish, and not in the technology of raising large numbers of yearling striped bass.

The Department of Fish and Game operates a fish hatchery at Elk Grove. This warmwater hatchery produced 50,000 to 75,000 yearling striped bass annually from 1975 to 1980, and is capable of producing up to 300,000 yearlings. The yearlings have been successfully stocked in several warmwater reservoirs in California.

Technology for raising striped bass differs from hatchery to hatchery. The Elk Grove hatchery uses several acres of ponds where the larval striped bass feed on naturally produced zooplankton. Upon reaching about three-fourths of an inch long, the fish are transferred to raceways, where they receive a commercial feed, much in the same manner as trout are reared.

Ecological Analysts, a consulting firm on the East Coast, uses a slightly different method in raising striped bass. Instead of large ponds with naturally produced zooplankton, its hatchery uses a more intensive method of artificially raised brine shrimp as the food source. Fish larger than three-fourths of an inch are raised in a similar procedure as at the Elk Grove hatchery.

The certainty of raising large numbers of striped bass is well documented; however, the Department of Water Resources recognizes the uncertainty of survival of these yearling fish once they are stocked in the Delta. Within the limits of present knowledge, it is the judgment of the Department of Water Resources and the Department of Fish and Game that stocking can be effective for some use as a mitigation measure for the existing pumps and for the proposed additional pumps. Some stocking of yearling striped bass is being considered because stocking can bypass several critical stages of the life

C—105482

C-105482

cycle. Striped bass losses due to loss of spawning or nursery areas, or due to entrainment at the fish screens because of reduced swimming ability, or any other unknown factors can be alleviated by these stocked fish. It is for these reasons that stocking is recommended as one form of mitigation for the adverse effects of the Banks Pumping Plant on Delta fish.

General Issue 6

The Department of Water Resources should apply for the necessary Federal permits before proceeding with the new pumps. Avoidance of the Federal permit process is neither legally justifiable nor sound public policy.

Comment by: National Marine Fisheries Service, Environmental Defense Fund, Sierra Club.

Response

The Department has made a commitment to meet, rather than avoid, Federal requirements. Planning for the proposed additional pumps at the Banks Pumping Plant includes close coordination with the U. S. Army Corps of Engineers in connection with the need for a regulatory permit and the possible effect of the pumps on navigable capacity. The Corps of Engineers determined that operations proposed by the Department would not affect navigable capacity and, therefore, an additional permit would not be needed. The Corps published its findings and requirements in Public Notice 5820A, Amended.

Various alternatives presented in the draft report would require a regulatory permit for navigation. This was discussed in Chapter 3, page 19 of the draft report, and Chapter 3 of the final report, under "Physical and Operational Comparison of Alternative Operational Plans". If the Department of Water Resources should select an alternative with operating criteria requiring a regulatory permit, then a permit would be applied for.

Actions by the Corps of Engineers in connection with the permit for the proposed additional pumps were upheld by the San Francisco U. S. District Court on December 30, 1982. The court ruled that the Corps could reasonably conclude that operation of the additional pumps under the criteria set forth in Public Notice 5820A, Amended, would have no significant effect on water levels in the Delta and that, as a result, a new permit would not be required. The decision stated that if, after installation and operation of the additional pumps, the evidence establishes that their limited operation would have a significant effect on navigable capacity of Delta waters, then such evidence would provide grounds for requiring the Department of Water Resources to apply for a permit.

Proceeding with the new pumps is legally consistent with the Burns-Porter Act, the Corps of Engineers permit process, and this recent U. S. District Court decision. Additional Federal permits may ultimately be needed to operate the additional pumps with future State Water Project development.

Increased use of the additional pumps, with or without other project development, would require initiation of the Federal regulatory permit process, further studies, and environmental documentation. The action in this environmental impact report should not be interpreted as eliminating the Department's option to apply for a permit in the future, but planning uncertainties must be resolved.

Department planning that could affect use of the pumps for full pumping capacity is discussed in the response to General Issue 2. Also, see "Planning Perspective" in Chapter 1 of the final report.

General Issue 7

There is no assurance that: (1) permanent facilities will be constructed to protect the Suisun Marsh, and (2) if the protective facilities are built that there will be available water supplies of adequate quality at Collinsville for distribution by the facilities throughout the marsh. The impacts on Suisun Marsh should be reassessed based on a condition that assumes no protective facilities and relaxed water quality standards for the marsh.

Comment by: National Marine Fisheries Service, U. S. Fish and Wildlife Service, California Waterfowl Association, Delta Environmental Advisory Committee, State Water Resources Control Board, Sierra Club.

Response

The Suisun Marsh Plan of Protection is a separate program of the Department of Water Resources independent from the proposal to install additional pumps. The marsh program is a response to requirements in Decision 1485 of the State Water Resources Control Board to protect Suisun Marsh. This decision is incorporated into the water right permits for the State Water Project and Central Valley Project.

The Department of Water Resources has adopted the plan of protection and is implementing the program. The Montezuma Slough Control Structure, a critical protective facility for the marsh, is in final design process. The initial facilities of the plan are already in place, at a cost of $12 million. Further, the Department has successfully negotiated an agreement on water quality protective facilities, cost sharing, and monitoring in the marsh with the U. S. Bureau of Reclamation, the California Department of Fish and Game, and the Suisun Resource Conservation District. The agreement has scheduled the Montezuma Slough Control Structure to be operational by 1988. The marsh water quality standards in this agreement are similar to those of Decision 1485; therefore, the parties have agreed to jointly petition the State Water Resources Control Board to substitute the agreement's water quality standards for those of Decision 1485.

The assumption in the draft report for evaluation of Suisun Marsh impacts was reviewed in accordance with progress for Suisun Marsh, including work on protective facilities and the recently negotiated agreement. The report evaluation assumed that the most critical protective facilities for Suisun Marsh would be operational by the planned 1990 installation date of the additional pumps and the protective water quality standards would be met. Therefore marsh protection would be provided. This assumption is valid for current planning and work being conducted for marsh protection. With physical protective facilities and water quality standards for marsh protection, the additional pumps would not cause any significant incremental adverse impact.

A Final Environmental Impact Report and Plan of Protection for Suisun Marsh completed in February 1984 sets forth a plan prepared in response to State Water Resources Control Board Order No. 7 under Decision 1485. This report describes overall protective facilities for the marsh and the draft agreement. The environmental documentation on Suisun Marsh includes discussions of a no-action plan alternative (no project) and proposed relaxation of post-1984 Decision 1485 standards during deficiency periods. Also, environmental documentation for the marsh evaluates these protective facilities and associated marsh protection to the year 2000 with the additional pumps installed.

Adopting no action as a plan would produce the same results as disregarding the problem of increasing saline water supply to Suisun Marsh. In years of below-normal runoff, salinity of the marsh would exceed tolerance levels of

C—105484

C-105484

many of the more desirable plants. These plants would gradually be replaced by less desirable, salt-tolerant species, including pickleweed and salt grass. The western areas of Suisun Marsh would become a salt marsh. Much of the marsh's value for recreation and wildlife habitat would be lost.

Proposed deficiency year standards in the agreement for the marsh are designed to provide the quality of water necessary to keep waterfowl food plants alive. Because of the naturally occurring salinity gradient in the marsh, providing this quality of water to the most salinity susceptible areas will result in better than minimal water quality in some other areas. A marsh model operation was made to assess the estimated impact of the proposed deficiency standard on alkali bulrush in the marsh. Present Decision 1485 standards are set to provide 90 percent production and 60 percent germination. The model operation indicated that meeting the deficiency criteria would reduce production and germination below expected Decision 1485 levels in about one-third of the marsh. In spite of these reduced levels of production and germination, salinities are not expected to be high enough to result in alkali bulrush tuber mortality.

The deficiency standards would be applicable about 12 percent of the time (80 months in a 57-year study period).

This final report contains an expanded and updated discussion of the Plan of Protection for Suisun Marsh in Chapters 4 and 5, and the February 1984 environmental impact report on Suisun Marsh is incorporated by reference.

General Issue 8

The economic analysis in the Draft Environmental Impact Report on the Proposed Additional Pumping Units shows a better benefit/cost ratio with two new pumps than with four pumps for operations under the Corps of Engineers constraints. The justification for proceeding with all four pumps is not clear.

Comment by: National Marine Fisheries Service, State Water Resources Control Board, Bay Conservation and Development Commission, Environmental Defense Fund, U. S. Fish and Wildlife Service, Sierra Club.

Response

The draft report identified a preferred alternative, which was four additional pumps operated to meet the constraints of Decision 1485 and the Corps of Engineers' diversion limits established in Public Notice 5820A, Amended. The economic assessment in the draft report showed favorable benefit/cost ratios for the alternatives operated under Corps constraints and less than 5 percent difference between the two- and four-pump options. The same preferred alternative, retained for the final report, is supported by an updated economic assessment, again with a favorable benefit/cost ratio and higher net benefits than the two-pump alternative.

The economic analysis in the draft report conservatively estimated benefits for on-peak power savings using a differential value of 5 mills per kilowatt-hour. This differential was based on spot-market economy energy brokeraging, which is a function of averaged State Water Project and purchasing utility generation costs, rather than of value to the purchasing utility. This conservative assumption was discussed in Appendix C, page C-7, of the draft report. This conservative value was used because the Department did not have the operating experience as a utility to justify a higher value.

For the final report, the Department has reviewed both economic and environmental

aspects of proceeding with two and four additional pumps. The economic analysis incorporates the following changes:

- Updated water supply and power operation studies provided yield estimates that were about the same as in the draft report; however, power studies showed added occurrence of capacity and peak energy advantages for four pumps when compared to two.

- Updated cost estimates showed higher costs for the additional pumps as well as water supply and demand reduction alternatives.

- Revision of the economic analysis to reflect the Department's increased operating experience as a utility, the costs of purchasing capacity and energy, and cost escalation. This revised analysis showed added value for the energy benefits for the additional pumps.

The preferred alternative of four additional pumps operated under the Corps criteria would provide about $13 million annual power cost savings and overall net benefits of about $24 million annually. The 2-pump alternative under Corps constraints would provide about $6 million annual power cost savings and overall net benefits of about $19 million.

The revised economic analysis for water supply and power is described in Chapter 3 and Appendix C of the final report, which show the benefit/cost ratio is still higher for the 2-pump alternative and also shows a definite economic advantage of net benefits for four new pumps over two for operations under the Corps constraints.

General Issue 9

The use of water conservation in the environmental documentation process is not adequately explained.

Comment by: Metropolitan Water District, State Water Contractors, State Water Contractors Audit Committee, National Marine Fisheries Service, Environmental Defense Fund, State Water Resources Control Board.

Response

Water conservation is discussed in the final environmental impact report in connection with:

- Project operation studies to evaluate the impacts of the ten alternative operational plans for the additional pumps.

- Water supply and demand reduction alternatives.

- Mitigation.

The demands assumed in the project operation studies incorporated an estimated 250,000 acre-feet per year for urban conservation. This demand is consistent with contractors' requested deliveries and the Department's recommended water management plans for State Water Project contractors. These plans are described in Chapter 3, under "Water Supply and Demand Reduction Alternatives".

The conservation measures in the water management plans are assumed to be implemented independent of the availability of State Water Project contracted entitlements and independent of the additional pumps. These measures are, therefore, likely to occur and are not alternatives to the additional pumps.

Water conservation measures were also included in the seven water supply and demand reduction alternatives. The two demand reduction alternatives are extraordinary measures that go beyond the conservation measures incorporated into the recommended water management plans.

Implementation of the two extraordinary conservation measures would reduce demands by an estimated 120,000 acre-feet. This amount represents about 3 percent of net demands in the Metropolitan service area, 8 percent of Metropolitan's demand from the State Water Project, and 3 percent of the total 1990 State Water Project demand.

The extraordinary measures are assumed to be achievable under conditions of significant State Water Project deficiencies. These extraordinary measures would be more costly, have some institutional problems, and are considered less acceptable. In addition to these conditions, selection of the extraordinary measures assumed:

- They would not impair the maintenance of present conveniences or esthetic and health conditions.
- Along with the water supply alternatives, they would cumulatively balance supplies and demands in the Metropolitan Water District service area if the State Water Project is not completed.
- They could provide effective yield reductions with or without installation of additional pumps and, therefore, they provide a sound basis for alternative comparisons. Other water resources planning projects would depend on the pumps and, therefore, could not be considered as alternatives.
- Urban waste water reclamation projects beyond those being considered in the water management plans would not be implemented because of uncertainties related to health standards. Industrial water conservation beyond that described in the water management plans would not be considered because of the relatively small amounts involved and extreme complexity in addessing further detail.

The extraordinary conservation measures were developed and applied in accordance with detailed studies, test programs, and research by the Department of Water Resources, Office of Water Conservation. This information was summarized in Appendix C of the draft report and is also included in this final report.

Although these extraordinary measures are alternatives to the water supply benefits of the additional pumps, they do not provide the operational advantages of the additional pumps for standby capacity and increased off-peak energy use. Cost and estimated yield of the extraordinary conservation measures were considered in the economic assessment of the additional pumps. This study showed that these extraordinary measures would be needed with the added pumps by the early 1990s, when the new pumps would become operational.

Under the study assumptions of added project water supply facilities, these measures were assumed to be implemented before the pumps could be installed and, therefore, did not compete with the additional pumps.

Water conservation through a contractual agreement is also discussed in the final report as a mitigation option for fish impacts. Such a mitigation option would not necessarily produce greater reductions than those assumed in determining the need for the pumps. This option could, however, provide a method to define aspects of conservation goals and methods of implementation not specified in the Urban Water Management Planning Act.

General Issue 10

The proposed project will increase water export by about 61 percent, more than 2.8 million acre-feet per year.

Comment by: The California Fisheries Restoration Foundation and Delta Environmental Advisory Committee.

Response

Operation of the State Water Project with the additional pumps would not increase water export by 61 percent. This comment incorrectly assumes that the new pumps will be operated at full capacity all the time. As explained in the draft report, the additional pumps would be used on a much more limited basis. A major use is to enable the project to shift its pumping from on-peak to off-peak. Under the Corps constraints, historical maximums would be required except in high-flow winter months.

Although the physical capability of Banks Pumping Plant would be increased from 6,400 to 10,300 cubic feet per second (61 percent) under the preferred alternative using four additional pumps, many factors will limit the actual increase in annual and monthly export water volume. These factors include:

- Available water supply.
- Variations in monthly and annual precipitation.
- Operational requirements under Decision 1485 or other appropriate regulations.
- Corps of Engineers operational constraints under Public Notice 5820A, Amended.
- Hydraulic constraints inherent with the present method of transporting water across the Delta; that is, channels are too small to carry all the water that would be needed if the pumps were to operate at full capacity.
- State Water Project storage capability and demands.
- Capacity at the Banks Pumping Plant.
- State Water Project water supply and power contracts.

Operation studies basic to the analysis of the additional pumps include 57 years of hydrologic data and considered all the foregoing factors. The yield increase from these studies for the preferred alternative was estimated to be about 60,000 acre-feet per year. This was presented in Table S-1 of the draft report, and represents an increase of less than 3 percent (not 61 percent) in yield from existing facilities.

Available water supply varies greatly due to extreme fluctuations in monthly and yearly precipitation. For example, the Delta water supply remaining in 1990 after other upstream uses would range from about 9 million acre-feet for a critical year to about 60 million acre-feet for a very wet year. State Water Project capability to meet demands from available Delta water supply depends on storage in San Luis Reservoir, aqueduct capacity, storage in facilities north of the Delta, and carriage water requirements to repel salinity. Project demands vary by month but generally increase in total each year. During 1981, project deliveries ranged from 134,000 acre-feet in February to 464,000 acre-feet in July.

Decision 1485 contains comprehensive outflow and quality standards for protection of municipal and industrial, agricultural, and fish and wildlife uses of water in the Sacramento-San Joaquin estuary. These standards must be met before the State Water Project can export water from the Delta. Also, project diversions are limited in May, June, and July to protect striped bass. These requirements are discussed fully in the final environmental impact report on Decision 1485, published in August 1978. All alternative operational plans presented in the impact analysis for the proposed additional pumping units would meet Decision 1485 standards.

The Corps of Engineers constraints limit Clifton Court Forebay diversion so that there will be no increased effect on navigable capacity of Delta waterways.

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C-105488

The constraints are part of the preferred alternative operational plan.

Hydraulic constraints are complicated and make computation of monthly maximum exports difficult. These constraints are related to:

- Volume of Clifton Court Forebay.
- Forebay inlet gate size and placement.
- Tidal fluctuations at the inlet gate.
- Capacity of southern Delta channels.
- Flows in the San Joaquin River.

The State Water Project is operated in accordance with 17 major electrical power contracts. These contracts, which influence present and future operations of the project, focus on load requirements, available capacity, power transmission, and emergency service provisions. In the past, the Department has operated the State Water Project to provide emergency assistance to Pacific Gas and Electric Company by reducing project pumping load. The Department has also provided additional capacity to Pacific Gas and Electric Company by generation at the San Luis pumping-generating plant. In addition, the Department has also retained a consultant to investigate the transfer of power between the State Water Project and a major utility by dymanic scheduling through a computer controlled process that continuously varies power flow to meet changing conditions. These operational factors can affect State Water Project deliveries.

The preferred alternative for the pumps would limit increases in State Water Project exports to about 60,000 acre-feet per year of firm yield. It is possible that other projects that would use the pumps would enable larger export increases. Four additional pumps at Banks Pumping Plant would be needed to meet the long-term firm yield of 4.23 million acre-feet. The annual yield of present facilities is about 2.3 million acre-feet. However, Delta water transfer facilities would also be necessary to achievement of the long-term yield. Implementation of this or other future facilities will require additional environmental documentation and the Corps regulatory permit process.

General Issue 11

The Department of Water Resources should not increase exports until the impacts of Delta outflow on fish are understood.

Comment by: Contra Costa Water Agency, National Marine Fisheries Service, California Regional Water Quality Control Board - San Francisco Bay Region, Sierra Club.

Response

There are reasons for proceeding with four additional pumps at this time even though there are uncertainties about the outflow needs for biological resources of San Francisco Bay and the Delta. The interrelationship between Bay and Delta resources is not well understood and may not be defined in the near future. Even if they are related, the proposal will have only a minimal impact, as shown by evaluation of operations with the Corps criteria. An average annual decrease in outflows for the preferred alternative amounts to about 0.4 percent. Outflow surges were investigated, and changes were small. These are shown in Table 5-5.

Even with many studies, a full understanding of the interrelationship between the bay's biological resources and Delta outflow is not expected for many years. Benefits of the additional pumps include power cost savings and increased reliability for water supply deliveries; these justify proceeding with the pumps.

The Department acknowledges the importance of the relationship between outflow and fish and is working to gain information on this subject. The Department has actively participated in and pro-

vided funding to help gain information on the effects of outflow on the environment through involvement in the following programs:

- Interagency Ecological Study, which includes the Delta Outflow/ San Francisco Bay Study.
- Advanced tidal hydrodynamic math modeling development.
- Water Right Decision 1485 monitoring by the Department.
- Comprehensive monitoring programs.

State Water Project funding for the interagency studies has amounted to about $20 million. The latest protection is Water Right Decision 1485 standards. The Department is committed to meeting these standards. Results of the interagency studies will be considered by the State Water Resources Control Board in a planned rehearing of Decision 1485, which may result in revised standards. If the State Water Resources Control Board amends Decision 1485, the Department will meet valid new standards, with or without the additional pumps.

Various factors influence outflow. Delta outflow varies as a result of natural variations in precipitation and water development activities. Both storage of Delta inflow and diversions affect outflow. Water projects in the drainage area to the Delta have different operations. The State Water Project and Central Valley Project divert directly from the Delta. Both projects decrease winter and spring outflow and increase summer outflow. Projects such as the Hetch Hetchy Aqueduct and the Mokelumne Aqueduct divert before the water reaches the Delta and transport water around the Delta year-round. All diversions, regardless of location, reduce Delta outflow. Local reservoirs in the Central Valley, with a gross storage capacity of 9 million acre-feet, store water for release at various times of the year and also affect Delta inflow and outflow.

Factors other than outflow that affect Delta fish include:

- Commercial, sport, and illegal fishing.
- Unscreened Delta diversions by about 2,000 agricultural water users.
- Unscreened Delta diversions through the Contra Costa Canal for municipal and industrial uses.
- Land reclamation.
- Waste water effluent and surface runoff from local and upstream urban development.
- Oil spills.
- Drainage and leaching water discharge from Delta and upstream agricultural water use.

Before the pumps become operational, the State Water Resources Control Board is scheduled to conduct water right hearings, which will include this subject. Any valid water right criteria will be met by the State Water Project, with or without the additional pumps. Installation of the pumps will not preclude revised operations if new information shows an adverse relationship of project operations on the bay.

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LETTER 1

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region, EAB
300 South Ferry Street
Terminal Island, CA 90731

February 2, 1983 F/SWR33:TGY

Mr. Wayne MacRostie, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, CA 95816

Dear Mr. MacRostie:

We have reviewed the Draft Environmental Impact Report (DEIR) for the Proposed Additional Pumping Units at the Harvey O. Banks Delta Pumping Plant of the California State Water Project (SWP). As we stated in our letter to the U.S. Army Corps of Engineers of August 1, 1980 (enclosed), we believe that present operation of the Delta Pumping Plant has contributed to the
1 declines in anadromous fishery resources in the Sacramento and San Joaquin River basins, the Sacramento-San Joaquin Delta, San Francisco Bay, and the continental shelf. We stated further that we believe that operation of this facility must be regulated to limit 1) the timing of pumping and 2) the quantities of water to be exported in order to slow the continuing degradation of fishery resources in California; our beliefs in this regard have not changed.

In a subsequent letter to the Corps (March 30, 1981, enclosed), we provided additional documentation of our concerns and we requested certain conditions be placed upon the operation of the Delta Pumping Plant as part of its proposed federal permit (some of these conditions are noted on page 5 of the DEIR). We asked that 1) annual export pumping be limited until certain studies relevant to the flow needs of the Bay-Delta estuary were completed, 2) the Department of Water Resources (DWR) provide
2 fish screens in the Delta to mitigate for losses at the Delta Pumping Plant, 3) if after five years of monitoring populations of fishes, impacts of plant operation had not been mitigated, DWR would provide fish hatchery production or habitat improvement measures to replace losses of fishes, and 4) in the event a delta transfer facility was built that demonstrably lessened the impacts of the Delta Pumping Plant, that permit conditions would be reassessed and changed accordingly.

We continue to believe that our concerns and proposed conditions are well founded. Recent studies by the Striped Bass
3 Working Group of the State Water Resources Control Board (Kelley et.al. 1982), the U.S. Fish and Wildlife Service (Martin Kjelson, personal communication), and the Department of Fish and Game

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(DFG) have confirmed the importance of Delta outflow to marine, estuarine, and anadromous fishery resources. Studies by DWR (Brown 1982) indicate that unscreened diversions in the Delta may remove as many (if not more) young fishes and fish eggs as the
3 Delta Pumping Plant. Although these studies suggest that altering pumping schedules and screening Delta agricultural diversions may provide fishery benefits, further reductions in Delta outflow could be detrimental (Kelley et.al. 1982). Accordingly, we believe that there are additional operational alternatives that DWR should evaluate in the DEIR.

Evaluation of Alternatives

The DEIR evaluates a number of alternatives under which two or four pumps are added to the Delta Pumping Plant and monthly diversion rates are set either by 1) Corps of Engineers constraints on navigable capacity (no federal permit required), 2) pumping or system capacity (federal Section 10 permit required), or 3) increased intake capacity by intake or channel modifications at Clifton Court Forebay (federal Section 10 and
4 Section 404 permits required). Your preferred alternative would allow addition of four pumps but would limit pumping to within Corps of Engineers constraints (as well as existing Water Right 1485 limitations). This alternative postpones permits which are likely to be needed ultimately by DWR in order to increase export capacity and it limits flexibility in pump scheduling to reduce fishery impacts. Thus, this alternative would not seem to be in the best interest of either the DWR or the fishery resources of the estuary.

The National Marine Fisheries Service (NMFS) believes that, for any given annual export rate, increased pumping capacity at the Delta Pumping Plant could be used to lessen the impacts of the State Water Project (SWP) on salmon, steelhead trout, striped
5 bass, and other species as well. Clearly, there are months when water is abundant and numbers of these fishes in the vicinity of the pumps are low. Pumping heavily during these periods would have relatively little impact on anadromous fishery resources, whereas curtailing pumping during "high-impact" months could significantly benefit these same resources.

Accordingly, the NMFS believes that the DWR should evaluate alternatives that are based upon annual export volumes rather than average monthly pumping rates. For any such annual volume, pumping schedules (rates) should be determined that would maximize pumping during "low-impact" periods and minimize or cease pumping when potential impacts to fishery resources are greatest. For example, pumping at capacity with four new pumps
6 (10,300 cfs) during December through early March with the Delta Cross Channel closed (although additional storage south of the Delta may be required) and allocating the additional annual export over the remainder of the year (with proposed savings through conservation programs) could result in net benefits to fishery resources and SWP firm yield. Winter pumping might also

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be cheaper because of increased availability of hydroelectric power. Although such alternatives would require federal permits, there is little question that such permits will eventually be required if the SWP seeks to meet its contractual obligations.

The NMFS is also concerned that the DEIR did not evaluate the impacts of additional storage south of the Delta (such as the Los Vaqueros Pumped Storage Facility) and a Delta transfer facility (such as the Delta waterways or "Orlob" plan or the Peripheral Canal). Facilities such as these are likely in the future and would affect the operations of the Delta Pumping Plant. Additional storage capacity south of the Delta could actually prove beneficial to fisheries if it were used to allow greater pumping from the Delta during periods of low potential
7 impact to fisheries. In short, there appear to be opportunities to benefit fishery resources and water users alike through the addition of pumping capacity at the Delta Pumping Plant, but the DEIR has not adequately evaluated such alternatives; the DWR should explore these in the final EIR, whether or not they entail obtaining additional permits. Under such an evaluation, a "no-action" alternative might involve addition of four pumps without increasing annual exports and scheduling pumping to minimize fishery impacts; the benefits to fishery resources should be included in any benefit-cost analyses (recent estimates made by the U.S. Fish and Wildlife Service place the overall value of a spawning chinook salmon between $550 and $869).

The alternatives should evaluate water conservation more thoroughly, including agricultural water conservation. According to some economic analyses, a 10% increase in water prices to agricultural users would result in about a 7% reduction in water use in California; pricing policies alone could "create" enough water to meet California's future needs (B. Delworth Gardner, personal communication). The DEIR evaluated a number of municipal sources of water conservation, but dealt inadequately
8 with agricultural conservation. In addition, we assume that the federal Central Valley Project (CVP) would seek to use the additional capacity at the Delta Pumping Plant in future negotiations of the coordinated operations agreement between the SWP and CVP. The possibilities of the SWP requiring certain constraints on the CVP operations in order to use the capacity (such as pump scheduling to protect fisheries, water conservation practices, and payment of capital and delivery costs) should be evaluated, as they could benefit the resources of the estuary. Such opportunities were not addressed in the DEIR, but should be.

Evaluation of Impacts to Fishery Resources

The Delta Pumping Plant (and the Tracy Pumping Plant of the CVP) have had devastating direct and indirect impacts on fishery resources in the estuary. These impacts of the existing operation and the potential impacts of the various alternatives
9 are evaluated inadequately in the DEIR. The DEIR underestimates the direct (entrainment) impacts to fish drawn into Clifton Court

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Forebay and inadequately considers the overall adverse impact that the pumping operation has on fishery habitat in the Bay-Delta estuary. The numbers of fishes that are lost to predation
9 in the southern Delta and Clifton Court Forebay may far exceed those that are screened at the Skinner Fish Facility, yet estimates of these losses are not presented. The numbers of fish eggs, larvae, and juveniles that pass through the screens are probably underestimated and a large, but undefined percentage of the fish that are screened (salvaged) ultimately die.

These methods might have merit if the estimates were presented with some indication of their statistical confidence. For example, it is well known that few of the smaller fishes entering Clifton Court Forebay may ever reach the screens because of intense predation within the forebay; Hall (1980) estimated that 95% of the salmon entering the forebay were eaten before
10 reaching the screens. Thus, it is possible that the number of fish salvaged may only be a very small fraction of the fish actually entering Clifton Court Forebay. In addition, the estimates of louver efficiencies are probably incorrect and may underestimate the losses of eggs, larvae, and small juveniles; louver efficiencies for these life stages are essentially unknown. For the purpose of the DEIR it would probably be most reasonable to assume that all fish entering Clifton Court Forebay are lost.

From these very rough estimates of direct losses, the DEIR estimates the number of eggs, larvae, and juveniles that would have lived to become yearlings, if they had not been entrained. The DEIR then uses the number of these "equivalent" yearlings to determine the impacts of each of the operational alternatives.
11 We question the validity of estimating the number of equivalent yearlings that would have resulted from those fish that were directly killed through entrainment or salvage. Such estimates may be useful in comparing relative impacts of various alternatives but are questionable in determining the absolute impacts of any alternative (and subsequent mitigation requirements).

The DEIR should evaluate the indirect impacts of the various operational alternatives on fishery resources in the Delta and the San Francisco Bay Estuary. As we stated earlier, we believe that some operational modes might actually be beneficial; given the evidence that the indirect impacts of the operation of the
12 Delta Pumping Plant on fishery resources may substantially outweigh the direct effects of entrainment (see Kelley et.al. 1982), the 1) opportunities to mitigate adverse impacts and 2) estimated magnitude of those impacts have not been adequately evaluated in the DEIR.

Mitigation Requirements

The NMFS does not believe that the estimates of fishery

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losses caused directly of indirectly by the various operational alternatives are correct. We believe that the magnitude of these losses are underestimated. We believe, further, that providing hatchery-reared yearling striped bass and salmon will do little to improve the deteriorated fishery habitat conditions in the estuary caused by the SWP and CVP operations. We do believe, however, that increasing the capacity of the Delta Pumping Plant could provide an opportunity to alleviate some of the direct and indirect adverse impacts of its past operations. We believe that
13 the DWR should use this opportunity to use the new capacity to reduce the adverse impacts of the SWP rather than to look to hatchery production as its sole means of mitigation. It has been our experience that hatchery production fails, unless the waters receiving that artificial production are capable of supporting healthy populations of the fish that are planted. Clearly, the declining populations of salmon and striped bass in the estuary do not give evidence of the healthy, productive habitat which would support that hatchery production.

The overall mitigation plan for the preferred alternative relies upon the proposed "Agreement to Manage Fish and Wildlife Resources in the Sacramento-San Joaquin Estuary" between DWR and
14 the Department of Fish and Game (see page S-8, DEIR). This proposed agreement has not been signed and we understand that there is some liklihood that it will not be signed. The mitigation/operations plans for all of the alternatives proposed in the DEIR should be presented explicitly in the DEIR without reference to this proposed agreement.

Benefit/Cost Ratios

According to the analyses conducted by DWR, the best benefit/cost ratio was obtained under the alternative where four pumps are added and pumping is restricted only by Decision 1485
15 standards. Such a plan would provide maximum flexibility to make use of high outflows and off-peak power; this alternative also has the greatest potential for harming fishery resources if annual exports increase significantly without additional fishery flow standards.

For all other alternatives, the benefit/cost ratio is higher when two pumps are added rather than four (for any given monthly average pumping limit). Thus, the preferred alternative, to pump at rates no higher than allowed by the Corps of Engineers criteria, is economically better with two pumps (B/C ratio=1.69) than with four pumps (B/C ratio=1.63). If, after evaluating
16 other alternatives (such as those we suggested earlier), DWR continues to favor the present preferred alternative, we believe that it is probably in the best economic interest of DWR and in the best interest of the resources of the estuary to select alternative 2-7.3 rather than alternative 4-7.3; the benefit/cost ratio is higher and the potential for further harm to fishery resources is reduced. Within the Corps of Engineers pumping constraints, two pumps can do the job and do it less expensively.

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Specific Comments

DEIR page 5.
17 Reference is made to our letter of March 30, 1981 and conditions we requested as part of a proposed Section 10 permit. Not all of the conditions are listed but should be. In addition, the name of our agency is the National Marine Fisheries Service (see also page 6).

DEIR pages 8-9.
18 The discussion of the "Two-Agency Agreement" does not indicate what actions the DWR will take if the agreement is not adopted. Much of the mitigation for the various pumping alternatives is dependent upon this agreement and, as such, the DEIR will be incomplete unless the agreement is signed prior to issuance of a final EIR. Accordingly, the final EIR should include complete mitigation proposals agreeable to DFG and other resource agencies for all alternatives proposed.

DEIR pages 9-10.
19 Proposed water conservation and reclamation studies are discussed in this section. We agree with the thrust of these efforts, as required under the Governor's Executive Order B-68-80. The DEIR should indicate the degree to which these efforts will continue should that executive order be rescinded by the new state administration.

DEIR Chapter 3, pages 19-30.
20 As we stated in our general comments, we believe that there are additional alternatives that should be considered in the DEIR. We believe that alternatives exist which could benefit fishery resources and that these alternatives and benefits should be evaluated. These should also incorporate recommendations of the Striped Bass Working Group (and others) to provide flows adequate to maintain the entrapment zone in Suisun and Honker Bays from late winter until early summer.

DEIR pages 68-81.
21 This section of the DEIR describes impacts to fishery resources of the various alternatives. Although we generally agree with the description of the types of impacts, we do not believe that the actual estimates of the impact of each alternative is adequate. If the "Two-Agency Agreement" was already adopted, there would be additional mitigation possible should the adverse impacts of the selected alternative be underestimated. The ability of fishery scientists to predict the consequences of various pumping and outflow regimes on populations of even well-studied species has come under serious question in recent years. However, it is clear

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that Delta outflow is important to the fish that live in or migrate through the estuary. We believe that the DEIR must give some indication of the confidence that can be placed upon the estimated impacts of each alternative; for example, if the estimates are "worst case", they should be presented as such.

DEIR page 83.
22 The impacts on Suisun Marsh should be reassessed. Although the proposed plan of protection is the subject of a 1980 EIR, the actual facilities have not been completed and the final facilities are likely to be different than those proposed in the EIR. Thus, statements that these facilities will fully mitigate the effects of the Delta Pumping Plant are premature. In addition, you are probably aware that the NMFS believes that the proposed plan of protection will adversely impact fishery resources that presently use the marsh as a nursery area and migratory pathway. We believe that these impacts should be mitigated.

DEIR pages 83-84.
23 The impacts of the various alternatives on San Francisco Bay fish populations are described in only one paragraph. We agree that few specifics are known about how flows (and export pumping) affect the estuary, with the exceptions of striped bass, salmon, and some assemblages of organisms in (or dependent upon) the entrapment zone. However, we do not question that a strong relationship exists. The DEIR, however, merely states that little is known about the needs of the Bay. A more thorough treatment is warranted and should be included in the final EIR.

DEIR pages 87-88.
24 Mitigation measures are not adequately described. The exact mitigation plans should be outlined in the DEIR and should include measures other than artificial propagation. The liklihood that the "Two-Agency Agreement" will not be adopted makes inclusion of a complete description of mitigation alternatives even more appropriate.

DEIR pages 89-95.
25 Although the DEIR adequately describes the number and type of projects that are likely to cause cumulative impacts, these impacts are not quantified in the DEIR but should be. In addition, we believe that the impacts of the Delta Waterways water transfer facility should be included in the DEIR, as we suggested in our general comments earlier.

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If you wish to contact us further on this matter, please direct comments to Mr. Thomas G. Yocom at: National Marine Fisheries Service, 3150 Paradise Drive, Tiburon, CA 94920-1299; telephone (415) 556-0565.

Sincerely yours,

Alan W. Ford
Regional Director

cc: CDFG, D. Lollock (W/Encl)
FWS, J. McKevitt (W/Encl)

Enclosures

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
300 South Ferry Street
Terminal Island, CA 90731

August 1, 1980 F/SWR33:TGY

Colonel Paul F. Kavanaugh
District Engineer
Sacramento District
Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Colonel Kavanaugh:

Subject: Public Notice No. 5820A (Department of Water Resources) to add four additional pumping units to the existing Delta pumping plant

We have reviewed the subject public notice and recommend that the permit for the project be held in abeyance until the existing pumping plant receives the necessary federal permit to continue operation. The National Marine Fisheries Service believes that present operation of this unauthorized plant has been a major cause of the decline in anadromous fishery resources in the Sacramento and San Joaquin River basins, the Sacramento-San Joaquin Delta, San Francisco Bay, and the continental shelf. We believe that this operation must be regulated through conditioning the pending permit (No.5820) to limit the timing of pumping and the quantities of water to be exported. Without such limitations, degradation of the fishery resources in the Sacramento-San Joaquin River Delta, the San Francisco Bay estuary, and the Pacific continental shelf is expected to continue; such degradation is unacceptable to the National Marine Fisheries Service.

The National Marine Fisheries Service believes that it is inappropriate to consider expansion of such an environmentally damaging project prior to determining if the pumping plant will receive a permit to operate; if such a permit were granted, the operation of the plant could be limited through permit conditions precluding the need for additional pumping units.

Should the Delta Pumping Plant be granted a permit under Public Notice 5820, we would request that the subject permit continue to be held in abeyance until an environmental impact statement is prepared.

Such a statement should assess the cumulative impacts of the Delta pumping plant, the Tracy pumping plant, the CVP reauthorization, implementation of Senate Bill 200 (including the Peripheral Canal), and the San Joaquin Valley Salt Drain in order to meet the requirements of NEPA. The areas of impact should include the Sacramento and San Joaquin River basins, the Delta, San Francisco Bay, Suisun Marsh, and the Pacific continental shelf in the vicinity of San Francisco Bay. The draft EIS should also consider alternatives to the proposed expansion of the pumping plant including water conservation, ground-water management, and alternative water pricing policies.

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If you wish to contact this agency further on this matter, please direct comments to Mr. Tom Yocom at: National Marine Fisheries Service, 3150 Paradise Drive, Tiburon, CA 94920; phone (415) 556-0565.

Sincerely yours,

for Troy S. Anders, Jr.
Acting Regional Director

cc: USFWS, J. McKevitt
CDF&G, D. Lollock

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
300 South Ferry Street
Terminal Island, California 90731

March 30, 1981 F/SWR33:TY

Colonel Paul F. Kavanaugh
District Engineer
Sacramento District
Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Colonel Kavanaugh:

On November 6, 1980, representatives of the National Marine Fisheries Service (NMFS) met with your staff and representatives of the California Department of Water Resources (CDWR) to express our concerns about the impacts of the continued operation of the Delta Pumping Plant (Public Notice 5820) and to attempt to resolve our concerns about the inadequacy of the Final Environmental Impact Statement (FEIS) on the operation of the Delta Pumping Plant and the need for mitigation and/or compensation. Following that discussion, we agreed to forward specific comments and recommendations for mitigation to the Corps, and the CDWR agreed to do likewise.

This meeting had followed our review of the FEIS, which in our judgment, failed to meet the requirements or intent of the National Environmental Policy Act (NEPA), the Magnuson Fishery Conservation and Management Act (MFCMA), the Fish and Wildlife Coordination Act (FWCA), the Coastal Zone Management Act (CZMA), and the water policy set forth in the President's June 6, 1978 Message to Congress (see our letter to you of October 6, 1980). Our chief concerns were that:

1. Fish and wildlife conservation had not received equal consideration and had not been coordinated with other features of the project as required under FWCA (16 USC 661).

2. Appropriate mitigation measures were not developed adequately to provide for minimizing adverse environmental impacts of the project as required under NEPA (40 CFR Part.1502.14). NMFS believes that additional alternatives should be considered which would reduce the amount of water delivered from the Sacramento-San Joaquin Delta for agricultural purposes (or reduce the demand for that water). This alternative should be coupled with policies and practices that charge water users the "true costs" of water delivery. These costs would reflect the amount required to compensate for project occasioned losses of fishery productivity within the San Francisco Bay and tributaries system.

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3. Operation of the project by itself, or in concert with other water facilities, conflicts with Federal efforts aimed at protecting the environment and enhancing the quality of renewable natural resources (i.e., NEPA, MFCMA, CZMA, and the President's June 6, 1978 Message to Congress).

4. To allow the project to continue operation without additional mitigation could establish precedents which, in our opinion, would be contrary to environmental policy set forth by Congress and provisions of the FWCA and MFCMA.

5. Cumulative impacts resulting from the Delta pumping operation in conjunction with other related federal or non-federal actions were not addressed thoroughly as required under NEPA (40 CFR Part 1508.7).

6. Direct and indirect effects of the project were not addressed adequately, including discussions as to the significant impact of water export on San Francisco Bay and the territorial sea. Such discussions are required under NEPA (40 CFR Part 1508.8).

7. Although the FEIS stated correctly that inadequate information was available to assess the impacts of the project on San Francisco Bay (and we presume the territorial sea), the FEIS should have identified studies to determine these impacts as required by NEPA (40 CFR Part 1502.22).

The following comments outline our views on the need for project mitigation and offer alternatives that would allow continued operation of the Delta Pumping Plant, while minimizing adverse environmental impacts and unnecessary costs. We believe that our recommendations provide a reasonable solution to the problems caused by the pumping plant operation and allow for modification of conditions when more complete information is available.

General Comments:

Water development in California has resulted in losses of fishery habitat and declines in populations of anadromous fishes (Advisory Committee on Salmon and Steelhead Trout, 1971). In particular, volumes of water exported by state and federal pumping plants in the Sacramento-San Joaquin Delta have been correlated strongly with year-class strength of the striped bass (Turner and Chadwick, 1972). Although it is generally recognized that other species of fish and invertebrates also have been affected by water development and export, data for striped bass are far more complete than those gathered on other species. Consequently, water quality standards have been formulated to maintain specific population indices of striped bass (State Water Resources Control Board, 1978).

An assumption inherent in these standards is that by providing a given degree of protection for certain life stages of one important and well-studied species, the entire community of organisms using the same habitat will also be protected (State Water Resources Control Board, 1978). This assumption has merit in some cases, especially where protection results in conditions that

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more closely resemble those that existed before the habitat was degraded by water development and export. However, because no two species use the same habitat in the same way, the degree to which factors that protect striped bass will protect other species may vary greatly. Some species may increase in numbers while others may decline (California Resource Agency, 1980).

State Water Right Decision 1485 established salinity standards for the Sacramento-San Joaquin Delta and Suisun Marsh and placed restrictions on export pumping during periods when young striped bass would be most vulnerable to entrainment into the state and federal pumping plants in the south Delta (State Water Resources Control Board, 1978). These standards were based on correlations developed by the California Department of Fish and Game (CDF&G), which related numbers of 38-mm. striped bass with monthly water exports during June and July. The facts that (1) export pumping caused many young striped bass to be entrained into the pumping plants (Chadwick et al, 1977) and (2) the fish salvaging facilities at these plants were ineffective for small fishes (California Resources Agency, 1973), led to a tentative conclusion that the declines in adult populations of striped bass in the estuary primarily were the result of entrainment losses of young striped bass (Chadwick et al, 1977). The CDF&G estimates that 40 to 80 million juvenile striped bass are lost annually through export pumping (Chadwick et al, 1977).

In recent years, the implementation of the water quality standards in Water Right Decision 1485 has failed to protect species other than striped bass. Further there have been sharp, unexpected declines in striped bass recruitment. The cause of the declines is unclear, but it is probable that direct entrainment losses are only partially responsible. The declines suggest that the water quality standards (including export pumping limitations in summer months) are not protecting the estuary adequately, and additional limitations on export pumping are warranted to mitigate fishery losses in the estuary.

Accordingly, researchers question if these export losses of fish are the major contributor to the decline in the population. Population projections, based on the relationship between pumping rates and export of young striped bass, have failed to predict the declines observed since the drought of 1976-1977 (Stevens, 1980). Some researchers suggest that reduced freshwater inflow into the estuary has limited its carrying capacity for striped bass (and other species) by limiting the dispersal of young and reducing their food supply (Cannon and Goyert, 1980). This may have merit due to the volume of freshwater diverted annually before it reaches San Francisco Bay Estuary. Studies of estuaries in the Soviet Union have shown that annnual reductions in freshwater inflow to estuaries by more than 25 percent of the historical inflow cause significant biological changes (Rozenguft and Haydock, 1980); freshwater inflow to the San Francisco Bay Estuary has already been reduced by approximately 50 percent (Hergessel et al, 1980). Further reductions may eliminate some species of fish from the Estuary. The cause of the decline of fishery resources should be determined soon if these resources are to be restored or, at the very least, maintained at present reduced population levels.

Present plans (Senate Bill 200) call for restoration and maintenance of "adult populations of fish and wildlife" at recent historical levels. These

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plans call for a facility (Peripheral Canal) that is designed to reduce entrainment of fish eggs, larvae, and juveniles, while allowing for significant increases in export pumping (California State Legislature, 1979). This planned facility is the result of the long-standing assumption that entrainment is the primary source of losses of fishery productivity. If, in fact, water exports are the primary source (or a significant source) of these losses, then the operation of facilities planned in Sentate Bill 200 would not restore fishery resources unless they export water at no greater than present levels; such operation could benefit fishery resources, but would void the primary purpose of the facilities (i.e., increased water export).

Regardless of whether entrainment or export of water is the more significant source of fishery losses, the operations of the Delta and Tracy Pumping Plants are a major cause of the losses. The magnitude of losses at each plant probably is proportional to the volume of water pumped by each annually (U.S. Department of the Interior, 1980). Discontinuation of operation by either plant would not result in complete recovery of fishery resources, but any reduction in operation by either or both plants would result in some mitigation of present adverse impacts. Similarly, increased annual pumping by either or both plants would result in further fishery declines (FEIS page 127).

The CDWR has applied for an after-the-fact permit from the U.S. Army Corps of Engineers (under Section 10 of the Rivers and Harbors Act of 1899) for the continued operation of the Delta Pumping Plant. This operation includes existing annual exports of approximately 3.0 million acre-feet with plans to expand the operation to deliver 4.23 million acre-feet (CDWR, 1978). Present adverse impacts have not been mitigated or compensated and impacts of increased future operations have not been assessed in order to propose mitigation or compensation. With the exception of losses of spawning and rearing habitat behind dams, there is little doubt that the present operations of the Delta and Tracy Pumping Plants have had the greatest adverse impact on the fishery resources in California of any existing projects, and their continued operation poses the greatest threat to the remaining resources.

Needs for Mitigation of Pumping Plant Impacts and Compensation for Project-Occasioned Losses:

It is the NMFS policy to recommend that projects requiring Corps permits be operated in a manner to minimize adverse impacts to marine, estuarine, and anadromous fishery resources. Where impacts cannot be eliminated by such mitigation, the NMFS recommends that losses be compensated by replacement of habitat values lost or destroyed. The NMFS generally believes it preferable to replace losses primarily through restoration or enhancement of habitat and only secondarily through artificial propagation (i.e., hatchery production).

The Delta Pumping Plant is responsible for diverting significant numbers of fish from the Delta (FEIS pg. 59). Annual losses of striped bass are estimated at between 40 and 80 million (Chadwick et al, 1977). These losses represent roughly 36 percent of all young striped bass, in the estuary (Chadwick et al, 1977). If this loss is translated into losses of adults (resulting from a single year class) then the loss of catchable adult striped bass, resulting from direct entrainment losses, could exceed 1.6 million fish

annually (CDF&G personal communication). Using recent CDF&G data for the average weight from the sport fishery and 1981 ex-vessel prices from 1981 east coast commercial fishery, these fish (if harvested) could be valued conservatively in excess of $25.6 million annually.

Similarly, losses of salmon resulting from pumping plant entrainment are significant. It is estimated that virtually all juvenile salmon in the San Joaquin River system are drawn into the state and federal pumping facilities in some years (Martin Kjelson, personal communication). Between 1968 and 1979, an annual average of 194,000 young salmon were salvaged on screens at the state and federal pumps (Kjelson, et al, 1980). In addition, as many as 68,000 juvenile salmon were lost through the screens (louvers) and could not be salvaged. This annual average of 262,000 salmon (194,000 + 68,000) may represent only 4 percent of those salmon that are entrained annually at Clifton Court, because 96 percent of the salmon that enter the forebay may be lost to predation before they can be salvaged (Hall, 1980). Thus, approximately 6.5 million salmon could be affected directly by the pumping facilities each year. Of these (based on the above data and salvage mortality figures) 98.8 percent could be killed.

If these 6.5 million salmon were not directly affected by pumping plant entrainment, approximately 5 percent might be expected to survive and return as adults. These 325,000 adult salmon could weigh an average of 10 pounds (1980 San Francisco chinook troll landing average). Assuming the September 1980 San Francisco ex-vessel price of medium chinook of $2.50 per pound, the value of these salmon to the sport and commercial fisheries would exceed $8 million annually. The "present value" (over 20 years) of direct losses of striped bass and salmon could then be estimated to be approximately $460 million. These figures, of course, do not reflect the impacts to other species of value (e.g., steelhead, sturgeon, and shad).

The losses discussed above are those associated only with direct entrainment into the pumping facilities. These direct losses of fish caused by entrainment of individuals do not nearly account for the declines observed in fish populations utilizing the estuary. These declines are very likely the indirect result of export of fresh water from the estuary. The exporting of water reduces Delta outflow, which has been shown to control the primary productivity (Arthur and Ball, 1980) and water quality (Conomos, 1979) in the San Francisco Bay Estuary. Delta outflow also determines the distribution of striped bass (FEIS page 59) and juvenile salmon (Kjelson, personal communication). When Delta outflow is high, juvenile striped bass and salmon are more widely distributed and plankton productivity is greater. In short, reductions in Delta outflow reduce the carrying capacity of the estuary and result in lower populations of fishes (CDF&G, 1976; Cannon and Goyert, 1980; and Thomas Cannon, personal communication).

In addition, evidence shows that even short-term (within-month) fluctuations in Delta outflow may impact fishery production significantly (Arthur and Ball, 1980; Cannon and Goyert, 1980). These within-month fluctuations may, in part, explain some of the unexpected declines in striped bass observed since the 1976-1977 drought. These declines were not predicted from the relationship developed by the CDF&G between mean monthly outflows and

resultant striped bass indices (Cannon, MS. in preparation).

Clearly, there is evidence that operation of the Delta Pumping Plant has had adverse impacts on fishery resources by directly entraining and killing fish and by reducing the productivity of the San Francisco Bay Estuary. The impacts of entrainment may be quantifiable at present, the impacts of water export are not, but probably are more significant than entrainment losses (Cannon and Goyert; 1980, Thomas Cannon, personal communication).

Quantification of the impacts of water exporting is underway. The CDF&G is conducting studies to determine the freshwater flow needs of San Francisco Bay Estuary (Hargessal et al, 1980). Studies sponsored by the Pacific Gas and Electric Company may provide additional quantification, when they are completed (see letter from NMFS to the Pacific Gas and Electric Company, enclosed). In addition, the CDF&G is conducting an extensive data review to determine the exact cause of recent sharp declines in striped bass recruitment. A report is expected to be available in March 1981 (Chadwick, personal communication). However, the CDF&G has stated that "it is physically impossible to offset project effects fully with the present system unless total exports were drastically reduced" (Chadwick, 1980). Until the results of these studies or others prove otherwise, it seems imperative that exports be limited to levels that resulted in strong subsequent year-classes of fishes (roughly equivalent to 1980 entitlement deliveries).

Losses of fishes attributed to entrainment could be mitigated by improved screening. The CDWR is modifying the existing John F. Skinner Fish Protective Facility at the Delta Pumping Plant, but the modifications may not result in significant protection from entrainment. The CDWR and CDF&G believe that the intakes of the state and federal pumping plants must be moved out of the Delta (by means of a Peripheral Canal) in order to reduce entrainment of anadromous fish significantly. However, the canal is not under construction, and may not be constructed for many years. Further, intakes for the canal will have to provide safeguards to prevent entrance or loss of eggs and young fish. If safeguards for existing projects and operations are not identified and implemented, remaining fishery resources may not be capable of withstanding many more years of export-related declines.

A viable solution to this problem (in part) is for screens to be placed on unscreened agricultural intakes in the Delta. This would reduce entrainment losses of juvenile fish for an annual export volume of water equivalent to that presently pumped at the Delta Pumping Plant (Dan Odenweller, personal communication). Such permanent screening would provide a long-term benefit, because the screens would reduce fishery losses with or without a Peripheral Canal. At the request of the CDWR, the CDF&G has prepared a report on unscreened diversions in the Delta and their impact on the fishery (FEIS page 77). This report is not available yet, but its results should be used to establish specific screening requirements on unscreened agricultural diversions (Dan Odenweller, personal communication).

Limitation of pumping to present or reduced levels, even with screens on Delta agricultural diversions, will not result in complete mitigation of adverse impacts. It is likely that remaining losses of striped bass and salmon

will have to be compensated by hatchery production. The quantification of such hatchery needs should be made following a monitoring of the response of fish populations to pumping limitations and screening of agricultural diversions.

The Delta Pumping Plant is only one of a large number of related projects that affect or will affect the quantity and scheduling of fresh water flowing through the Delta and into the San Francisco Bay Estuary. Other projects such as the Peripheral Canal, the Los Vaqueros Reservoir, the San Luis Drain, and the Sacramento Deepwater Ship Channel will alter conditions and, therefore, the impacts of the Delta Pumping Plant. It is important that the Corps retain jurisdiction over any permit for continued operation of the Delta Pumping Plant.

Summary

The NMFS objects to issuance of a Corps permit for the continued operation of the Delta Pumping Plant, unless the applicant modifies the application to include the following conditions as part of the permit:

1. The volume of water to be pumped annually will be limited to 1980 entitlement water and pumping will be scheduled to minimize impacts to fishery resources. The Corps agrees to retain jurisdiction over the operation of the plant until ongoing studies are completed including:

(a) freshwater flow needs for San Francisco Bay (four-agency committee);

(b) flow requirements for salmon (four-agency committee);

(c) flow requirements for resident fishes (four-agency committee);

(d) causes of striped bass declines (CDF&G); and

(e) studies of Pittsburg eight and nine (see enclosed NMFS letter to Pacific Gas and Electric).

Following completion and subsequent evaluation by NMFS, the U.S. Fish and Wildlife Service (USFWS) and the CDF&G, increased or decreased annual pumping may be recommended to meet Bay-Delta requirements.

2. The CDWR will provide installation and maintenance of fish screens (acceptable to NMFS, USFWS and CDF&G) on Delta agricultural diversions diverting a volume of water at least equivalent to that pumped by the Delta Pumping Plant. Any expansion of pumping by the Delta Pumping Plant would require additional screening.

3. If, after five years of monitoring the impacts of conditions one and two, losses have not been mitigated, the CDWR will provide fish hatcheries or other habitat improvement measures to replace losses of fishes.

4. In the event a Peripheral Canal or other facilities are built that demonstrably lessen the impacts of the Delta Pumping Plant, one of the parties may request that conditions be reassessed and changed accordingly.

These conditions represent the mitigation measures that the NMFS considers necessary to allow the Corps to issue a permit for the continued operation of the Delta Pumping Plant. If you wish to contact this Agency further on this matter, please direct comments to Thomas Yocom, National Marine Fisheries Service, 3150 Paradise Drive, Tiburon, CA 94920, telephone (415) 556-0565.

Sincerely yours,

Floyd S. Anders, Jr.
Acting Regional Director

Enclosures

1B

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LETTER 2

United States Department of the Interior
~~WATER AND POWER RESOURCES SERVICE~~
BUREAU OF RECLAMATION
MID-PACIFIC REGIONAL OFFICE
2800 COTTAGE WAY
SACRAMENTO, CALIFORNIA 95825

IN REPLY REFER TO MP-150

FEB 23 1983

Mr. Robert G. Potter, Chief
Central District
Department of Water Resources
P. O. Box 160088
Sacramento, CA 95816

Dear Mr. Potter:

Thank you for the opportunity to comment on the draft EIR for the proposed additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Problems noted were as follows:

1 Page S-4, Table S-1 and related explanation: There is some question as to what studies were utilized for the yield increase determination. Should the new criteria of the proposed draft Coordinated Operating Agreement be used?

2 Page S-9, Mitigation: Enforced conservation programs should be described in more detail. Also, how such programs mitigate additional pumping should be explained.

3 Page 1, Introduction: The Delta Cross Channel should be referred to as a Bureau facility.

4 Do the yield figures reflect related aspects of the draft Coordinated Operating Agreement negotiations?

5 Page 2, paragraph 4: Releases from San Luis Reservoir are normally made during late spring and summer months, not summer and fall months.

6 Page 57, Table 10: Keeping the May, June, and July exports below maximum will increase the pumpback amount at San Luis Reservoir. In examining the monthly exports related, this could be 100,000 acre-feet per year.

7 Page 58, Table 11: Outflow values for the month of June for the below normal, dry and critical years do not appear to match D-1485 requirements.

8 Page 67, Impact on Cross-Delta Flows: Operationally, the cross channel gates are closed when Sacramento River flows exceed 30,000 ft^3/s.

2

9 Page 72, Table 15: Tests during 1978 by DWR and Bureau personnel indicated essentially no difference in cross channel and Georgiana Slough flows as a result of export rate changes.

10 Page 74, Second Operational Constraint: The closure of the cross channel gates during April 16 through May 31 is only required for up to 20 days of closure.

11 Page 82, No action Alternative: Under the new draft Coordinated Operating Agreement assumptions, CVP exports are essentially maximum at 1980 levels. Water not delivered to San Felipe was assumed to be delivered as an interim supply elsewhere.

12 Page 82, last paragraph: The increase in hyacinths expected to be caused by the proposed action will aggravate the Bureau's removal operations more than the one percent increase stated in the subject document. This problem should receive more analysis and emphasis.

The probability and effects of increased pumping head resulting from lower water levels at the Tracy pumping plant must be more clearly determined and analyzed. Appropriate mitigation must be provided for any loss of pumping capacity at the Tracy plant because of the proposed action.

Sincerely yours,

Neil W. Schild

NEIL W. SCHILD
ACTING REGIONAL DIRECTOR

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LETTER 3

United States Department of the Interior

FISH AND WILDLIFE SERVICE
DIVISION OF ECOLOGICAL SERVICES
2800 Cottage Way, Room E-2727
Sacramento, California 95825

FEB 11 1983

Mr. Robert G. Potter, Chief
Central District
California Department of Water Resources
P.O. Box 160088
Sacramento, California 95816

Dear Mr. Potter:

This provides our review comments on the Draft Environmental Impact Report (DEIR) entitled "Proposed Additional Pumping Units, Harvey O. Banks Delta, Pumping Plant," dated November 1982. Following are general and specific comments for your consideration.

General Comments

1 The U.S. Fish and Wildlife Service (Service) does not believe that additional export of water from the Sacramento-San Joaquin Delta can do anything but contribute to the further declines of fish and wildlife resources in California. Previous adverse impacts of water development have not been corrected and fish and wildlife resources are still declining. Evidence collected to date indicates that some of the damage is attributable to the pumping plant's direct impact and many direct and indirect impacts of the State Water Project, as well as the Bureau of Reclamation's Central Valley Project. The impact of additional pumping capacity without a description of the Delta transfer facility cannot be evaluated. A more comprehensive package in this sense is definitely needed to assess the potential impacts of additional pumps at Banks.

Specific Comments

2 1. Pages S-3, S-7, 25: The preferred alternative is designated as 4-7.3, which represents four new pumps and an export capability of 7,300 cubic feet per second (cfs). Alternative 2-7.3 represents two new pumps and still maintains the same pumping capacity. The benefit-cost ratio for the two alternatives is 1.63 and 1.69, respectively; a higher benefit for the two-pump unit. In addition, fish losses resulting from pumping are greater with the four-unit proposal. As the main proposed objective is the pumping of 7,300 cfs, and that objective can be attained with two pumps, we suggest that the two-pump alternative is appropriate if more export is determined to be necessary.

3

3 2. Pages S-1, 22: Additional water diversion will occur when the San Joaquin River flow exceeds 1,000 cfs at Vernalis from December 15 through March 15. Salmon in the San Joaquin system are already under major stress as a result of limited flows and export pumping. Any further diversions through pumping will adversely impact these runs. We believe the DEIR does not convey the serious impact of project pumping upon the San Joaquin River salmon stocks. Increased pumping during the early spring can only diminish these stocks further.

4 3. A draft coordinated operations agreement between Department of Water Resources (DWR) and U.S. Bureau of Reclamation (USBR) has been negotiated recently to govern the operations of the State Water Project (SWP) and Central Valley Project (CVP). We suggest that the agreement be noted in the DEIR relative to the proposed additional pumps. Will the agreement require a separate EIR or EIS? The CVP could increase exports with the SWP's additional pumping capacity if coordinated with the State.

5 4. Pages 4, 20, 22, and 81: Off-peak hours are being proposed for pumping, as it minimizes energy costs during low electrical demand periods. Evidence exists that off-peak or nighttime pumping will contribute to additional losses of downstream migrant salmon. A 1974 report by the California Department of Fish and Game (CDF&G) entitled "A Study of the 1970 Fingerling King Salmon Emigration in the Merced River at George Hatfield State Park" compared day and night movement of fingerling by trapping. The study concluded that 88% of the fingerlings were captured at night. This evidence indicates that salmon have a preference for movement at night. This preference should be discussed in the DEIR as it relates to potential increased fishery losses during off-peak pumping periods.

6 5. Auburn Dam: The proposed pumping at Banks assumes that water is available from Auburn Dam; however, there is a question whether Auburn will be constructed by the time pumping is planned to begin. What will occur if no Auburn water is available? A discussion of this condition should be included in the final statement.

7 6. Pages 22 and 27: Mitigation is proposed for both salmon and striped bass, but not for losses of American shad, steelhead, forage fish, and white catfish. As more water will be exported from this system, including greater numbers of the latter species, it seems appropriate that some mention should be made as to the feasibility and necessity of mitigating for these losses. These species are very significant to the Delta and river systems and should not be overlooked. A habitat improvement program for these species would be desirable.

8 7. Pages 37 and 38 - Suisun Marsh: This discussion indicates that the DWR has recently completed facilities to protect the more vulnerable area in the Marsh and that these initial facilities are a part of an overall plan that is scheduled for completion in 1984. However, we understand that the completed facilities will help only some of the more vulnerable areas, not all areas as implied. The statement should reflect this fact. In addition, we further understand that the overall plan scheduled for completion in 1984 may not be accomplished as scheduled. In this event it would be highly undesirable to export additional water through the Banks pumping facility before the permanent facilities are completed and operating. This condition should be discussed in the DEIS.

3

9 8. Pages S-5 and 57: Tables combining the SWP and CVP exports and Delta outflows are confusing. It is difficult to identify impacts of each project in relation to the proposed pumping. We recommend that a separate table be developed for each project.

10 9. Two-Agency Agreement: The two-agency agreement is mentioned in several parts of the DEIR; however, the agreement hasn't been signed as yet. The agreement will provide some of the action necessary to lessen the impacts of additional pumping on fish and wildlife resources. If the agreement is not signed, does that mean there will be no pumping?

11 10. Page 68: The discussion on salmon and steelhead should be expanded to address flows and temperatures in relation to salmon survival during smolt migration (see discussion in two-agency agreement and appropriate Department of Fish and Game and U.S. Fish and Wildlife references).

12 11. Pages 68 and 78: Evidence gathered in recent years by the CDF&G, Schaffter and later Hall, documented low survival of tagged juvenile fish when released into Clifton Court Forebay. Losses were attributable to predation and approached 95%. These losses are not noted in the DEIR and should be discussed relative to the additional pumps.

13 12. Page 72: Table 16 should be expanded to convey all the alternatives and their incremental impact on salmon.

14 13. Page 73: The DEIS does not provide an up-to-date description of the present understanding of the factors causing the striped bass decline. The striped bass task force report does this and offers potential studies and experiments directly related to documenting further the impact of the SWP upon striped bass. This information should be provided in the DEIR.

15 14. Pages 73 and 74: The striped bass index is referenced in several sections of the DEIR. Weighted Average in Table 18 is indicated as 79 for the proposed alternative. It should be noted that the striped bass index concerning the relationship between young bass abundance, flows, and diversions has not held since 1976. In 1982, an extremely wet year, the measured index was 50, whereas it should have been 97 if the relationship still held. We suggest that the striped bass task force report be used to update this section.

16 15. Page 78: Impacts on fish salvage operations are discussed. Additional formal evidence is available to convey the losses of salmon due to handling and hauling based on a CDFG tagging study by Robert Menchen. An average of over 50% loss was attributed to these factors. This information should be noted.

17 16. Pesticide Evaluation: It is expected that pesticide use will increase with the expansion of irrigated lands in the new service areas. We recommend that a discussion of pesticide use and impacts on fish and wildlife be included in the DEIR as it relates to potential toxic buildup in the Delta and in the new service area irrigation and drainage canals.

3

18 17. Pages 86 and 87: Impacts found to be insignificant are discussed in the section on Summary of Operational Impacts Under the Proposed Alternative. We question the analysis and interpretation, as many of the listed incremental environmental impacts are of definite concern to us. As an example, all impacts on the fish species listed, Delta outflow, San Francisco Bay, etc., are significant. We suggest the statement be reworded to convey a more accurate picture of the impacts.

Thank you for the opportunity to comment on the DEIR. If we can be of any additional assistance, please let us know.

Sincerely yours,

for James J. McKevitt
Field Supervisor

cc: Reg. Dir. (AE), FWS, Portland, OR
Dir., CDF&G, Sacramento, CA
NMFS, Tiburon, CA
Fish. Asst. Ofc., FWS, Sacramento, CA
Fish. Asst. Ofc., FWS, Stockton, CA
Felix Smith, FWS, Sacramento, CA

C-105497

LETTER 4

State of California
GOVERNOR'S OFFICE
OFFICE OF PLANNING AND RESEARCH
1400 TENTH STREET
SACRAMENTO 95814
(916/445-0613)

George Deukmejian
GOVERNOR

January 14, 1983

Mr. Wayne MacRostie
Department of Water Resources
3251 'S' Street
Sacramento CA 95816

SUBJECT: SCH# 82113008 BANKS DELTA PUMPING PLANT, PROPOSED ADDITIONAL PUMPING UNITS

Dear Mr. MacRostie,

State agencies have commented on your draft environmental impact report (EIR). If you would like to discuss their recommendations and concerns, contact the staff noted in the comments. The following is in summary:

FISH AND GAME

1 The department agrees with the draft EIR's conclusion that the preferred alternative describes adequate mitigation measures for fish and wildlife in the Delta. However, the department concludes that the draft EIR needs to be revised in certain areas including: the operations studies to evaluate project impacts do not represent an accurate enough description of project operations; and discussion of project impacts on the fish and wildlife resources of San Francisco Bay and the San Joaquin River system must be more fully addressed.

PARKS AND RECREATION

2 The Office of Historic Preservation is requesting a copy of the cultural resources assessment report prepared for the proposed project for incorporation into their review process.

State Clearinghouse

3 When preparing the final EIR, you must include all comments and responses (CEQA Guidelines, Section 15146). The certified EIR must be considered in the decision-making process for the project. In addition, we urge you to respond directly to the agencies' comments by writing to them, including the State Clearinghouse member on all correspondence.

4 A 1981 Appellate Court decision in Cleary v. County of Stanislaus (118 Cal.App.3d 348) clarified requirements for responding to review comments. Specifically, the court indicated that comments must be addressed in detail, giving reasons why the specific comments and suggestions were not accepted. The responses should indicate any factors of overriding significance which required the suggestions or comments to be rejected. Responses to comments must

4

Mr. Wayne MacRostie 2 January 14, 1983

not be conclusory statements but must be supported by empirical or experimental data, scientific authority or explanatory information. The court further said that the responses must be a good faith, reasoned analysis.

5 Section 15002 (f) of the CEQA Guidelines requires that a governmental agency take certain actions if an EIR shows substantial adverse environmental impacts could result from a project. These actions include changing the project, imposing conditions on the project, adopting plans or ordinances to avoid the problem, selecting an alternative to the project, or disapproving the project. In the event that the project is approved without adequate mitigation of significant effects, the lead agency must make written findings for each significant effect (Section 15088) and it must support its actions with a written statement of overriding considerations for each unmitigated significant effect (Section 15089).

6 If the project requires discretionary approval from any state agency, the Notice of Determination must be filed with the Secretary for Resources, as well as with the County Clerk.

Please contact Anna Polvos at (916) 445-0613 if you have any questions.

Sincerely,

Charles K. Brandes
Deputy Director
Projects Coordination

Anna Polvos
State Clearinghouse

CKB/ap
attachments

cc: Resources Agency

State of California **4A** The Resources Agency

Memorandum

To : Projects Coordinator
Resources Agency

Date : February 15, 1983

From : Department of Fish and Game

Subject: Draft Environmental Impact Report - Proposed Additional Pumping Units, Harvey O. Banks Delta Pumping Plant, SCH 8211 3008

The Department of Fish and Game (DFG) does not oppose the installation of the additional four pumps. However, we believe that appropriate measures to offset project impacts to fish and wildlife need to be agreed upon by our two agencies. In addition, certain technical improvements are needed in the Draft Environmental Impact Report (DEIR).

1. The operation studies used to evaluate project impacts need to be updated. Significant improvements to both the State Water Project-Central Valley Project (SWP-CVP) system model and Delta routing models have been made since the studies used in the DEIR were generated. Items that we are aware of that could affect fish and wildlife resource analysis include:

   a. The condition that a barrier be placed at the head of Old River in October and November to improve conditions in the San Joaquin River for adult chinook salmon migrating into and out of the San Joaquin River.

   b. Central District DWR modeling work that indicates a different relationship for outflow vs. water quality than previously thought proper. **1**

   c. Conditions placed on the SWP and CVP by operation under the terms of the recently negotiated Coordinated Operations Agreement between DWR and the U. S. Bureau of Reclamation (USBR).

   d. Differences in project operation due to changes in energy policy, including the expiration of the power contract at Oroville Reservoir in 1983.

   e. The likely situation that Auburn Reservoir will not be built, and the certainty that it would not be operational by 1990.

4A

Projects Coordinator -2- February 15, 1983

   f. The likely situation that CVP user deficiencies are assumed to be too great.

   g. Substantial model improvement of the system-wide model (HEC-3), including expansion of the data base from 50 to 57 years, including the 1976-77 drought years.

2. The report states on pages S-8, 86, and C-8 that the project will result in urban and agricultural expansion but makes no effort to quantify this expansion or its impacts upon wildlife resources. An assessment of adverse impacts occurring in these areas should be completed, and specific mitigation measures defined. These measures should emphasize the protection of endangered species habitat, riparian vegetation, and wetlands. **2**

3. Project impacts on fish and wildlife resources of San Francisco Bay are discussed as being insignificant (page 87 of DEIR); however, it is recognized on page 83 that impacts are presently unknown. Not being able to identify impacts does not make them insignificant. **3**

4. It should be recognized that an agreement is required to provide compensation for on-going SWP impacts on fish and wildlife resources in the Delta and would form the basis for a mitigation proposal for the project proposed in this DEIR. **4**

Our review of the DEIR revealed deficiencies as follows, as noted by page:

Page S-2, second item under new concepts not included in D-1485. This item should recognize that stocking of salmon would continue at a slightly decreased level when DWR increases exports within the Corps of Engineers' criteria. **5**

Page S-5, Table S-2. This table presents seasonal and annual changes in SWP and CVP Delta exports and outflows. The DEIR is supposed to be analyzing changes in the SWP operations. The CVP diversions should be excluded or analyzed separately so a clear picture can be obtained on how much the SWP is actually going to increase diversions on a seasonal and annual basis. **6**

7 Page S-6, Table S-3. The first alternatives should be titled "Mandatory Nonresidential..." (see Table C-6, page C-11).

Page 20. It would appear that the addition of the four pumps would provide an opportunity to increase deliveries of CVP water per current agreements with the USBR. The environmental consequences of this potential have not been examined. **8**

C—105498

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9 Page 31, Chapter 4. This chapter purports to describe the environmental setting of areas related to the operation of the SWP, including the Sacramento and San Joaquin Valleys. The Sacramento Valley is not described and the description of the San Joaquin Valley is incomplete regarding fish and wildlife resources. These areas contain most of the spawning and nursery habitat for the Central Valley's salmon and steelhead populations.

10 Page 37, section on Delta Region. Reference should be made to the DEIR on the Proposed Agreement to Manage the Fish and Wildlife Resources of the Sacramento-San Joaquin Estuary (September, 1982) for a detailed description of Delta fish and wildlife.

11 Page 37, top paragraph, right column. There are numerous resident warmwater fish found in the Delta.

12 Page 38, third paragraph, left column. Recent acquisitions have increased land owned and managed by DFG to 13,024 acres.

13 Page 38, last paragraph, left column. DWR has notified the State Water Resources Control Board that the Suisun Marsh facilities will not be completed in 1984. The EIR should also recognize DWR's negotiating position that critical year relaxations are needed for Suisun Marsh standards.

14 Page 57, bottom paragraph, left column. Stable water levels during warmwater fish spawning periods are preferable to increasing water levels. Increasing levels can result in lower water temperatures at nests and nest abandonment.

15 Page 57, second paragraph, right column. It would appear that if salmon and steelhead nursery areas would be reduced by modified CVP and SWP operations, then there would most likely also be a reduction in outflows which have been shown to be extremely important for the survival of downstream migrant salmon in the San Joaquin River system. This impact needs to be examined.

16 Page 57, Table 10. Again, CVP and SWP exports are combined and one cannot make an analysis of changes associated with the addition of the four pumps at the SWP.

17 Page 68, top paragraph, right column. Impacts on salmon in the San Joaquin system need to be critically reevaluated to determine whether the historical relationship between survival in the San Joaquin River and in the Delta will continue at the higher exports considered in this EIR.

4A

18 Page 68, right column, third paragraph. Adequate water temperatures and a net downstream flow of homestream water are also important to juvenile downstream migrant salmon.

19 Page 69, Figure 9. The fall-run salmon figure should show some downstream migration during the October through December period for yearling fish, which are an extremely important element of the Merced River population.

20 Page 73, section on General Impacts on Striped Bass. This section does not describe recent work by the Striped Bass Working Group nor does it reflect the uncertainty associated with using the outflow-diversion relationships that have not accurately predicted the Striped Bass Index since 1976. The report should state that bass abundance has not followed these relationships since 1976 for some unknown reason. Thus the striped bass population levels reported will not occur unless the reason for the post-1976 decline is found and corrected. If the decline is due to SWP/CVP operations, the actual impacts of these projects could be quite different than those described, with impacts being greatest for the 4-8.5 and 4-10.3 alternatives. If the recent decline is not due to project operations, the relative impacts of installing additional pumps may well be assessed correctly.

21 Pages 76 and 77, the sections relating to Resident Fish. The discussion of project impacts upon resident fish are inadequate. These species, especially black bass and white catfish, support a substantial sport fishery. These sections should be expanded by reference to the catfish tagging study, fish screening results, distribution and population data, and other existing information. Finally, it appears that no effort has been made to quantify the incremental increase in winter losses of these species due to the project.

22 Page 78, section on Impacts of Fish Salvage Operations. Estimated annual salvage and loss numbers contained in Table 19 and discussed in the text allows comparisons between alternatives, but is not conducive to discussion of absolute losses. This is due to the fact that (1) Clifton Court Forebay losses are not part of the calculations, (2) handling and hauling losses are not part of the calculations, and (3) losses of fish too small to be screened are not included in the calculations. These losses should be computed if statements concerning absolute losses are to be made.

23 Pages 80 and 81. Although the annual overall loss of salmon due to the pumps is decreased, an increase of about 772 fish are lost during December, January, and February. A proportion of these fish are winter and spring-run fish, depleted resources. The adverse impact upon these resources should be determined and appropriate mitigation measures defined in the DEIR.

4A

24 Page 87, section on Mitigation Measures. Mitigation for chinook salmon provided in the Proposed Agreement to Manage the Fish and Wildlife Resources of the Estuary should be expressed as 100 yearling salmon per 1,000 acre-feet of export for the No-Action alternative, and 99 yearling salmon per 1,000 acre-feet of export for the Proposed alternative.

25 Page 90. Statements concerning a Delta Transfer Facility are not candid enough. Such a facility has been considered an essential part of the SWP for so long that it is inconceivable that it will not be pursued vigorously and be designed to meet full contractual commitments. Activities in the water industry and legislature since the defeat of Proposition 9 substantiate that expectation. The cumulative impact of this project and a Delta facility will obviously be significant.

26 Page 93, Table 21. Potential cumulative impacts on wildlife should be included.

We recommend that the DEIR be changed and re-issued to address our concerns.

My staff is available to discuss our concerns with the project sponsor. Contact H. K. Chadwick, Program Manager, Bay-Delta Fishery Project, 4001 N. Wilson, Stockton, California 95205; telephone (ATSS) 423-7800, if consultation is desired.

EC Fullerton
Director

4B

State of California — The Resources Agency of California

Memorandum

Date : 12-22-82

To : (1) Mr. James Burns
Project Coordinator
Resources Agency

In reply, refer to: COM 821208A

From : Department of Parks and Recreation

Subject: SCH# 82113006 Additional Pumping Units, Banks Delta Pumping

The Office of Historic Preservation cannot complete its review of the environmental document referenced above without additional information. A copy of the cultural resources assessment report prepared for the proposed project should be submitted to this office for incorporation into our review process.

If you have any questions concerning this review, please contact Michael Rondeau, Staff Archeologist, at the Office of Historic Preservation by calling (916) 445-6766.

Knox Mellon
Dr. Knox Mellon
State Historic Preservation Officer

RECEIVED
JAN 11 1983
State Clearinghouse

LETTER 5

State of California
GOVERNOR'S OFFICE
OFFICE OF PLANNING AND RESEARCH
1400 TENTH STREET
SACRAMENTO 95814

January 19, 1983

Mr. Wayne MacRostie
Department of Water Resources
3251 'S' Street
Sacramento, CA 95816

SUBJECT: SCH# 82113008 Banks Delta Pumping Plant, Proposed Additional Pumping Units

Dear Mr. MacRostie:

The enclosed comments on your draft environmental documents were received by the State Clearinghouse after the end of the state review period. We are forwarding these comments to you because they provide information or raise issues which you should address in the final environmental documents.

1 We have explained to the departments preparing late comments that according to a recent Appellate Court decision, Cleary v. County of Stanislaus, you need not respond to these comments in the final document. However, to ensure the adequacy of the final document and compliance with the intent of CEQA, you should attempt to incorporate these additional comments into the preparation of your final environmental document.

Sincerely,

Anne Poloso
Charles E. Brandas
Deputy Director for Projects Coordination

enclosures

cc: Ken Fellows, DWR
RWQCB-San Francisco

5A

STATE OF CALIFORNIA—RESOURCES AGENCY GEORGE DEUKMEJIAN, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION
1111 JACKSON STREET, ROOM 6040
OAKLAND 94607

Phone: Area Code 415 464-1360

January 13, 1982

File No. 2118.04(MJA)tmh
2198.09

Mr. James W. Burns
Projects Coordinator
Resources Agency
1416 9th Street, 13th Floor
Sacramento, CA 95814

Dear Mr. Burns:

Subject: Draft EIR on the Proposed Additional Pumping Units Banks Delta Pumping Plant (SCH #82113008)

We have reviewed the subject draft EIR and have the following comments.

1 The San Francisco Bay Regional Water Quality Control Board is concerned about the impacts of water developments on the estuarine environment of San Francisco Bay as stated at the January 19, 1982 hearing on the State Board's Water Availability Study. We are concerned that the acknowledged lack of information on Delta outflows needs for the health of the estuarine environment (pg. 84) will not be considered and compensated for during operational planning of the proposed pumping units. The final EIR should clearly provide information on how operation of the proposed pumping units and the State Water Project will be modified as new data on Delta outflow needs for San Francisco Bay and the Delta are provided from the Four-Agency Ecological Study Program and future Delta outflow-related studies including those presently being undertaken in San Francisco Bay.

Should you have any questions regarding this matter, please call Mike Ammann at (415) 464-1357.

Sincerely,

FRED H. DIERKER
Executive Officer

RECEIVED
JAN 17 1983
State Clearinghouse

LETTER 6

ADDRESS ALL COMMUNICATIONS TO THE COMMISSION
CALIFORNIA STATE BUILDING
SAN FRANCISCO, CALIFORNIA 94102
TELEPHONE (415) 557- 3398

Public Utilities Commission
STATE OF CALIFORNIA

FILE NO

January 21, 1983

Wayne MacRostie, Chief
Central District
Department of Water Resources
P. O. Box 160088
Sacramento, CA 95816

RE: Comments on SCH 82113008, DEIR, Proposed Additional Pumping Units, Harvey Banks Delta Pumping Plant

Dear Mr. MacRostie:

Here are the comments of the staff of the California Public Utilities Commission on your DEIR regarding the Harvey Banks Delta Pumping Plant. I regret the lateness of this response, but hope that our energy-related questions can be reviewed for the final EIR. Our staff comments are:

1 1. The CPUC staff believes that the purpose of load management identified on page 13 is a desirable goal. However, we are concerned whether, absent other necessary improvements, the proposed project will achieve this purpose.

2 2. For each of the proposed levels of modification to Clifton Court Forebay and to the San Luis Reservoir, the effects on the achievable load management should be identified. For example, what level of load management can be achieved if the operational criteria developed by the Corps of Engineers are followed without forebay modifications? What level of load management is made possible by the alternative Clifton Court Forebay modifications described on page 17? What level of load management is achievable without modification of San Luis Reservoir? What levels are made possible by anticipated changes in the reservoir?

---

6 -2-

3 3. When and to what extent are the necessary improvements at Clifton Court Forebay and at San Luis Reservoir to be made?

4 4. If these improvements are not made, what guarantees exist that the proposed installed increased pumping capacity will not be operated so as to increase peak loads on electric energy? We do recognize that there is a rate benefit for pumping off peak. However, a question remains as to whether the off-peak rate incentive is adequate to assure off-peak pumping if improvements are not made.

5 5. Has additional information been developed to describe the whole of the action necessary to achieve operation of the proposed project so as to effect the load management program described?

Thank you for this opportunity to comment.

Yours very truly,

JOSEPH E. BODOVITZ
Executive Director

cc: State Clearinghouse

State of California

LETTER 7

Memorandum

To : Mr. Robert G. Potter, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, CA 95816

Date : FEB 17 1983

From : STATE WATER RESOURCES CONTROL BOARD

Subject: COMMENTS ON THE NOVEMBER, 1982 DRAFT ENVIRONMENTAL IMPACT REPORT (DRAFT EIR) - PROPOSED ADDITIONAL PUMPING UNITS, HARVEY O. BANKS DELTA PUMPING PLANT (SCH. NO. 82113008)

We have reviewed the subject Draft EIR and have the following general comments. Our specific comments are attached.

Striped Bass

1 The State Board is fully aware that the Department must consider additional facilities to meet State Water Project (SWP) water supply commitments. Nonetheless, we are concerned with the prospect of increasing exports from the Delta at a time when the Bay-Delta striped bass fishery is continuing to decline at an alarming rate. Since 1976 observed levels of young striped bass in the estuary have been 38 to 77 percent below predicted levels based on traditional statistical relationships with Delta outflow and export rates. This decline has continued even though flow and export standards were established in the State Board's 1978 water right Decision 1485.

2 In an attempt to discover appropriate action to reverse this decline, the State Board appointed a Work Group of fishery experts in January 1982 to investigate the problem. After exhaustive review, the Striped Bass Work Group issued its final report in November 1982. The report concluded that there is probably no single cause for the decline but a combination of several factors. Export operations may be a factor contributing to the recent decline by reducing the young bass food supply in the spring and by entraining large numbers of young bass at the export pumps. Accordingly, new studies have been recommended by the Work Group to investigate more thoroughly the impact of export operations on young bass survival. These studies may form the basis for revised State Board export limitations in Decision 1485.

3 Until such studies are conducted, we cannot be certain that increasing exports will not cause significant additional harm to the striped bass fishery. The final EIR should include and evaluate information obtained from these new studies before any conclusion is reached as to whether striped bass can tolerate substantial increases in exports.

Memorandum of Understanding

4 It should be noted that without an executed Two-Agency Agreement there are no fishery-related constraints on the operation of the four additional pumps. In adopting the Decision 1485 standards the State Board did not contemplate an enlarged Delta Pumping Plant facility. Considering the current critical state of the striped bass fishery, it is possible that the State Board might

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Mr. Robert G. Potter -2- FEB 17 1983

modify export constraints when Decision 1485 is reopened to consider necessary revisions to the standards. Such constraints could considerably alter operation of the proposed enlarged pumping facility and affect the cost-benefit ratios presented in the Draft EIR. The July 1979 Memorandum of Understanding among the State Board, Department and Bureau sets forth procedures for coordination of water rights and environmental impact assessments for proposed federal water projects. The same principles should apply to State water projects. The Memorandum provides for obtaining appropriate State Board action on proposed facilities before the environmental assessments are finalized. Such early and close coordination with the State Board will provide the Department with the most realistic criteria for evaluating alternatives to the proposed pumping facilities, cost-benefit ratios and operational schemes.

Evaluation of Alternatives

5 The information presented in the Draft EIR does not appear to support the selection of a pumping alternative as the best means to increase yield and alleviate pumping operation and maintenance costs. This information indicates that conservation measures (i.e., toilet and shower head retrofit, residential and nonresidential landscaping) can achieve all of the water yield benefits proposed under the preferred pumping alternative at a substantial yearly energy and cost savings to State Water Project users. The Draft EIR is unclear as to whether these conservation measures are actual alternatives to the four pumps or part of the "no action" alternative. This ambiguity should be resolved in the final EIR. In addition, the Department's own benefit/cost analysis shows the comparable two pump option to be slightly superior to the selected four pump alternative. The Department's rationale for selecting the alternative with a lower cost/benefit ratio should be presented in the final EIR.

Delta Water Transfer Facility

6 The Board does not question the water supply value of having four additional pumps at the Delta pumping plant in conjunction with a future Delta water transfer facility. If such is the case, the Department's plans should be fully discussed in the final EIR.

7 The use of the four additional pumps as the first stage of a future Delta water transfer facility is of great concern to the State Board. In the Board's 1978 Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh, it established a program of implementation. As part of this program of implementation the State Board set forth (on pg. VII-18) the following policy guidance:

> "Based on existing conditions the Board has determined that fishery resources in the Bay-Delta estuary should be maintained at levels that at least approach those levels that would have existed had the CVP and SWP not been built. Higher levels of fishery resources are desirable, but cannot be attained in the public interest with current project facilities. However, any future Delta transfer facility or upstream project facilities should (emphasis added):

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Mr. Robert G. Potter -3- FEB 17 1983

> (1) ensure the maintenance of fishery resources in the estuary on the average at historical levels (1922-1967). (Conditions upstream of the estuary may limit the abundance of some species. This policy deals only with those factors in the Bay-Delta estuary that limit species abundance), and
>
> (2) include a fish screen system capable of salvaging 95 percent of the fish more than 1-1/4 inches long"

Pursuant to section 13146 of the water code, the Department must state in its final EIR how the four additional pumps comply with this policy or cite the Department's authority for not complying with this policy.

Suisun Marsh

8 The Draft EIR states that the Department has plans underway to protect the Marsh by meeting the State Board's Decision 1485 Marsh standards. The conclusion is reached that because of this, the proposed action to increase exports will not adversely affect the Marsh. Decision 1485 requires that the SWP and federal Central Valley Project (CVP) mitigate their impacts on the Marsh by meeting specific standards which become effective October 1984. Although the Department has submitted draft plans for accomplishing this, no final plan has been issued which commits the Department to a course of action to insure the 1984 Marsh standards will be met. In fact, the Department has advised the State Board that once a final plan is released, it will indicate that needed mitigation facilities will not be completed by October 1984. The State Board is concerned that the Department's final plan may not be completed in time to allow even a portion of the overall mitigation facilities to be started by October 1984. The final EIR should address this concern more thoroughly.

Thank you for the opportunity to comment on the Draft EIR. If you have any questions regarding the detailed comments attached, please contact Gerald E. Johns, Bay-Delta Program Manager, at 322-9870.

M A Campos

Clint Whitney for
Executive Director

Attachment

cc: State Clearinghouse (with attachment)
Office of Planning and Research
1400 Tenth Street
Sacramento, CA 95814

7

DETAILED COMMENTS ON THE NOVEMBER, 1982 DRAFT EIR - PROPOSED ADDITIONAL PUMPING UNITS, HARVEY O. BANKS DELTA PUMPING PLANT (SCH NO. 82113008)

9 1. Page S-6, Table S-3
It appears from the discussion on page 27 and Appendix C that "Mandatory Residential Landscape Design" should be relabelled "Mandatory Nonresidential Landscape Design".

10 2. Page 1, Left Column
The first paragraph indicates that addition of four new pumping units would raise total pumping capacity from 6,400 cfs to 10,300 cfs. However, on page 16 the new pumps are each rated at 1,067 cfs maximum pumping capacity. If this is correct the total pumping capacity would be raised to 10,668 cfs, not 10,300 cfs as described. This apparent inconsistency should be resolved in the final EIR.

11 3. Page 8, Right Column
The third paragraph states that the fish and wildlife standards in Decision 1485 will be incorporated into the proposed Two-Agency (DWR/Fish and Game) Agreement. According to the final EIR on the draft Two-Agency Agreement released December 1982, this is no longer correct with respect to the Suisun Marsh standards of Decision 1485. Therefore, the final EIR should address this fact.

12 4. Page 9, Left Column
The discussion mentions that there are only two differences between fish and wildlife protection measures in the proposed Two-Agency Agreement and Decision 1485. As pointed out in our recent comments on the draft EIR for the proposed Agreement, there are several other areas where Decision 1485 is more stringent than the proposed Two-Agency Agreement. Therefore, the final EIR should mention these other differences as well. The discussion should also state that the proposed agreement will not incorporate the 1984 Suisun Marsh standards in Decision 1485 (see Comment No. 3, above).

13 5. Page 19, Right Column
The first paragraph states that although water demand reduction alternatives could substitute for the water supply developed by the proposed additional pumps, they could not remove altogether the need for additional pumps. The reason cited is that not all of the project purposes identified for the additional pumps would be met. We are confused by this line of reason. The project purposes for the additional pumps are listed on page 13 as follows:

> "1. Alleviate scheduling problems for maintenance of the existing units.
>
> 2. Minimize the on-peak power requirements and energy costs of the State Water Project.
>
> 3. Increase the firm yield of the State Water Project."

7

The draft EIR states that the third purpose (including projected intermittent yield benefits) can be met by substituting 110,000 acre-feet equivalent yield (60,000 acre-feet firm plus 50,000 acre-feet intermittent) from the water demand reduction alternatives listed on Table S-3 (page S-6). The other two purposes are largely economic. According to Table S-3, the 110,000 acre-feet can be achieved by 1990 simply through mandatory nonresidential landscape design and showerhead and toilet dam retrofit at a cost of less than $100/acre-foot. This computes to an annual cost of about $11 million. However, according to Table 2 (page 25) the annual
13 costs for installing at least two more pumps to deliver that same amount of additional water will exceed $21 million. Therefore, it appears that use of water conservation measures in lieu or more pumps will yield an annual savings of at least $10 million ($21 million - $11 million). This is more than enough to compensate for the maximum power savings and energy generation benefits (estimated at about $3.25 million for the preferred alternative in Table 2) that would be foregone or any existing pump scheduling problems. Thus, the draft EIR does not support the selection of additional pumps as a preferred alternative. The final EIR should explain the Department's rationale for selecting a more costly alternative.

6. Page 20, Left Column
14 It is not clear how the Bureau's plans for delivering San Felipe water are relevant to additional pumps for the SWP. If SWP facilities are intended to be used for wheeling some of this water, the final EIR should acknowledge this fact.

7. Page 25, Table 2
Table 2 shows that a two pump (2-7.3) option has a higher benefit/cost ratio and provides greater net benefits than the selected four pump
15 (4-7.3) option. In fact, the higher annual capital recovery and maintenance costs associated with installing four pumps rather than two exceed the potential gain in on-peak power savings by $650,000 per year. The justification for selecting the four pump (4-7.3) option over the two pump (2-7.3) option is not clear.

8. Pages 26-27
In the discussion of municipal demand reduction alternatives, the estimated costs per acre-foot seem high, given the modest costs expected for purchasing and installing the fixtures mentioned and the expected substantial energy savings. Also, the supporting benefit/cost analysis in Appendix C (pages C-12 to C-13) indicate per household costs which seem high for the same reasons. The basis for these costs should be more fully detailed in the final EIR. In addition, since many of these measures would involve one-time rather than continuing investments, the
16 final EIR should explain why annual costs per acre-foot conserved should not decline with time.

It is also interesting to note that the mandatory nonresidential landscape design and shower and toilet dam retrofit options are expected to save a combined total of 346 million kilowatt-hours annually by 1990, whereas the two and four pump options discussed on page 22 will save only between 149 and 249 million kilowatt-hours. This provides another reason for seriously considering conservation measures in lieu of costly new pumps. (see comments No. 5 and 7 above).

7

9. Page 38, Left Column
The last paragraph discusses actions to protect Suisun Marsh. The discussion should be modified to explain State Board actions in Decision 1485 which require the Department of Water Resources and the U.S. Bureau of Reclamation to mitigate their impacts on the Marsh by meeting specific Marsh water quality standards by October, 1984. Although the Department has submitted draft plans for accomplishing this, no final plan has been issued which commits the Department to a course of action to insure the
17 1984 Marsh standards will be met. In fact, the Department has advised the State Board that once a final plan is released, it will indicate that needed mitigation facilities will not be completed by October 1984. The State Board is becoming increasingly concerned that the Department's final plan may not be completed in time to allow even a portion of the overall mitigation facilities to be started by October 1984. Until the Department's final plan for mitigating both SWP and CVP impacts on the Marsh is released and approved by the Board, the EIR should not conclude that increasing exports will not further impact the Marsh. The final EIR should address these concerns more thoroughly.

10. Page 55, Left Column
The first paragraph mentions that scouring can be minimized by diverting
18 on ebb tides as much as possible. The potential impact that this change in operation of Clifton Court Forebay will have on water levels in the Southern Delta should be throughly addressed in the final EIR.

19 11. Page 57, Right Column
It should be noted that Decision 1485 operational constraints apply in July as well as in May and June.

12. Page 57, Table 10
20 It appears that the value listed in Table 10 for September in a wet year under the 6300 cfs alternative should be 10,419 instead of 20,419.

13. Page 64, Left Column
21 In the first sentence of the third paragraph, insert "municipal and industrial" after "Decision 1485."

14. Page 66, Left Column
22 In the fourth paragraph, the discussion should provide information relative to the extent the proposed alternative will further aggravate the agricultural water supply problem in the southern Delta identified in Chapter 4.

23 15. Page 71, Left Column
In the second paragraph, the discussion should add that Decision 1485 export limits apply in July as well as in May and June.

16. Page 71, Right Column and Table 14
24 The discussion on the proposed alternative asserts that no significant impacts on juvenile salmon will occur. However no statistical basis for this conclusion is provided. The final EIR should address this issue more throughly.

7

17. Page 73, Right Column
25 In the last two paragraphs the discussion should be expanded to explain the recent dramatic decline in young striped bass since 1976, despite the fact the Decision 1485 outflow and export standards have been in effect since 1978.

18. Page 74, Left Column
26 With regards to the last paragraph, what is the basis for assuming that under the proposed alternative no significant effect on young striped bass survival will occur even though there will be increased exposure of young striped bass to the fish screens during winter? (Also see Comment No. 19, below).

19. Page 74, Table 18
The operation study results presented in Table 18 may not be valid for projected 1990 level exports because since 1976 observed levels of young striped bass have been markedly below levels predicted using traditional
27 statistical relationships with outflow and export levels. Given this, the Department should not conclude that increasing exports further will not significantly affect young striped bass. The Department should participate in the conduct of new studies proposed by the Striped Bass Work Group, and concurred upon by the State Board, to investigate the impact of exports on striped bass survival more thoroughly before final conclusions are reached on this issue.

20. Page 77, Right Column
The first paragraph states that Neomysis is the food of young striped bass. This is true for young of the year bass in summer. However, during the spring very young striped bass begin to feed primarily on micro-zooplankton. Therefore the final EIR should discuss the possibile effects of increased spring pumping on these small zooplankton and the resultant effects on very young striped bass.

28 The fifth paragraph states that the proposed alternative would not effect aquatic invertebrates because monthly operations during spring and summer would not change. This would be true only if:

a. changes in daily or weekly export patterns have no effect on phytoplankton blooms and therefore on aquatic invertebrates, and;

b. the proposed increased diversion of San Joaquin River water in winter has no effect on spring development of phytoplankton.

Neither of these conditions has been demonstrated to be true in the draft EIR. The final EIR should address these issues.

21. Page 83
The discussion of impacts on Suisun Marsh is misleading. The Department mentions that physical facilities needed to protect the Marsh are
29 detailed in a plan of protection and draft EIR dated September 1980. This conveys the impression that a plan to meet the 1984 Marsh standards

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in Decision 1485 is currently being implemented by the Department. The September 1980 Plan of Protection was a draft, and a final plan of protection has yet to be released. As stated above, in Comment No. 9, the Department has already advised the Board that the final plan, once released, will indicate that facilities will be delayed beyond 1984. The Department has not provided adequate assurance that the facilities will be complete even by 1990. The conclusion drawn in the Draft EIR that the proposed alternative will not significantly affect the Marsh because Decision 1485 standards will be met with facilities is misleading. A more accurate account of the status of Department plans to meet the State Board's 1984 Marsh standards is needed in the final EIR.

22. Pages 86-87
The discussion of impacts found to be insignificant mentions that the pumps will be operated under Decision 1485 criteria and further lists
30 Suisun Marsh as an area that will not be adversely impacted. As stated in Comment Nos. 9 and 21, above, this may not be true with respect to Suisun Marsh in the absence of an adequate commitment on the part of the Department to diligently pursue compliance with the Decision 1485 Marsh Standards. The final EIR should clarify this issue.

23. Page 87, Right Column
The Third paragraph states that if the proposed Two-Agency Agreement is not finalized, the Department will establish a "similar" fishery mitigat-
31 ion program for the proposed pumps. If the Two-Agency Agreement is not signed by the time the final EIR is released, the final EIR should detail the mitigation program to be followed and explain the basis for discrepancies between this program and the one provided under the proposed Agreement.

24. Page 93, Table 21
Table 21 should include review of potential cumulative impacts of the pumps in conjunction with the proposed San Luis Drain discharge into
32 Suisun Bay. Also, indirect effects on the adult fishery caused by increased diversions of eggs, larvae and food organisms through the screens of any new Delta transfer facilities should be indicated. Screening losses for these forms may not be decreased.

25. Page B-12, Table B-7
The proposed off-peak velocity standards for the Skinner Delta Fish Protective Facility are about 2-3 times higher than the Decision 1485 standards for optimal salvage of striped bass during the critical period
33 of May 15 through October. Given the present critical state of the striped bass fishery, the final EIR should discuss the basis for concluding that the fishery could tolerate the additional losses that such drastic changes in approach velocity would bring about. Such changes may negate the effectiveness of current plans to improve the secondary screens at the facility.

C—105502

C-105502

LETTER 8

DIRECTORS
FRANK BORGHI, JR.
President
HARRY D. BRUMBAUGH
JOSEPH G. DAMAS, JR.
CLARK W. REDEKER
CARL H. STRANDBERG

ALAMEDA COUNTY WATER DISTRICT

OFFICERS
ROY E. COVERDALE
General Manager
RUTH R. EVANS
District Secretary

February 15, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
Post Office Box 160088
Sacramento, California 95816

DRAFT EIR ON PROPOSED ADDITIONAL PUMPING UNITS AT THE HARVEY O. BANKS DELTA PUMPING PLANT

Dear Mr. Potter:

1 The Alameda County Water District has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contractors, Inc. on the four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Please be advised that we support the comments submitted.

Yours truly,

for ROY E. COVERDALE
General Manager

LETTER 9

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ANTELOPE VALLEY - EAST KERN WATER AGENCY

A PUBLIC AGENCY

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General Manager
REMUSET and ORR
Attorneys
BETTY J. BEGAN
Secretary, Treasurer
BOYLE ENGINEERING CORP
Consulting Engineers

February 9, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
Post Office Box 160088
Sacramento, California 95816

Re: Draft EIR on Proposed Additional Pumping Units at the Harvey O. Banks Delta Pumping Plant

Dear Mr. Potter:

1 The Antelope Valley-East Kern Water Agency has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contractors, Inc. on the four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Please be advised that we support the comments submitted.

Very truly yours,

Wallace G. Spinarski
General Manager

WGS:bjr

4500 WEST AVENUE N • POST OFFICE BOX 3176 • QUARTZ HILL, CALIFORNIA 93534 • (805) 943-3801

LETTER 10

CASITAS Municipal Water District
serving and conserving

Site of the 1984 Olympic Rowing & Canoeing Events

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Division V
ROBERT N. McKINNEY
General Manager and Chief Engineer
JAMES H. LIEBIG
Attorney
LAVERNE LEE HAHN
Auditor

February 10, 1983

Mr. Robert G. Potter, Chief
Central District
Department of Water Resources
P. O. Box 160088
Sacramento, CA 95816

DRAFT EIR ON PROPOSED ADDITIONAL PUMPING UNITS AT THE HARVEY O. BANKS DELTA PUMPING PLANT

Dear Mr. Potter:

1 The Casitas Municipal Water District has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contractors, Inc. on the four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant.

We support the comments submitted.

Very truly yours,

Robert N. McKinney
General Manager and Chief Engineer

1055 Ventura Ave. • P.O Box 37 • Oak View, California 93022 • (805) 649-2251

LETTER 11

ESTABLISHED IN 1918 AS A PUBLIC AGENCY

COACHELLA VALLEY WATER DISTRICT

POST OFFICE BOX 1058 • COACHELLA, CALIFORNIA 92236 • TELEPHONE (619) 398-2651

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BERNARDINE BUTTON, SECRETARY
VICTOR B. HARDY, AUDITOR
REDMINE AND BARRILL, ATTORNEYS

February 14, 1983

Robert Potter
Department of Water Resources
Post Office Box 160088
Sacramento, California 95816

Dear Mr. Potter:

Subject: Harvey O. Banks Delta Pumping Plant

1 This District supports and recommends the installation of the four additional pumps at the Harvey O. Banks Pumping Plant as soon as possible.

2 The Environmental Impact Report should be more positive and strengthened to indicate the necessity and need for these pumps.

3 The Environmental Impact Report should be relieved of all unnecessary verbiage and material that would be detrimental to the State Water Project and which could create some future commitment or obligation.

4 The Environmental Impact Report should not contain any wording that would prevent future maximum pumping by these pumps.

5 The Environmental Impact Report should be void of minuscule, unimportant detail and wording or comments that can not be adequately substantiated.

6 This Environmental Impact Report needs to be completed without any further delay.

Yours very truly,

for Lowell O. Weeks
General Manager-Chief Engineer

KHA:bas

TRUE CONSERVATION
USE WATER WISELY

LETTER 12

Water Agency

Sixth Floor
County Administration Building
Martinez, California 94553
(415) 671-4295

J. Michael Walford
Chief Engineer

Contra Costa County

Board of Supervisors
(Ex-Officio Governing Board)

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1st District
Nancy C. Fahden
2nd District
Robert L. Schroder
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Sunne Wright McPeak
4th District
Tom Torlakson
5th District

February 14, 1983

Mr. Robert Potter, Chief
Central District
Department of Water Resources
P. O. Box 160088
Sacramento, CA 95816

SA III-35

Dear Mr. Potter:

This letter is to transmit comments by the Contra Costa County Water Agency (CCCWA) on the Draft Environmental Impact Report on the Proposed Additional Pumping Units at the Harvey O. Banks Delta Pumping Plant.

The CCCWA notes that this Draft EIR is very similar to the EIR on the "Agreement to Manage Fish and Wildlife Resources." Both EIRs are based on the water quality standards included in Decision-1485. The continued decline of
1 fishery resources and water quality in the Delta since D-1485 has clearly shown that these standards are not adequate. The CCCWA has legally challenged the adequacy of D-1485 and its EIR and feels that the Draft EIR on the proposed additional pumping units is also inadequate.

2 The CCCWA's comments on the Draft EIR on the Water Quality Control Plan, dated June 15, 1978 are applicable to the draft EIR on the proposed additional pumping units and we include them in our comments by this reference.

Additionally, the CCCWA would like to comment on several points of the draft EIR.

1. The draft EIR does not analyze the environmental damages that have already taken place in the Bay-Delta System due to the existing State and Federal pumping facilities. The CCCWA feels that discussing only the incremental environmental damages from the additional pumping units is not an adequate analysis of these
3 very significant environmental impacts. It is the Department of Water Resources' (DWR) obligation to demonstrate in the EIR that the Bay-Delta system will not be adversely impacted by the additional pumping units. The simple statement in the draft EIR referencing flow studies that are in progress is not adequate. All necessary studies should be performed before additional export is allowed to either prove that the Bay-Delta system is not adversely impacted or to clearly identify the impacts.

2. The draft EIR states that the four new units would increase pumping capability to the design capacity of 10,300 cubic feet per second.
4 The State Water Project (SWP) has signed contracts to deliver more water than it is capable of delivering to water contractors. The draft EIR should clearly specify the impacts of diverting

2 12

water from the Delta at the design capacity (10,300 cfs). The CCCWA feels that the DWR should state how operationally they plan to deliver "Table A" entitlement contract water exports in the future and how the additional pumping units are a part of that plan. There is no statement in the draft EIR as to how the DWR plans to export interim or surplus water under SWP contracts.

3. The draft EIR states that there will be a detrimental impact on fish, in particular the striped bass. The CCCWA feels that any detrimental impact to a fishery resource which is continuing to decline is not acceptable. The CCCWA's position is that fishery resources must be returned to historical levels before any additional water is diverted from the Delta. The CCCWA is also aware that
5 the Delta Environmental Advisory Committee has challenged the accuracy of the data concerning fish losses from the pumping facilities. The CCCWA feels that this discrepancy should be settled before the EIR is certified. Also, draft EIR states that the loss of striped bass resources will be mitigated by a stocking program using hatcheries. The use of striped bass hatcheries is still experimental and we do not feel that this is an adequate mitigation measure.

4. The draft EIR references the "Agreement to Manage Fish and Wildlife Resources in the Sacramento-San Joaquin Estuary" for mitigation measures. The CCCWA notes that the Agreement has not been signed and it is possible that substantial changes may be proposed to the Agreement, therefore, we feel that references to this Agreement add nothing to adequacy of the draft EIR and should not be made
6 a part of the EIR. Additionally, the Agreement does not address the damage to fish from the Central Valley Project (CVP) pumps nor does it evaluate the environmental impacts of that damage. The mitigation measures for the four additional pumping units must stand alone. The CCCWA feels that it is the joint obligation of the CVP and SWP to mitigate the loss of fishery resources in the Bay-Delta system. If one project fails to mitigate damage, the other must accept full responsibility to do so.

5. The draft EIR states that the yield of the SWP will be increased, resulting in a decrease in Delta outflow. The CCCWA's position is that no additional export from the Delta should be authorized
7 until adequate standards for the Delta and the Bay are constitutionally and contractually guaranteed. The draft EIR should discuss the impacts of the additional export at the design capacity (10,300 cfs) on low flow (dry year) situations and on the impact on unregulated flows.

6. The draft EIR does not address the energy impacts of pumping
8 the additional yield of the SWP from the additional pumps to SWP contractors. The analysis of the energy impacts should include pumping costs south of the Delta, including pumping over the Techacapi mountains.

In summary, the CCCWA fees that the draft EIR on the proposed additional pumping units is weak, inadequate and deficient as is the EIR on the Water

3 12

Quality Control Plan, D-1485 and the proposed Agreement to Manage Fish and Wildlife Resources in the Sacramento-San Joaquin Estuary. Our basis
9 for this criticism is included in the "Petition of Writ Mandamus filed September 18, 1978 in the Superior Court in the City and County of San Francisco, and action entitled "Contra Costa County Water Agency versus State Water Resources Control Board of the State of California No. 743385." We incorporate these criticisms by reference. The Department of Water Resources is party to these proceedings and has copies of this pleading.

If you have any questions, please contact Dave Okita at 671-4295.

Very truly yours,
J. Michael Walford
Chief Engineer
Contra Costa County Water Agency

by Paul E. Kilkenny
Paul E. Kilkenny
Assistant Public Works Director
Environmental Control

PEK:DBO:cal
dbo:DWRdraft.t2

LETTER 13

CRESTLINE-LAKE ARROWHEAD WATER AGENCY
A Public Agency
P.O. BOX 698 • PHONE (714) 338-2779
34116 GREEN FOREST DRIVE
CRESTLINE, CALIFORNIA 92325

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Secretary
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General Manager
WILLIAM J. HUCKELL

February 14, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, Ca. 95816

Re: Draft EIR On Proposed Additional Pumping Units At The Harvey O. Banks Delta Pumping Plant

Dear Mr. Potter:

The Crestline-Lake Arrowhead Water Agency has reviewed the comments prepared and submitted by the State Water
1 Contractors Audit Committee and the State Water Contractors, Inc. on the Four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Please be advised that we support the comments submitted.

Yours very truly,

William J. Huckell
General Manager

WJH:dh

C—105504

C-105504

LETTER 14

DESERT WATER AGENCY
A PUBLIC AGENCY
1200 SOUTH BOGIE ROAD, P.O. DRAWER 1707 ▸ PALM SPRINGS, CALIFORNIA 92263-1707
TELEPHONE (714) 323-4971

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PAUL G. PAYNE
General Manager
BEST, BEST & KRIEGER
General Counsel
KRIEGER AND STEWART
Consulting Engineers
S. R. SHARP AND COMPANY
Certified Public Accountants
Auditors

February 10, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
Post Office Box 160088
Sacramento, Ca. 95816

RE: Draft EIR on Proposed Additional Pumping Units at the Harvey O. Banks Delta Pumping Plant

Dear Mr. Potter:

The Desert Water Agency has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contractors, Inc.
1 on the four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Please be advised that we support the comments submitted.

Yours very truly,

DESERT WATER AGENCY

GENERAL MANAGER

PGP:rg

ASSURED WATER FOR THE FUTURE OF PALM SPRINGS, CATHEDRAL CITY AND DESERT HOT SPRINGS

LETTER 15

Devil's Den Water District
P.O. BOX 1833
FRESNO, CALIFORNIA 93717

February 17, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, CA 95816

Re: Draft EIR On Proposed Additional Pumping Units At The Harvey O. Banks Delta Pumping Plant

Dear Mr. Potter:

The Devil's Den Water District has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contractors, Inc. on the four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Please be advised that we support the comments submitted.

Very truly yours,

DEVIL'S DEN WATER DISTRICT

R. E. Lundquist
President

REL:mb

LETTER 16

DIRECTORS
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WILLIAM KLEPPER
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ROBERT WEISENBERGER

CLARENCE EMERZIAN
Assessor-Collector-Treasurer
ROBERT WEISENBERGER
Secretary

DUDLEY RIDGE WATER DISTRICT
3636 NORTH FIRST STREET, SUITE 118
FRESNO, CALIFORNIA 93726

February 14, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
Post Office Box 160088
Sacramento, California 95816

Re: Draft EIR On Proposed Additional Pumping Units At The Harvey O. Banks Delta Pumping Plant

Dear Mr. Potter:

The Dudley Ridge Water District has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contractors, Inc. on the four (4)
1 additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Please be advised that we support the comments submitted.

Yours truly,

James R. Provost
Manager-Engineer

cc: Ned Smith, President
Ben Ewell, Attorney

LETTER 17

KERN COUNTY WATER AGENCY
4114 Arrow Street, P.O. Box 58
Bakersfield, California 93302-0058

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President
Gene A. Lundquist — Division 7

Telephone (805) 363-8200
Stuart T. Pyle
Engineer-Manager
George E. Robbs
Assistant Engineer-Manager
Lee Buchenberger
Secretary

February 15, 1983 4.3.4

Robert G. Potter, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, CA 95816

RE: Draft EIR on Additional Pumping Units

Dear Mr. Potter:

This is in response to your request for comments on the Draft EIR on the Proposed Additional Pumping Units at the Harvey O. Banks Delta Pumping Plant. We have reviewed the general comments submitted by repre-
1 sentatives of the State Water Contractors, Inc. and the State Water Contractors Audit Committee at the public hearing on February 4, 1983, as well as their more specific written comments submitted since the hearing date. We endorse these comments and urge the Department to incorporate the recommended changes in the final Draft of the EIR.

Sincerely,

Stuart T. Pyle
Engineer-Manager

LETTER 18

The Metropolitan Water District of Southern California

February 14, 1983

Mr. Robert G. Potter
Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, California 95816

Dear Mr. Potter:

DEIR for Additional Pumps at the Delta Pumping Plant

Metropolitan supports the Department's efforts to install four additional pumps at the Harvey O. Banks Delta Pumping Plant. Our general comments on the draft Environmental
1 Impact Report (EIR) were presented to you at the February 4, 1983, public hearing. Enclosed with this letter are our specific comments which are arranged by chapter in sequential order. The page of the draft EIR to which the comment refers is indicated in parentheses following the comment.

In the draft EIR, you discuss the future availability of Colorado River water to Metropolitan. We have enclosed a
2 copy of our recently published Report No. 947 which indicates estimates of our Colorado River supply. Our specific comments make observations on the discussions of energy benefits, benefit/cost analysis, groundwater storage, water conservation, and fisheries and on other topics.

Our concern with the energy discussion centers on the specific generation figure assigned to Metropolitan's hydroelectric energy production. In the benefit/cost analysis, the Department has assigned dollar amounts to the benefits provided by municipal and industrial water outside the South Coastal area. These dollar amounts are indicated to be
3 $167 per acre-foot prior to the year 2000 and $267 per acre-foot beyond. We believe these values to be low. In the December 30, 1982, "Revised Guidelines on Funding Local Water Supply Projects," the Department indicates its willingness to fund local water supply projects based on:

1111 Sunset Boulevard, Los Angeles, Calif. / Mailing address. Box 54153, Los Angeles, Calif. 90054 / Telephone: (213) 250-6000

18

"...the capital component of the melded costs associated with the construction of future SWP water conservation facilities and with those avoided costs of SWP transportation facilities not yet constructed and which would not be needed."

These costs can be expected to be greater than the $167 or $267 per acre-foot figures.

In the discussion of groundwater storage, a storage program's effect on the Delta is indicated. Table 21 states that there is potential for increased Delta outflow and reduced Delta export with no significant change in Delta inflow. We infer that this means that pumping from the Delta would be reduced in
4 dry years. This reduction would presumably be offset by increased groundwater pumping in Southern California. Prior to this time, our understanding of the Department's conjunctive-use proposals has been different. We believed that pumping of previously stored State project water from groundwater basins would be used to augment supplies from the Delta during periods of State project water shortages, not to reduce Delta exports and increase Delta outflow.

Our concerns with the water conservation discussion center on its presumed enforceable nature which we covered in our February 4 statement, and the ability of the indicated demand reduction alternatives to achieve the savings suggested. These assumed savings are indicated to be in addition to those assigned
5 in the Department's Bulletin 76-81. Also, the draft EIR does not discuss whether these assumed savings are in addition to those suggested by various organizations for residents of the City of Los Angeles. Those organizations want to require the city to reduce its deliveries from the Los Angeles Aqueducts. Should all the savings not materialize, State project water will be necessary to meet the demands.

We believe that references to the Two-Agency Fish Agreement should be deleted as it has not been executed. In
6 place of that agreement, we suggest that the Department consider: 1) basing mitigation on the recommendations of the Striped Bass Working Group, and 2) including hatchery production to replace fish losses.

18

The Metropolitan Water District of Southern California

We appreciate this opportunity to comment and thank you for extending the period granted for comments. Should you have any questions regarding our comments, please contact Mr. Richard C. Clemmer at (213) 250-6000, extension 666.

Very truly yours,

Evan L. Griffith
General Manager

JPM:gg

Enclosures (2)

18A

STATEMENT OF
THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
ON
ADDITIONAL PUMPING UNITS AT THE DELTA PUMPING PLANT *

My name is Richard Clemmer and I represent The Metropolitan Water District of Southern California. We would like to express our support for the statements made by Mr. Schuster on behalf of the State Water Contractors. Also, we commend the Department for its efforts to complete the Harvey O. Banks Delta Pumping Plant. Today, we will make a few general comments and will submit further detailed comments prior to the February 15 deadline.

Like Mr. Schuster, we also feel that the draft EIR should be modified to fully disclose that it is the Department's intention, in fact, obligation to complete the Delta Pumping Plant and when required, operate the plant up to its full 10,300 cfs capacity.

It was the desire of Northern Californians in 1959 when the Burns-Porter Act was enacted, as it is now, that water to be exported from the Delta should come primarily from high winter flows. To substantiate this, I would like to quote from the January 12, 1983, recommendation of the Assembly Water Committee's Emergency Delta Task Force referring to water for areas south of the Delta.

"The design of the Delta water transfer facility should permit water to be provided to Southern California

* Presented by Richard C. Clemmer at Department of Water Resources hearing on February 4, 1983 in Sacramento.

and to the San Joaquin Valley in a manner that better permits water to be taken when there is excess in the north. This should include more storage of water south of the Delta."

We fully concur with that statement, and prompt installation of the four additional pumps is essential to accomplishing that end.

We would like to comment further on the State's obligation to complete the entire State Water Project, not just the Delta Pumping Plant. The draft EIR does not clearly state the Department's plans for meeting this obligation. While we realize that the Department must reformulate its plans to meet that obligation in light of the failure of Proposition 9, the draft EIR is silent on this subject. Metropolitan pledges to work closely with the Department in its efforts to augment the State project water supply in an economically and environmentally sound manner.

Now turning specifically to environmental matters, we would like to discuss the Two-Agency Fish Agreement. Metropolitan is on record as opposing the agreement in the form that it was proposed last year. However, please understand that we do not oppose, but in fact, support mitigation measures to protect fish and wildlife as they are impacted by State project operations. To that end, we again pledge to work with the Department to meet the State project's responsibility.

A matter that continues to concern us and is especially bothersome in the draft EIR is related to enforceable water conservation plans. We support voluntary workable water conservation programs in our service area. Numerous programs have been in operation for years and as responsible programs emerge they are added regularly. However, we look on water conservation as being essential to only diminish the shortages we can expect in the near future. These and future programs are independent from the installation of the four pumps and will occur irrespective of actions in the Delta. They should not be considered mitigation measures nor should they be labeled substitute water supplies. All such references should be excluded from the final EIR.

In conclusion, we appreciate the opportunity to make our comments today and we will submit detailed comments in writing later.

18B

Comments on Draft EIR, "Proposed Additional Pumping Units, Harvey O. Banks Delta Pumping Plant," Department of Water Resources, November 1982

Summary

1. In the sentence, "The pumping plant and forebay...would be operated in accordance with the SWRCB constraints and U.S. Army Corps of Engineers' constraints...." change "SWRCB constraints and U.S. Army Corps of Engineers' constraints" to "SWRCB water rights permits and U.S. Army Corps of Engineers' Public Notice 5820A Amended October 13, 1981." Change the phrase, "The Corps of Engineers' constraints limit forebay diversions such...." to "The Corps of Engineers' Public Notice indicates DWR's intent to now limit forebay diversions so...." Change the phrase, "Under these constraints, the Department of Water Resources would not divert into Clifton Court Forebay...." to "DWR does not now intend to divert into Clifton Court Forebay...." After the phrase, "...in any three consecutive days." insert the sentence, "These amounts are based on historical maximum diversions for the existing Delta Pumping Plant complex." After the phrase, "...(1,000 cubic feet) per second." insert the sentence, "The U.S. Army Corps of Engineers has determined that the diversion would have no effect on navigable capacity." Delete the following two sentences beginning with "These operational constraints were presented to the public on October 13, 1982 (sic)...." (Page S-1)

2. Clarify the statement that daily, weekly, and monthly diversions from December 15 to March 15 are limited by San Joaquin River and Delta flow conditions. (Page S-2)

3. In the sentence discussing the U.S. Army Corps of Engineers' Environmental Statement on the existing pumping plant prepared pursuant to litigation, clarify the meaning of "pursuant to." (Page S-2)

4. Update the status of the Sierra Club litigation to include the U.S. District Court's December 30, 1982, decision. (Page S-3)

5. In Table S-1 and Table C-1, change the footnote discussing Category B to read "Catergory B - Application for Federal permit may be required if daily diversions exceed those discussed in U.S. Army Corps of Engineers' Public Notice 5820A, amended October 13, 1981." (Pages S-4, C-3)

6. What studies of groundwater and surface water storage programs in San Joaquin and Southern California service areas are referenced? (Page S-4)

7. Note that the availability of intermittent deliveries to groundwater storage--limited to the period December through April, is different from that in the ongoing DWR-Metropolitan Chino Basin Groundwater Storage Feasibility Study. The availability of water in that study is based on data from DWR's Division of Operations and Maintenance Memorandum Reports, "Analysis of Ability of California Aqueduct to Deliver Water to Groundwater Storage and Colorado River Banking," Studies A (March 1981), B (April 1981), C (April 1981), D (September 1981), E (September 1981), F (May 1982), and G (May 1982). These operation studies show water to be available for delivery to Southern California groundwater basins in months other than December to April, both in 1990 and in other years prior to the time when State project supplies were assumed to be augmented. (Pages S-4, 21)

8. In Table S-2, why do Delta outflows decrease in May to July when Delta exports decrease? Is it because of modified releases from upstream reservoirs? Please clarify. (Page S-5)

9. The demand reduction alternatives and water supply augmentation measures shown in Table S-3 should be deleted. These are independent actions--irrespective of the four pumps installation, which if economically sound will be implemented to reduce future water shortages. Reference to them as mitigation measures or substitute water supplies should be excluded. Examples of realistic alternatives to the four pumps which should be considered are water supply augmentation proposals such as the Cottonwood Creek Project and Shasta Lake enlargement. Some of the comments that follow relate to the demand reduction and water supply augmentation measures and have been included should DWR choose not to delete these alternatives. (Page S-5)

10. Delete the statement that the nine water supply and demand reduction alternatives could possibly balance demand and supply in the South Coastal service area. (Pages S-5, C-9)

11. Whether the water conservation options suggested would not impair maintenance of present esthetic or convenience conditions is subjective and the writer's opinion. (Pages S-5, 20)

12. In the draft EIR, water conservation by several methods to reduce demand is a solution proposed to satisfy several different water requirements. Document the assertion that the water conservation alternatives proposed have not been double-counted. As an example, water conservation has been proposed by several organizations for residents of the City of Los Angeles. Those organizations want to require the city to reduce its deliveries from the Los Angeles Aqueducts. Should all the savings not materialize, State project water will be necessary to meet the demands. (Pages S-5, 26)

C-105507

13. Table S-3 indicates that there are no institutional problems in the proposed mandatory (non?) residential landscape design and free residential landscape design reduction alternatives. This is false as ordinances and policing would be required in the first case, and personnel and funding would be required in the second. (Page S-6)

14. Indicate that Santa Barbara County voters have only opted to not finance an in-county distribution system from the Santa Maria terminus of the Coastal Branch. Design and construction of the Coastal Branch is scheduled to commence in July 1984. Initial delivery is scheduled for 1990 according to the January 1983 "Report of the California Water Resources Development Finance Committee and DWR to the Legislature on the State Water Resources Development System." (Pages S-8, 40)

15. Delete enforceable water conservation as a mitigation measure. DWR does not have nor is it likely to receive authority to enforce water conservation programs. (Pages S-9, 88)

16. Delete all references to the Two-Agency Fish Agreement as a mitigation measure as it has not been executed. Some of the comments that follow concern this agreement and are included should DWR choose not to delete this item. (Page S-9)

Chapter 1

17. Specify that State project reservoirs in Southern California are transportation features and not conservation features of the project. (Page 2)

18. Indicate that DWR's contractual obligation to deliver entitlement water will at some time in the future require it to operate the Delta Pumping Plant at rates up to its proposed 10,300 cfs capacity. Also, indicate that the Burns-Porter Act authorized construction of the California Aqueduct, north of San Luis Reservoir, at a capacity of at least 10,000 cfs. (Page 2).

19. Change the sentence, "The maximum total reduction allowable...deliveries for other uses." to the language contained in Article 18 of the water supply contracts. (Page 3)

20. Discuss DWR's plan to complete the State Water Project. (Page 3)

21. Remove the word "all" from the phrase, "These standards are for protection of all reasonable, beneficial uses of water in the Sacramento-San Joaquin estuary...." (Page 3)

22. In the phrase "National Marine Fishery Service," change "Fishery" to "Fisheries." (Pages 5, 6)

23. Revise discussion of mitigation for four additional pumping units analyzed in the Two-Agency Fish Agreement EIR to exclude enforceable water conservation. This item was not analyzed in the Two-Agency Fish Agreement EIR. That final EIR indicated on Page 133 in Response 1 to Letter 32 that the Two-Agency Fish Agreement provides full mitigation for the added pumps. Indicate that the Two-Agency Fish Agreement has not been executed. (Page 8)

24. Neither the Two-Agency Fish Agreement nor the final EIR on that agreement state that 100,000 AF of water must be stored in groundwater basins before wet year exports are increased or controlled flow condition exports are decreased in the groundwater storage program operational mode. Modify the text to reflect this. (Page 9)

25. Specify that groundwater management, watershed management, and interbasin and intrabasin transfers of developed water supplies are of statewide interest, but are local responsibilities. (Page 10)

Chapter 2

26. For the savings in costs resulting from a shift from on-peak to off-peak energy use, indicate the manner in which the 5 mill per kilowatt-hour value was calculated. (Page 13)

27. In Figure 3 in the "Representative California Load Curve with Project", the magnitude of the State project load seems to be overemphasized, but it is not labeled so. During the hour of the year when the total State energy load is least, the figure implies that the State project is responsible for 30 percent of the total State load. Figure 3 should include the magnitude of energy demand. (Page 14)

28. Indicate in the text that the shortage in SWP supply expected in 1985 assumes that conservation and reclamation goals are met. Indicate that the date will be sooner if the goals are not met. Indicate the years by which shortages are expected to occur in meeting contractor requests for entitlement water, for both agricultural and municipal and industrial purposes at various levels of water supply (wet, above normal, below-normal, dry, and critical year types.) (Page 14)

Chapter 3

29. Does any wheeling of water take place for the CVP to San Luis Reservoir? (Page 20)

30. When submitting our request for water to DWR, Metropolitan takes into account the water conservation and reclamation anticipated in our service area. Reduction of demands further because of arbitrary conservation and reclamation goals results in an underestimate of demands. (Pages 20, B-2)

31. Monthly target storage level values for San Luis and Southern California reservoirs should be specified. In the operation studies, were Southern California reservoirs operated to develop yield? (Page 20)

32. In making entitlement deliveries, state that the goal to minimize on-peak power is secondary to the goal to maximize State project yield. (Page 20)

33. Have power requirements been taken into account in plotting Average Annual Usable Intermittent Export Supply in Figure B-2? If so, was on-peak power use minimized? If on-peak power use was minimized, state that the goal to minimize it is secondary to the goal to maximize intermittent export deliveries. (Pages 21, 22)

34. Specify where the local surface storage facilities are that can increase State project yield. (Page 21)

35. Emphasize that the costs of regulating intermittent supplies--$35/AF in Kern County, and $44 to $1/AF in Southern California, are for groundwater storage and not surface storage and are local costs only. Indicate that the costs do not include the costs to initially deliver the water to the California Aqueduct turnout from the Delta. Discuss the volume stored, the length of time necessary to store the water, the average annual intermittent supply, and the dry-period yield. Discuss whether availability of power was taken into account in determining the amount of water stored and hence, the cost. (Page 21)

36. Clarify how dry-year augmentations from groundwater programs will replace historical surplus deliveries. Did DWR intend to say that intermittent export deliveries in above-normal and wet years for the groundwater storage program would replace historical surplus deliveries? (Page 21)

37. Clarify whether each of the three effects of operating the East Branch enlargement refer to operating with or without the additional pumps. (Page 21)

38. In the discussion of physical contraints affecting project operations, change "channel velocities" to "Requirement to restrict channel velocities." Change "Channel scouring" to "Requirement to restrict channel scouring." (Page 21)

39. If the Tracy Pumping Plant is not operating at full capacity because of pumping unit outages, will implementing the proposed alternative foreclose use of the Delta Pumping Plant above 7,300 cfs to wheel CVP water? If so, this restriction should be removed. (Page 21)

40. In the discussion on Alternative 2-6.3, specify to what location the 8,000 cfs is diverted. (Page 22)

41. For alternatives that increase the yield, do the energy savings take into account the additional energy expended in pumping intermittent supplies? (Page 22)

42. Further explain the relationship between off-aqueduct hydroelectric supplies in wetter years and increased average annual net energy requirements. (Page 23)

43. In the discussion of higher storage levels at San Luis influencing storage north of the Delta, change "would conserve storage" to "would allow storage of additional water." (Page 23)

44. Explain why the present size of Clifton Court Forebay is adequate for the 4-10.3 alternative. (Page 24)

45. The text indicates that values in Table 2 are in thousands of dollars while the Table indicates that they are in dollars. (Pages 24-25)

46. Implementation of the demand reduction alternatives should not be discussed as it is speculative. (Page 24)

47. The rationale of using the low unit cost for landscaping new homes as the upper limit to the average urban supply unit cost in State project service areas, other than the South Coastal, should be justified. (Pages 25, C-12)

48. Explain in the text how the $267/AF vendibility value was determined for the other SWP service areas and why such a low value is appropriate. (Pages 25, C-12)

49. Discuss the rationale for using marginal costs rather than melded costs for energy to pump water through the California Aqueduct. (Page 25)

50. Clarify the statement as to whether the East Branch as

it exists at present or enlarged, would maximize benefits and costs in the economic analysis. (Page 26)

51. As DWR's Office of Water Conservation no longer recommends the placement of toilet dams but instead placement of plastic bags in toilets, the estimated life is only 5 years instead of 15 years and the savings per flush is only 0.6 gallons instead of 2 gallons. Toilet dams are no longer recommended because they were often found to have shifted position and hence interfered with proper operation of the toilet. A current study by Brown and Caldwell consulting engineers for the U.S. Department of Housing and Urban Development, in which DWR personnel participated, is finding that installing low-flow showerheads is saving 1 gallon per minute instead of 3 gallons per minute as previously estimated by DWR. DWR's Office of Water Conservation also no longer recommends installation of devices by water agency personnel for economic and legal reasons, but instead installation by homeowners. Retention rates are estimated on Page III-21 in DWR's December 1982 report, "State Water Project Recommended Water Management Plan for The Metropolitan Water District of Southern California in Response to Governor's Executive Order B 68-80." These rates are 25 percent for toilet bags instead of 83 percent as in the Oak Park study, and 13 percent for showerhead inserts instead of 73 percent as in the referenced study. Also, Oak Park is a relatively new community. Its inhabitants live in single-family dwellings and their income is in the upper-middle class range. Older communities could have corroded plumbing which has already reduced flow to the showerhead to the point that low-flow inserts would not provide acceptable flows. And low-flow inserts cannot properly be installed in the ball-type shower necks found in many older homes. Futhermore, the study period over which results were gathered was limited. In conclusion, the savings anticipated are far too high, based on the retention assumed for toilet dam retrofit and showerhead retrofit. (Pages 27, C-12)

52. Free residential landscape design is not an appropriate field for the water service contractors to compete with private enterprise. If DWR chooses not to delete this alternative, discuss who would be responsible for the design, the source of funding, and the propriety of public agencies conducting it. (Page 27)

53. Mandatory non-residential landscape design is not appropriate for the water service contractors to implement. If DWR chooses not to delete it, indicate who would be responsible for the design and how it would be enforced. (Page 27)

54. In the statement concerning Metropolitan obtaining rights to Imperial Valley water salvage savings, delete the phrase "rights to." (Page 27)

55. Indicate that unit costs for Imperial Valley water salvage include urban water quality detriment costs for replacement of plumbing and appliances, but not for water softening. Metropolitan can no longer soften its Colorado River water supply. The water quality detriment costs were based on figures in Kleinman and Brown's December 1980 report, "Colorado River Salinity, Economic Impacts on Agricultural, Municipal, and Industrial Uses," which were then reduced by the costs of water softening and bottled water, and updated to 1981 dollars. Details on the estimated water quality detriments are shown on Page 19 of DWR Central District's December 1982 report, "Benefit-Cost Analysis of the Proposed Peripheral Canal Project." (Pages 28, C-13)

56. Energy required for the Imperial Valley water salvage program would be 2000 kilowatt-hours per acre-foot to transport water through the Colorado River Aqueduct. However, energy generation would be foregone at power plants downstream on the Colorado River and All American Canal. The statement should be clarified. (Pages 28, C-13)

57. Mention the environmental effects of salvaging water which would otherwise flow into the Salton Sea on the Sea, its fisheries, and wildlife refuges. Mention the environmental effects of Imperial Valley not using the water to be salvaged for leaching purposes. Mention the effects of current water rights laws on transferring water. For information on these subjects, refer to the discussion in the draft DWR Bulletin 198-82. (Page 28)

58. In Table 3, define IMS. (Page 29)

59. In the discussion on Imperial Valley water salvage, the $40 per acre-foot figure is indicated as being for energy for local distribution. However, in the Imperial Valley desalting discussion, the $40 per acre-foot figure is indicated as being for energy for local distribution and urban water quality detriment costs. (Page 29)

60. Clarify first sentence of San Joaquin Valley desalting discussion. Revise fourth sentence of the discussion as a portion of it is missing. (Page 29)

61. Does the estimated cost of San Joaquin Valley desalting reflect the cost of developing or using a drainage system to collect the water? (Pages 29, C-13)

62. Discuss environmental effects of disposing of brine produced from San Joaquin Valley desalting. (Page 29)

Chapter 4

63. Indicate that Delta outflow is the major freshwater inflow source to San Francisco Bay. (Page 32)

64. Indicate the range of monthly Delta outflows in critical and wet years. (Page 32)

65. Indicate that the stricter standards are on waste discharge. (Page 32)

66. Indicate which project is being referenced, CVP and/or State project, in USBR's statement indicating that the South Delta Water Agency would be receiving benefits beyond pre-Project conditions. (Page 36)

67. Indicate that the overall plan for Suisun Marsh cannot be completed in 1984. (Page 38)

68. With reference to the total maximum annual entitlements of 4,177,986 acre-feet shown in Figure 7, indicate that the minimum project yield as defined in Article 1 of the water supply contracts is 4,230,000 acre-feet. (Page 42)

69. Correct spelling of rescinded. (Page 44)

70. Change the text on the unarmored three-spine stickleback to indicate that it is no longer found in the Los Angeles, San Gabriel, and Santa Ana Rivers, instead of having been exterminated from those rivers. (Page 50)

71. The influence of the Los Angeles Aqueduct and the Colorado River Aqueduct on land use is speculative and should be deleted. (Page 50)

Chapter 5

72. The text states that the present State project-CVP system was used as the base. Indicate that the new Coordinated Operations Agreement and the overall Suisun Marsh facilities are assumed to be in place as discussed in Appendix B. (Page 55)

73. Why was pumping limited to a 1990 "target export" of 3.37 MAF for the study period when demands are projected to increase in the future to 4.2 MAF? (Page 58)

74. The Table 11 value for Alternative 4-7.3 in April of above-normal years (21,365 cfs) does not agree with that in Table 4 of the Two-Agency Fish Agreement Final EIR (21,315 cfs). The annual value for Alternative 4-7.3 in above-normal years

(10,535 cfs) also does not agree with that in Table 4 of the Final EIR (10,554 cfs). (Page 58)

75. The Delta outflow value shown in Table 11 for the month of June of below-normal years violates the D-1485 Chipps Island standard for striped bass survival. Minimum Delta outflow is to be 9500 cfs. (Page 58)

76. The headings of Table 10 and 11 should begin with the word "Average." (Pages 57, 58)

77. Indicate in the text that the high-high tide drawdowns shown, are for the sources indicated. (Page 65)

78. Indicate that the negative signs in Table 14 represent upstream flow. (Page 71)

79. Instead of stating that reduced exports would be offset by reduced inflow, indicate that reduced exports would take place and reduced inflow would occur. (Page 71)

80. Discuss findings of the Striped Bass Working Group in the discussion of numbers of bass becoming adults. (Page 73)

81. Discuss the lack of correlation of Delta outflow to survival of striped bass since the 1976-77 drought. (Page 73)

82. In Table 18, indicate the significance of a striped bass index of 100. (Page 74)

83. *In Table 19, indicate that the difference in striped* bass losses is for yearling equivalents. (Page 80)

84. Supplies from groundwater storage and banking programs in drier years release additional water for use to the South San Francisco Bay service area. The service area impacts should be distributed to the South Bay service area along with the Southern California and San Joaquin service areas. (Pages 84, D-24)

85. Text in the right column of Page 85 repeats language contained in the left column of that page.

86. The number of chinook salmon to be stocked was changed in the final Two-Agency Fish Agreement from that shown in this draft EIR. (Page 87)

87. The discussion of the proposed Two-Agency Fish Agreement in the Mitigation Measures section is not "detailed." (Page 87)

88. The description of and environmental effects of a mitigation program "similar" to the proposed fish and wildlife agreement should be discussed in this EIR. (Page 87)

Chapter 6

89. Discuss financing for the Cottonwood Creek Project. (Page 90)

90. Change the statement regarding the SWRCB public hearings on the DWR water management plans for the State project service areas to indicate that DWR has suggested to the SWRCB that it may wish to hold hearings. (Page 91)

91. In Table 21, for ground and surface water storage south of the Delta, Delta export changes could occur in seasons other than those indicated. According to DWR's Division of Operation and Maintenance Memorandum Reports, "Analysis of Ability of California Aqueduct to Deliver Water to Groundwater Storage and Colorado River Banking," (Studies A through G) deliveries to groundwater storage could take place in other months of the year. Indicate that annual Delta export changes could occur in above-normal years. Yield from a groundwater storage program will only reduce State project shortages, not reduce Delta exports. Therefore, delete the statements that, (1) there is a potential reduction in dry-year Delta exports on an annual basis; (2) there is a potential increase in summer and fall Delta outflow on a seasonal basis; and (3) there is a potential reduction of screening losses. (Page 93)

92. In Table 21 indicate that south of the Delta desalting, demand reduction, conservation, and recycling would not cause changes in Delta inflow, outflow, and in potential fisheries losses during times the State project is short of water. (Page 93)

93. Indicate that groundwater storage programs south of the Delta may also require construction of recharge facilities. (Page 94)

94. Does Table 22 include intermittent deliveries for conservation storage south of the Delta, for example groundwater storage? (Page 95)

95. From the data contained in Table 23, can any conclusions be drawn concerning the loss of income and employment that would result should the State project not be completed? (Page 95)

Appendix B

96. Why wasn't an operation study made for the 7,300 cfs alternative instead of adjustments to the 6,300 cfs operation study? (Page B-1)

97. Indicate the amounts of scheduled deficiencies and the shortage amounts beyond those scheduled deficiencies and the years in which they occurred. (Page B-2)

98. Clarify the statement that reduction of dry-year shortages is reflected in the yield estimate with adjustments for storage. (Page B-3)

99. All the maximum intermittent export deliveries shown in Table B-2 and Figure B-2 cannot be stored in areas DWR has contemplated for groundwater storage programs. The Colorado River banking reconnaissance-level study is ongoing and no estimate is yet available of the amount of additional State project water that can be delivered instead of Colorado River water. (Pages B-3, B-18).

100. Was the average annual usable intermittent export supply determined by dividing by the 50-year study period or by the number of years in which this supply was available? (Page B-17)

101. Comment on the appropriateness of determining service area impacts for intermittent exports on an average annual basis rather than a dry-period basis. The drier years are when the incremental exports would be distributed from groundwater storage and used. (Page B-4)

102. To what incremental energy requirements does the right vertical axis refer: pumping through the Delta Pumping Plant, pumping to Southern California, pumping to Southern California and from the groundwater basin, or what? (Page B-18)

103. Why isn't the proposed alternative represented on figures showing exports (Figure B-3), Delta outflows (Figure B-4), flows in Delta channels (Figures B-5A, B-5B, B-5C), and salinities (Figures B-6A, B-6B, B-6C, B-7A, B-7B, B-7C)? (Pages B-19 to B-29)

104. In Figure B-4, for below-normal years, operation in June is shown to be in violation of a D-1485 outflow standard. (Page B-20)

105. Correct spelling of "CVP" in footnote to Figure B-6C. (Page B-26)

106. Correct spelling of shift. (Page B-5)

107. Comment on the appropriateness of conducting power operation studies using statistical hydrology and increasing demands while water yield operation studies are conducted using historical hydrology and constant demands. (Page B-5)

108. Did the power operation studies include intermittent deliveries for groundwater storage? (Page B-5)

109. Comment on the appropriateness of using 3.203 MAF as the target export demand for the Delta Pumping Plant in the water supply operations studies while using an average of 3.43 MAF for the power operations studies with annual values as high as 3.70 MAF. (Page B-6)

110. Is Table B-7 for four-pump operation and not two-pump operation? Indicate an annual total for Row 1 to complement that for Row 1 in Table B-6. (Page B-12)

111. Indicate why maximum off-peak pumping is limited by off-peak pumping capability for half the month in Line 2. Is it that the number of hours in which off-peak rates occur in a month equals half the month? (Page B-8)

112. Indicate significance of half of March in Lines 6-7. (Page B-8)

113. Indicate that Line 1 of Table B-8 refers to an average. (Page B-13)

114. Clarify Footnote 1 of Table B-8 as to the meaning of Bay A and Bay B. Figure B-9 indicates that Bays 3A and 3B are operated together as are Bays 4A and 4B. (Page B-13)

115. In the equation describing the Yearling Equivalent, correct the value of the exponent, -xt, in July from -2,6676 to -2.6676. (Page B-9)

116. Change 100 to 1.00 in Line 4 in the May 1-14, May 15-31, and June columns of Tables B-6 and B-7 and in the October column of Table B-7. (Pages B-11, B-12)

117. Define "Exp" in Lines 14, 15, 24, and 25 of Tables B-6 and B-7. (Pages B-11, B-12)

Appendix C

118. Indicate the firm yield resulting from the groundwater storage program discussed. Appendix B refers only to average annual usable intermittent export supply. (Page C-1)

119. Define what is meant by "average-year conditions during the study period." Does this refer to the average water supply upon which the benefits were calculated? Define what is meant by "projected beyond 1990" in reference to the analysis. (Page C-1)

120. Does the statement that power savings are for deliveries within present capabilities mean that the savings estimate could change if the assumptions about modifications to Clifton Court Forebay are altered? (Page C-2)

121. As intermittent export supplies (exported and stored in wetter years, but used in drier years) are calculated on an average annual basis, is it appropriate to add these supplies to firm supplies (available in years with supplies equal to or greater than the dry period) which is calculated on a dry-period basis? (Pages C-3, D-14)

122. Indicate in the text that the benefit-cost analysis does not include the value of the pumps to provide standby pumping capacity. (Page C-1)

123. How was the "SWP Agricultural Supply Unit Value" determined? What factors are inputed to the "quadratic programming approximation model"? (Pages C-2, C-7)

124. In Table C-3, how were SWP and local energy costs determined? (Page C-5)

125. Is the assumption of no additional plants to produce energy for the State project after 1995 appropriate considering that DWR Energy Division is only planning to meet year 2000 demands and not full Table A entitlements? (Page C-7)

126. Change "bass load power" to "base load power". (Page C-7)

127. For unit costs of alternatives to balance supply and demand, how was the DWR equivalent annual energy cost of 56 mills/kwh obtained? Page C-7 indicates the annualized SWP energy and capacity cost to be 65 mills/kwh. Since these alternatives are local in nature, wouldn't energy be more likely obtained from the local utility? Hence, wouldn't PG&E energy and capacity unit cost be appropriate? (Page C-9)

128. Is the "retail cost" cited meant to be the retail price of water to the consumer? (Page C-12)

129. The Imperial Irrigation District diverts water from the Colorado River into the All American Canal, not the Colorado River Aqueduct. (Page C-13)

130. The estimate used for energy generation at Metropolitan's distribution system was calculated to determine the energy generation foregone by increasing Colorado River deliveries from 800,000 to 1,200,000 AF/yr and reducing State project deliveries by 400,000 AF/yr. This is stated in the "Report of Interagency

Task Force on Increased Use of Colorado River Water." Because energy production at our hydroelectric plants varies with flow and head through our pipelines, the use of this figure to indicate energy generation with less than 550,000 AF of Colorado River water delivered, and the remainder State project water, is inappropriate. Also, generation is not limited to portions of our distribution system which convey only State project water. It is not appropriate to compute energy benefits from DWR unit energy costs as that is not the price being paid to Metropolitan. (Page C-14)

131. What is the significance of separating Casitas watershed supplies from other local supplies? (Page C-10)

132. Indicate the reason why SWP imports with the pumps shown in Table C-5 (64,000 to 190,000 AF) are different from yield shown in Table C-2 (65,500 to 186,000 AF). (Page C-10)

133. Colorado River imports are overestimated in Table C-5. Estimates from Metropolitan Report No. 947, which is enclosed, should be used. (Page C-10)

134. Change "Residual Demand" to "Projected Shortages." (Page C-10)

135. Indicate the costs for stocking the chinook salmon required by the Two-Agency Fish Agreement. (Page C-18)

136. Indicate that without enlargement of the California Aqueduct's East Branch, addition of the second barrel of the Peace Valley Pipeline and units at Warne Powerplant are required to deliver Metropolitan's requests for water in the future. (Page C-19)

Appendix D

137. Change "yield developed by groundwater" to "yield developed by groundwater storage." (Page D-1)

138. Indicate how the year 2000 goal of 600,000 is incorporated in the service area impact study. In the water supply operations study, 345,000 AF is incorporated. (Page D-4)

139. It is stated that the service area impacts represent dry hydrologic year impacts. Would it be more appropriate to state that the impacts represent the increase in firm yield which results in dry and critical years? (Page D-6)

140. Correct spelling of "longhand". (Page D-14)

141. Correct spelling of "potentially." (Page D-14)

142. Correct spelling of "alternative" and "about." (Page D-16)

143. Indicate that no costs have yet been developed in the Colorado River banking reconnaissance-level study and that the costs indicated are for groundwater storage. (Page D-16)

144. Indicate reference for Footnote 1 to Table I-7. (Page D-20)

145. Indicate whether air quality standards are the same throughout the state, or whether they vary with air basins. (Page D-24)

146. Indicate that instream programs utilizing State project supplies depend upon the availability of these supplies. With current plans, State project supplies won't satisfy existing requirements let alone provide for instream programs. (Page D-27)

147. Indicate that groundwater management programs in the South Bay service area are a local responsibility. (Page D-28)

148. Indicate that the air quality, biological, and land-use effects of providing additional water from the four pumps would also occur with the additional water provided by other alternatives. (Page D-24)

149. Indicate that purchase and preservation of local lands with significant biological resource value is a local option, should the local communities believe it to be in the public interest. (Page D-32)

150. Correct spelling of "North." (Page D-35)

151. Correct year from "200" to "2000" in Footnote 9. (Page D-35)

152. The effects of urbanization in the Central Coastal service area are speculative. Urbanization could take place in areas along the south coast of the county or in the northern portion of the county near already developed areas. (Page D-36)

153. In the cumulative effects of SWP deliveries discussion, Table I-11 shows 1990 level deliveries to be 3.056 MAF. The water supply operation studies assumed a target export of 3.247 MAF. The service area impact analysis takes projected deliveries from Bulletin 132-81, while the water supply operation studies takes its target export demand from Bulletin 132-78,

according to the Two-Agency Fish Agreement Final EIR. Indicate the reason for the difference. (Pages D-37, D-38)

154. Table I-11 deliveries are indicated to be cumulative. Substitute "projected" for "cumulative." Cumulative deliveries would more appropriately refer to the total deliveries of State project water since the advent of the project. The amount of water allocated to replacement is low. (Page D-38)

155. Indicate the origin of the 3.112 MAF figure in the cumulative environmental impact discussion. (Page D-51)

156. The last paragraph, which is a discussion of air quality, has been misplaced in the hydrology discussion. (Page D-53)

LETTER 18

PALMDALE WATER DISTRICT

2005 East Avenue Q · Palmdale, California 93550 · Telephone 947-4111

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ROSS W. ANSPOKER, Attorney

February 10, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
Post Office Box 160088
Sacramento, CA 95816

Re: Draft EIR on Proposed
Additional Pumping Units
At the Harvey O. Banks
Delta Pumping Plant

Dear Mr. Potter:

The Palmdale Water District has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contractors, Inc. on the four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant. 1

Please be advised that we support the comments submitted.

Very truly yours,

PALMDALE WATER DISTRICT

Frank Sherrill, Manager

FS:sw

LETTER 20

STATE OF CALIFORNIA

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION
30 VAN NESS AVENUE
SAN FRANCISCO, CALIFORNIA 94102
PHONE: 557-3686

February 10, 1983

Mr. Robert G. Potter, Chief
Central District
Department of Water Resources
P. O. Box 160088
Sacramento, California 95816

SUBJECT: Draft Environmental Impact Report; Proposed Additional Pumping Units, Banks Delta Pumping Plant; SCH #2113008 (BCDC Inquiry File No. MC.MC.7415.11)

Dear Mr. Potter:

The following comments have been prepared by the staff of the San Francisco Bay Conservation and Development Commission. Although the Commission has not had an opportunity to review the comments, the comments are based on the past policy decisions of the Commission.

There are three major flaws in the conclusions reached by the Draft Environmental Impact Report:

1. Construction of four new expensive pumps, with a greater diversion capacity than the amount currently proposed for diversion, will again create the types of controversies and regulatory difficulties experienced with projects such as the New Melones Dam. The decision to build something when it is not yet known whether it can be used to its capacity is questionable, particularly when alternatives identified in the Draft Environmental Impact Report (discussed below) have better benefit/cost ratios. From the text of the Draft Environmental Impact Report it is hard to resist the conclusion that the project is being constructed with the intention of using its capabilities in the future to argue for greater diversions. It would be sounder, in our opinion, to first determine what diversions can be accommodated by the Bay/Delta system and then design a cost-effective system to accomplish that end. 1

2. Substantial emphasis in the Draft Environmental Impact Report is placed on the provisions of the Department of Water Resources-Department of Fish and Game agreement to guarantee that the pumps 2

20

Mr. Robert H. Potter
February 10, 1983
Page Two

will be operated as represented. However, that agreement has not been signed and there is no indication that it will be signed in the near future, if ever. This situation, coupled with the decision to avoid a Corps of Engineers permit, will lead to a situation in which the operational restrictions on the project can be easily changed without the full review that would otherwise take place with an ordinary project. This is particularly true since the constraints on the project required to avoid a Corps of Engineers permit are jurisdictional in nature and have little to do with protection of fish and wildlife resources. Consequently, the operational restrictions assumed in the Draft Environmental Impact Report do not appear to be justified. 2

3. It is difficult to understand how the four-pump alternative was found to be preferable when the Draft Environmental Impact Report notes that Alternative 2-T3, with only two pumps, has a better benefit/cost ratio. More importantly, however, the Draft Environmental Impact Report also states that there is a greater potential for increased yield at lower cost from water conservation. Why the preferred alternative is selected instead of relying on the alternatives listed in the Draft Environmental Impact Report is never clearly explained. Given the risk that the high capital cost and capacity of the preferred alternative will be used as a justification for increasing diversions at the expense of the fish and wildlife resources of the Bay/Delta system. It seems to us that selection of the four-pump alternative is very dubious. 3

Very truly yours,

FRANK R. BROADHEAD
Staff Counsel

FRB/mm

cc: State Clearinghouse

LETTER 21

SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT
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THOMAS H. STETSON, Consulting Engineer

February 10, 1983

Mr. Robert G. Potter
Chief
Central District
Department of Water Resources
P. O. Box 160088
Sacramento, California 95816

Subject: Draft EIR on Proposed Additional
Pumping Units at The Harvey O.
Banks Delta Pumping Plant

Dear Mr. Potter:

The San Gabriel Valley Municipal Water District has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contractors, Inc. on the four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant. 1

Please be advised that we support the comments submitted.

Very truly yours,

William M. Whiteside
General Manager

WMW:hw

BOYS KEEN OPERATIONS CENTER, 540 EAST SIERRA MADRE AVENUE, P.O. BOX 1290, AZUSA, CALIFORNIA 91702
Tel. (213) 960-3710, 960-3519

LETTER 22

COURT HOUSE

Santa Barbara County Flood Control and Water Conservation District and Santa Barbara County Water Agency

123 E. Anapamu Street
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JAMES M. STUBCHAER
Flood Control Engineer
Water Engineer-Manager

ROBERT L. PARTIS
Assistant Flood Control Engineer

February 15, 1983

Mr. Robert G. Potter, Chief
Central District
Department of Water Resources
P. O. Box 160088
Sacramento, California 95816

Re: Draft EIR on Proposed Additional Pumping Units at the Harvey O. Banks Delta Pumping Plant

Dear Mr. Potter:

The Santa Barbara County Flood Control and Water Conservation District has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contractors, Inc. on
1 the four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Please be advised that we support the comments submitted.

Very truly yours,

James M. Stubchaer
Engineer-Manager

JMS:mk
cc: SW Contractors Audit Committee
SW Contractors, Inc.

Administration & Finance
Mary S. Pinoli
Accounting Officer

Engineering
Will Copeland
Senior Civil Engineer

Operations
J. L. Fertig
Operations Engineer

LETTER 23

Santa Clara Valley Water District

5750 ALMADEN EXPRESSWAY
SAN JOSE, CALIFORNIA 95118
TELEPHONE (408) 265-2600

February 15, 1983

Mr. Robert G. Potter
Central District
Department of Water Resources
Post Office Box 160088
Sacramento, California 95816

Dear Mr. Potter:

This transmits Santa Clara Valley Water District's comments regarding the Draft Environmental Impact Report on the "Proposed Additional Pumping Units, Harvey O. Banks Delta Pumping Plant", dated November 1982.

Our District concurs with the comments submitted on behalf of the State Water
1 Contractors, Inc., and the State Water Contractors Audit Committee. Summaries of these comments were presented at the Public Hearing which DWR held on the Draft EIR in Sacramento on February 4, 1983.

One area of particular concern to us is that the Draft EIR proposes enforceable water conservation programs as mitigation measures. We strongly support voluntary water conservation (water savings) programs, and include a continuing water conservation effort in our overall water management program. While we
2 have included savings based upon ongoing water conservation efforts in projecting our future water demands, our present and future water conservation programs are independent of the installation of the four additional pumps or other actions in the Delta, and will occur because we recognize them as effective tools for prudent water management. They should not be considered as either mitigation measures or as substitute water supplies. These types of references should be excluded from the Final EIR.

The reference to the San Felipe Division on Page 90 is incorrect in its statement that the project will increase Delta exports. The project should not
3 increase Delta exports at all, because the water allocated to the project is currently being used on an interim basis by Westlands Water District. As the San Felipe Project comes on line, Westlands will lose the use of that water.

Thank you for the opportunity to present our comments.

Sincerely,

David K. Gill
Water Supply Manager

AN AFFIRMATIVE ACTION EMPLOYER

LETTER 24

PUBLIC WORKS DEPARTMENT
HALL OF JUSTICE
600 Union Avenue
Fairfield, California 94533
Telephone (707) 429-6461
707-429-6336

EUGENE H. KNAPP
DIRECTOR

February 14, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
Post Office Box 160088
Sacramento, California 95816

RE: Draft EIR On Proposed Additional Pumping Units At The Harvey O. Banks Delta Pumping Plant

Dear Mr. Potter:

The Solano County Flood Control and Water Conservation District has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contrac-
1 tors, Inc. on the four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Please be advised that we support the comments submitted.

Very truly yours,

EUGENE H. KNAPP
Public Works Director

By: John T. Swenson
Water Resources Engineer

JTS:jg

LETTER 25

TULARE LAKE BASIN WATER STORAGE DISTRICT

ESTABLISHED 1926
1109 WHITLEY AVENUE • PHONE (209) 992-4127
CORCORAN, CALIFORNIA 93212

February 11, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
Post Office Box 160088
Sacramento, California 95816

Re: Draft EIR On Proposed Additional Pumping Units At The Harvey O. Banks Delta Pumping Plant

Dear Mr. Potter:

The Tulare Lake Basin Water Storage District has reviewed the comments prepared and submitted by the State Water Contractors Audit Committee and the State Water Contractors,
1 Inc. on the four (4) additional pumping units at the Harvey O. Banks Delta Pumping Plant.

Please be advised that we support the comments submitted.

Yours truly,

Brent L. Graham
Manager

BLG:cc

• COMPRISING TULARE LAKE BASIN IN KINGS AND TULARE COUNTIES, CALIFORNIA •

1121 L Street Sacramento, Ca. 95814 (916) 447-7357

LETTER 26

state water contractors

Directors
Ronald R. Esau, President
Santa Clara Valley Water District
Lowel O. Weeks, Vice President
Coachella Valley Water District
Stuart T. Pyle, Secretary-Treasurer
Kern County Water Agency
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Castaic Lake Water Agency
Wallace C. Spinaraki
Antelope Valley-East Kern Water Agency
James M. Stubchaer
Santa Barbara County Flood Control and Water Conservation District

February 15, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, CA 95816

Dear Bob:

The State Water Contractors offer the following comments on the Draft Environmental Impact Report for the Proposed Additional Pumping Units at the Harvey O. Banks Delta Pumping Plant. These comments are in addition to the comments presented at the February 4, 1983, hearing. A copy of February 4th comments are enclosed. For purposes of organization, we will present our comments by chapter heading.

Introduction

1 1. It should be specified that the 2.2 and 1.7 million acre-feet State Water Project (SWP) yield estimates assume the SWP and the Central Valley Project (CVP) are operated by the 1971 Draft Coordinated Operations Agreement. (page 2)

2 2. As suggested in our February 4th comments, the section entitled "Proposed Agreement to Manage the Fish and Wildlife Resources of the Sacramento-San Joaquin Estuary" should be deleted and replaced later in the Draft Environmental Impact Report (DEIR) text with a discussion of the Department of Water Resources' plans for mitigation of the unavoidable impacts of the proposed additional units. (page 8-9)

Project Description

3 1. There is no discussion in this chapter or in Appendix C on how the estimated benefit of 5 mills per killowatt hour (kwh) for shifting energy from on-peak to off-peak periods was determined. This estimate seems low to the contractors.

26 - 2 -

3 The data presented on page C-6 shows the difference between peak and off-peak energy cost for PG&E is 9 to 15 mills per Kwh in 1990 and 23 to 29 mills per Kwh estimated to be in the year 2000. If capacity costs are included, an additional 6 to 47 mills per Kwh plus inflation could be added. Although this rough analysis assumes the availability of a firm supply for sale and therefore probably leads to an inflated estimate, it does make the Department's 5 mills per Kwh look low. Please explain how the 5 mills per Kwh estimate was determined. (page 13 and C-7)

4 2. The statement that State Water Project shortages will begin showing up in 1985 on page 14 must be clarified. Shortages would occur only if a drought period equal to or worse than assumed in the Department's dependable supply studies should occur. Shortages will not be imposed outside of drought periods in the near future. (page 14)

5 3. The statement on page 14, that the Department will declare a permanent shortage when water supply forecasts indicate the need, is unclear. If the term "permanent shortage" is being used here as the term is used in Article 18 of the contracts for purchase of SWP water, then the reference to water supply forecasts is incorrect. A permanent shortage would be triggered when the minimum projected yield is less than the contractor's water supply demand not by a water supply forecast. If "permanent shortage" as used in the DEIR was not intended to indicate a permanent reduction in the contractor's entitlements, a different term should be used. (page 14)

6 4. The Department has reduced the contractors' request for entitlement water because of projected savings from water conservation and reclamation programs. The contractors have requested less entitlement water than the contract annual maximums because of slower than expected population growth and because of existing and planned water conservation and reclamation programs. The Department's reduction in the contractors' request probably results in double accounting of future demand reduction programs. (page 15, figure 4)

Description and Comparison of Alternatives

7 1. Demand reduction alternatives should not be used for economic comparison to the water supply augmentation benefits of the additional pumping units. The Department's projections show shortages in SWP deliveries in the near future even with the implementation of those demand reduction alternatives assumed by the Department to be reasonable, cost effective, and environmentally acceptable. Therefore, water augmentation alternatives should be compared with other water augmentation alternatives not with demand reduction alternatives. (page 19)

26 - 3 -

8 2. The Two Agency Fish and Wildlife Agreement has not been executed and should not be referred to as an operational constraint. (page 20)

9 3. The DEIR assumes that the East Branch has been enlarged. The reason given is to assure that the maximum Delta impacts, maximum intermittent yield potential, and maximum energy cost will result. This conservative assumption will result in the least favorable Delta impact analysis for adding the new pumping units. The Department consistently made the most conservative assumption possible when analyzing the impacts of the new units. Examples in addition to the East Branch enlargement would include the analysis of the water level impacts and the assumptions behind the operation studies used to measure the impacts of the new units.

The contractors agree with the Department's apparent decision to make the most conservative assumption possible when analyzing the impacts of adding pumping units at the Delta Pumping Plant. However, the fact that the Department has been conservative should be discussed and highlighted here. Those reading the DEIR should be informed that the impacts discussed are in all probability worse than will actually occur. (page 21)

10 4. The "Physical Constraints Affecting Project Operations" section is unclear. I believe the Department is trying to explain that there may be limits to the south Delta's channel capacity in addition to the Clifton Court Forebay's intake capacity limitation. This section should be expanded. The effect of the Department's uncertainty as to the South Delta's capacity to move water to the Delta Pumping Plant with average monthly flows greater than 7,300 cfs on the selection of the proposed alternative should be discussed. (page 21)

11 5. The Department state flatly in the DEIR that at the present time, it has no intent to apply for a federal permit to modify Clifton Court Forebay. Therefore the 4-7.3 alternative was selected. Please expand and give reasons for making this decision. (page 21)

12 6. The DEIR states that all that is needed to increase the monthly diversion rate to 10,300 cfs is the four additional units, the second intake at Clifton Court Forebay, and minor dredging of the West Canal. Is this true? Can the other south Delta channels handle 10,300 cfs during periods of low San Joaquin River flows? Does Clifton Court Forebay have sufficient storage? I think the Department is uncertain on the answers to these questions and so stated on page 21. Don't you really mean to say that "For purposes of comparative analysis the Department assumed that all that is needed

26 - 4 -

to increase the monthly diversion rate to 10,200 cfs is ... etc." (page 24)

13 7. State that Table 2 does not place an economic value on the operational advantages if two new units versus no new units and four new units versus two new units or no new units. (page 25)

14 8. The reason for placing the restriction of no additional storage facilities on the selection of alternatives to the additional pumping units is hard to understand. Please explain why this restriction was imposed. (page 26)

15 9. Discussion on alternatives. See comment 1 this section and February 4, 1983, comments. (page 26-30)

16 10. The cost of some of the alternatives selected seem much too high to be considered feasible. Examples, Imperial Valley Desalting ($648 per acre-foot) and Riverside County Desalting ($490 per acre-foot). (page 28-30)

Environmental Setting

17 1. The DEIR states that the Suisun Marsh overall plan facilities are scheduled for completion in 1984. This is no longer true. Please revise. (page 38)

Environmental Impacts of Installing and Operating Additional Pumps

18 1. The statement in the DEIR that except for the West Canal the velocities in south Delta channels will be below scouring levels with maximum exports of 15,000 cfs seems inconsistent with other statements in the DEIR and past statements made by the Department. I have always believed, based on past statements made by the Department, that it would take more than the installation of an additional Clifton Court Forebay intake and dredging of the West Canal to prevent channel scouring with export levels at 15,000 cfs. Have I misunderstood the Department or has the Department changed its past position? Please expand to help answer this question. (page 55)

19 2. The text states that the present SWP and Central Valley Project (CVP) facilities were assumed in the operation studies. This should be corrected to state that the Auburn-Folsom South Unit and Suisun Marsh Facilities were assumed to be completed. In addition, it should be stated here that the two projects were operated as one and the SWP used CVP water supplies not needed by the federal water users in 1990. (page 55)

3. The results of the four operation studies as shown in table 10 raise a question in the months of May and June. The May and June export levels never reach the maximum allowable
20 D-1485 level of 6,000 cfs. This is inconsistent with actual operations. Although this inconsistency will probably not effect the analysis of the additional pumps, please explain why the export levels are not at 6,000 cfs in some of the year, types and alternatives shown. (page 57)

21 4. The Delta outflows shown in Table 11 for the months of May and June in Below Normal years are less than required by D-1485. Why? (page 58)

5. On page 67 the DEIR states that export rates can effect the flow in the Delta Cross Channel and Georgiana Sloughs during balanced conditions. Other than by requiring a change in
22 upstream reservoir releases, how can export rates effect this flow? Did you mean to imply the water levels could be increased or decreased by the exports and therefore impact the flow rates of the Delta Cross Channel and Georgiana Slough? (page 67)

6. The "General Impacts on Striped Bass" section is written with the tradition Department of Fish and Game (DFG) bias that the CVP and SWP are the sole cause of the striped bass population decline in the Delta. This bias was questioned first in the State Water Resources Control Board's Triennial
23 Report on D-1485 and more recently by the Board's Striped Bass Working Group. Although it is agreed that the two projects impact striped bass, this section should be rewritten to include the more recent information on pesticides, etc. In addition, it should mention that the striped bass index has not predicted populations accurately since 1976. (page 73)

7. The reference to the Two Agency Fish and Wildlife Agreement
24 should be dropped. A mitigation program which would consist of SWP financed fish hatcheries and the planting of striped bass should be developed and agreed to with the DFG. This program should then be described here. (page 87)

8. The proposal to include enforceable conservation programs
25 for the SWP contractors should be dropped. There is no connection shown in the DEIR between water conservation programs and mitigation of the impacts of the additional units. (page 87)

Cumulative Impacts

1. The following key statement is made in this chapter:

26 "However, the four additional pumps are key elements of any plan to balance supplies and needs in the services areas."

The contractors strongly agree with this statement and would add that the Delta Pumping Plant with the four additional units must eventually be operated at the full capacity of 10,300 cfs when water that is surplus to the Delta's needs
26 is available.

The Department should make it clear that they ultimately plan to operate the Delta Pumping Plant at the capacity of 10,300 cfs. However, the Department should also make it clear that they intend to provide additional environmental documentation on the impacts of the change from the Corps of Engineers operational limits to the ultimate operation. (page 89)

27 2. San Felipe should not increase Delta exports at all. The 200,000 acre-feet allocated to San Felipe is presently being used by the Westlands Water District. As San Felipe comes on line Westlands will lose the use of that water. (page 90)

3. The section dealing with water conservation in the "Executive Order B-68-80" should be deleted. This cumulative impacts chapter is dealing with water augmentation programs
28 which the desalting portion of the Governor's order may become. However, water conservation programs reduce the demand and do not augment the supply. Therefore, the portion of this section following "Executive Order B-68-80 also directs..." should be deleted. (page 91)

Appendix B

1. The assumptions used to develop the operation studies result in a significant overstatement of the SWP's yield in 1990. The Delta export yield in the studies (3,250,000 acre-feet) is probably 750,000 to 1,000,000 acre-feet too high. Some of the questionable assumptions are:

29
a) The CVP is operated to help SWP operational and delivery requirements.

b) The Auburn-Folsom South Unit is assumed to be in operation by 1990 with no significant CVP demand.

c) The Suisun Marsh facilities are assumed to be in operation.

d) The DEIR is silent as to the assumptions used concerning Delta Transfer Facilities. I would guess, however, that carriage water impacts were ignored to get a yield of 3,250,000 acre-feet. Ignoring carriage water would be the same as assuming the existence of a Delta Transfer Facility.

The result of the above is an overstatement of the amount of water available for export by the existing Delta Pumping Plant and each alternative for adding the new pumping units.
29 While the results do not reflect the amount of water that will probably be available in 1990 to the contractors, the results are not necessarily improper if used only to for assess the impacts of adding the new units. In fact, the above assumptions would lead to a conservative assessment since more than likely less water will be exported than shown by the operation studies. In addition, since the same assumptions are made for each operation study, the incremental increases in yield for each alternative and the export patterns should be correct.

It should be explained in the text and in this appendix that the SWP yield estimates are overstated and explained what impact this will have on the environmental and service area impact assessments in the DEIR.

2. The use of the intermittent export deliveries concept in this DEIR is very good. However, it should be explained in
30 the text and in this appendix that all of the assumptions made on intermittent exports are conservative and will maximize the Delta impacts.

Sincerely,

David R. Schuster
General Manager

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STATEMENT OF THE STATE WATER CONTRACTORS
ON THE DRAFT ENVIRONMENTAL IMPACT REPORT
FOR THE
PROPOSED ADDITIONAL PUMPING UNITS AT THE
HARVEY O. BANKS DELTA PUMPING PLANT

February 4, 1983

My name is David R. Schuster and I am here today on behalf of the State Water Contractors, Inc. I appreciate this opportunity to comment on the Draft Environmental Impact Report (DEIR) for the proposed additional pumping units at the Harvey O. Banks Delta Pumping Plant. I will present our general comments on the DEIR today and will submit our more detailed comments in writing by February 15, 1983.

Our most important comment relates to our concern that the DEIR does not clearly outline the Department of Water Resources ultimate intention. That is to operate the Harvey O. Banks Delta Pumping Plant at the maximum capacity of 10,300 cfs on a sustained basis, subject to Delta water quality requirements and the availability of a water supply. The Department has apparently chosen a two-step process for the installation of the four pumping units. The first step is to install the four additional pumping units and to operate the Delta Pumping Plant in accordance with the Corps of Engineers operational constraints as set forth in the Corps' October 13, 1981 Public Notice. The second step would be to propose a new operational scheme and possibly some construction in the south Delta which will allow the export of the full 10,300 cfs. The second step would not be implemented until the institutional, technical and mitigation constraints had been satisfied. While we do not necessarily object to this program strategy, we are concerned that the DEIR is not clear.

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As you know, the authorizing legislation for the State Water Project required the construction of the California Aqueduct at a capacity north of San Luis Reservoir of at least 10,000 cfs. The legislators and water experts of that time wanted a Delta Pumping plan which could maximize the Project's ability to make use of winter surplus flows in the Delta. They believed that by maximizing the use of winter flows which were not needed by northern California water users or by the Delta for controlling ocean salinity, they could minimize the competition for water during dry periods between northern and southern California water users and between the water users and the environment.

We believe that they are still correct. Any long-term plan for meeting the water needs of the State Water Project contractors will include some sort of Delta water transfer facility, water storage facilities north and south of the Delta, and operation of the Delta Pumping Plant, after installation of the four new units, at the full capacity of 10,300 cfs during periods of surplus Delta flows. For all of the above reasons, the Department should rewrite the DEIR so that the long-term intentions of the Department are clear to all who are interested in the operations of the State Water Project.

A corollary question relates to the Department's choice to adopt the two-step program. I assume from reading the DEIR that the Department apparently believes it does not have enough information to prepare an environmental impact report on the 4-10.3 alternative. (For purposes of brevity, I will use the DEIR alternative description method) The main reasons for this conclusion are that the Department has not decided how it is going to increase the water transfer capacity of the southern Delta and because the Department apparently believes a Corps of Engineers permit is needed before the Delta Pumping Plant can be operated at the full capacity of 10,300 cfs. Therefore, the Department apparently decided, to operate the Delta Pumping Plant

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after installation of the four new units under the Corps of Engineers operational constraints, for the present, so as to receive the increased off-peak pumping and limited yield increase benefits.

The above assumptions do not agree with much of the information presented in the DEIR. The benefit/cost analysis, fish screen loss analysis and impacts on south Delta water levels analysis point toward the 4-10.3 alternative. It is not clear why the Department chose the proposed 4-7.3 alternative and not the 4-10.3 alternative. For this reason, the contractors request the redrafting of the DEIR so the reasons for selecting the proposed alternative are expanded and clarified. We want to make sure that it is clear that the Department's choice of the 4-7.3 alternative now is not misinterpreted as a rejection of the 4-10.3 alternative and that the public is not misled.

Our third comment pertains to the continued reference to the proposed Two Agency Fish and Wildlife Agreement. It is our understanding that this agreement will not be executed in its present form. The DEIR should be rewritten to take out all references to the Two-Agency Fish and Wildlife Agreement. However, we acknowledge the responsibility of the State Water Project to provide mitigation for significant adverse impacts which the operation of the additional pumping units may cause. The proposal in the DEIR to provide mitigation for the four new units by augmenting fish stocks through State Water Project financed hatchery production and subsequent planting makes eminent sense to us.

The DEIR contains the following statement on Page 87:

> "If the proposed fish and wildlife agreement is not finalized, the Department of Water Resources will establish a similar mitigation program for the proposed pumps."

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We believe the Department should establish the striped bass augmentation program referred to above and rewrite the DEIR accordingly.

The Department continues to mix water demand reduction schemes such as a toilet dam retrofit program with water supply augmentation schemes such as an enlarged Shasta Dam alternative or the Imperial Valley Conservation Program. The Department must assume that all cost effective and environmentally acceptable conservation programs will be implemented with and/or without State assistance by the appropriate water users in an effort to minimize the impacts of future water shortages. However, the Department's own projections indicate that, even with water conservation, shortages will occur in the near future unless there is significant augmentation of the State Water Project firm water supply. The addition of the four units at the Delta Pumping Plant is the first step toward augmenting that water supply. Feasible water supply development or augmentation alternatives should be used to compare with the four additional units, not water conservation programs. Non-feasible alternatives such as Imperial Valley Drainage Water Desalting ($648/AF) should not be included.

On pages S-9 and 87, it is stated that in addition to the stocking program, mitigation will include enforceable water conservation programs for State Water Project contractors. According to the DEIR, these programs will be developed by the Department and will be reasonable, cost effective, financially feasible, environmentally acceptable and legally implementable. This is the extent of the discussion in the DEIR on these enforceable conservation programs. The contractors do not understand how an enforceable water conservation program could mitigate for any unavoidable impacts of the four new units. In addition, we believe the Department does not have the authority to implement this program. Each of the State Water Project

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contractors is purchasing very expensive water for areas of deficient water supply. Unless we can be shown to the contrary, it should not be presumed the contractors are not using their limited water supplies in a well managed and efficient manner. Including water conservation as mitigation is inappropriate and the two paragraphs of discussion in the DEIR should be deleted.

The contractors want to commend the Department for its efforts to install the additional pumping units. Once again I would like to thank you for this opportunity to comment on the Draft Environmental Impact Report on the proposed additional pumping units at the Harvey O. Banks Delta Pumping Plant.

C-105516

LETTER 27

STATE WATER CONTRACTORS AUDIT COMMITTEE

c/o 1109 Whitley Avenue
Corcoran, California 93212
(209) 992-4127

Alameda County Flood Control and Water Conservation District
Alameda County Water District
Antelope Valley-East Kern Water Agency
Castaic Municipal Water District
Castaic Lake Water Agency
City of Yuba City
Coachella Valley Water District
County of Kings
Crestline-Lake Arrowhead Water Agency
Desert Water Agency
Devil's Den Water District
Dudley Ridge Water District
Empire Westside Irrigation District
Kern County Water Agency
Littlerock Creek Irrigation District
Mojave Water Agency
Napa County Flood Control and Water Conservation District
Palmdale Water District
San Bernardino Valley Municipal Water District
San Gabriel Valley Municipal Water District
San Gorgonio Pass Water Agency
San Luis Obispo County Flood Control and Water Conservation District
Santa Barbara County Flood Control and Water Conservation District
Santa Clara Valley Water District
Solano County Flood Control and Water Conservation District
Tulare Lake Basin Water Storage District

February 15, 1983

Robert G. Potter, Chief
Central District
DEPARTMENT OF WATER RESOURCES
Post Office Box 160088
Sacramento, California 95816

Re: Draft EIR On Proposed Additional Pumping Units At The Harvey O. Banks Delta Pumping Plant

Dear Mr. Potter:

Please find attached "Comments of State Water Contractors Audit Committee On Draft Environmental Impact Report On Proposed Additional Pumping Units, Harvey O. Banks Delta Pumping Plant."

Yours truly,

Brent L. Graham
Secretary

BLG:cc

Enclosure

27

COMMENTS OF
STATE WATER CONTRACTORS AUDIT COMMITTEE
ON
DRAFT ENVIRONMENTAL IMPACT REPORT ON
PROPOSED ADDITIONAL PUMPING UNITS
HARVEY O. BANKS DELTA PUMPING PLANT

The State Water Contractors Audit Committee has reviewed the Draft Environmental Impact Report on the proposed additional pumps at the Harvey O. Banks Delta Pumping Plant and offers these comments.

1 The State Water Contractors Audit Committee supports the installation of the additional four pumps at the Delta Pumping Plant and urges the Department to expedite the final EIR and their installation.

2 One of the major concerns the Audit Committee has with the Draft EIR is that the selection of the preferred Alternative 4-7.3 (7,300 cfs pumping limitation) obscures the greater benefits of Alternative 4-10.3 (10,300 cfs pumping limitation). Further discussion of the ultimate operational mode which would involve Alternative 4-10.3 should be included.

3 The draft EIR apparently uses a two-step approach to installation of the additional four pumps. The basis for this approach should be clarified with recognition of the need to pump at the higher level of 10,300 second-feet under ultimate conditions and at other times when flow in the Delta will permit. The limitations to 7,300 second-feet relate to the State's share of total diversion capacity from the southern Delta

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channels which include the Tracy Pumping Plant of about 4,800 second-feet.

4 When the permanent Delta transfer facility is constructed, there will be pumping at the higher rate more frequently. This higher pumping rate was the intention of the Burns-Porter Act legislation which recognized the concept of maximizing diversions from the Delta during the periods of high inflow.

5 The two-step procedure the Department is using should be further explained. The Corps of Engineers Public Notice (draft EIR, p. 7) allows diversion greater than 13,250 acre-feet per day when flows in the San Joaquin River at Vernalis exceed 1,000 second-feet. Our analysis indicates that over the historical period sufficient flows in the San Joaquin River ocurred to allow additional divertable flows amounting to an average of about 140,000 acre-feet per year.

6 It should be noted that the United States District Court in Sierra Club v. James G. Watt (Supplemental Memorandum of Opinion and Order) on December 30, 1982 dismissed the action premised on the Corps of Engineers on-going monitoring of the effects on navigable channel capacity resulting from the operation of the Delta Pumping Plant, including the additional four pumping units. The EIR should be revised to recognize this decision.

7 The EIR should also discuss compliance with the Burns-Porter Act (Water Code Section 12934(d)(2)) which mandates an aqueduct system with an intake and diversion works north of

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San Luis Reservoir with a capacity of not less than 10,000 second-feet. The intention to operate at a diversion level of 10,300 second-feet when conditions permit should be emphasized.

8 There should be recognition given to the additional flexibility and reliability that will be given to the Central Valley Project and State Water Project with the additional four pumps should failure occur in the existing pumping units either at the Delta Pumping Plant or at the Tracy Pumping Plant. In the past, there have been canal lining failures in both the Delta-Mendota Canal and the California Aqueduct which indicate a need for additional pumping capacity to offset periods of canal shutdown. The draft EIR recognizes that some additional inlet work will be necessary at Clifton Court Forebay.

9 The draft EIR implies all problems of striped bass decline are due to diversions from the Delta; however, the conclusions of the Striped Bass Working Group for the SWRCB (Report November 1982) indicate stresses put on the bass population by toxic substances and other causes are also factors that should be discussed. Reference should be made to the conclusions of that Working Group and to the SWRCB "Trienneial Review of the Water Quality Control Plan for the Delta" where additional causes for striped bass decline are reported. There is a lack of correlation of Delta outflow to survival of striped bass since the 1976-77 drought. This should be discussed. The striped bass fishery throughout the SWP system should be discussed.

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The draft EIR discusses the proposed "Agreement to Manage Fish and Wildlife Resources in the Sacramento-San Joaquin Estuary." This agreement has not been signed and will probably not
10 be consumated in its present form. The State Water Contractors fully support a mitigation program for loss to fishery, but believe this can be largely done through a hatchery stocking program. The EIR should acknowledge the Fish Agreement will be revised and hatchery mitigation should be discussed.

One of the mitigation measures discussed in the draft EIR is an enforceable conservation program. This is entirely unacceptable as a viable mitigation measure and should be deleted from the EIR. Conservation and waste water reclamation programs are being undertaken by the State Water Contractors and these are reflected in the future water requirements from the SWP
11 developed by the individual contractors. Conservation has been taken into consideration as a part of stretching out existing supplies and in recognition of the high cost of imported water. It is unrealistic, however, to assume the enforceability of such programs by the State and reference to such should be deleted. The EIR should acknowledge conservation as an on-going program and not as a mitigation measure.

More consideration should be given in the EIR to structural alternatives as being more practical than such items as desalting, mandatory landscape design and Imperial Valley water con-
12 servation. These are not viable alternatives because of cost, inability to enforce and/or institutional and legal constraints.

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Structural alternatives such as surface water conservation works should be discussed.

The draft EIR makes reference to SB 200 and the defeat of Proposition 9 by the electorate and the resulting impact on the water resources planning program. For whatever reasons Proposition 9 was defeated, the obligations of the State under the Burns-Porter Act and the water contracts remain. Authority of the Department to add units to the SWP as contained in Water Code Sections 12931 and 12934(d)(2) should be recognized in the
13 EIR. We recommend the EIR stress the obligation of the State to develop the project yield and base the service area impacts on a full supply to meet the demands. As a consequence, uncertainty resulting from the defeat of Proposition 9 should be deemphasized. The intention to construct the additional facilities to deliver the full contracted supplies including a Delta facility operation at the 10,300 second-feet level of diversion should be included in the EIR.

We question the need for the EIR to include an analysis of economic justification of the installation of the additional pumps. Whereas it is appropriate to address the question of efficient allocation of resources, benefit-cost analysis is
14 not required to do so. This is particularly cogent when only one increment of the total project is given such analysis. Since the State has contracted to provide the project yield and since the additional pumps are essential, any benefit-cost analysis is moot. The EIR should emphasize the four additional

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pumps were not installed earlier as a matter of staging for the purpose of deferment of invested capital. This deferment was an economic decision at the time of original construction and the project cannot function as authorized without them. It is noted that the alternative with the highest benefit-cost ratio is the 4-10.3 alternative. This demonstrates the importance of the EIR clarifying the plan for ultimate operation of the pumping plant to its full 10,300 second-feet capacity.

There is an economic impact related to the installation of the additional pumps that should be addressed in the EIR. The additional pumps with the increased diversion capability will prevent an economic loss of some magnitude to much of the agricultural service area in the San Joaquin Valley. Information presented by the State Water Contractors during the D-1485 water rights hearings demonstrates the importance of
15 the full contractual water supply. Water agencies in reliance of the water contracts assumed major financial obligations to construct distribution systems. The fixed obligations for those systems in addition to repayment of the SWP facilities must be met whether or not a full water supply is received. Since the major source of revenue from the agricultural water users comes only from a financial return from the land, anything short of a full supply results in an economic loss. This should be recognized in the EIR.

27

The draft EIR makes reference to Executive Order B-68-80 which requires the Department to prepare water conservation
16 plans for submittal to the State Water Resources Control Board which will conduct public hearings on those plans. This Executive Order may no longer be extant which should be reflected in the final EIR.

Improvements in the EIR can and should be made that will more fully demonstrate in a positive way the need for the additional pumps and their future operation. The SWP water demands used in the draft EIR are understated at the year 1990 level by about 100,000 acre-feet per year as shown in the water contractors requests in Bulletin 132-81. On the other hand, it is
17 noted that the operation study assumptions are conservative in that they overstate the amount of water that will be available to be pumped. We question that the export yield will be as high as indicated in the draft EIR. How have the carriage water losses been accounted for? These may be offsetting factors in the final water quantities diverted, but the EIR should clarify this.

LETTER 28

THE CALIFORNIA FISHERIES RESTORATION FOUNDATION

CFRF

2-5-83

1146 Pulora Court
Sunnyvale, CA 94087

Robert G. Potter, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, CA 95816

REF: Comments, Draft EIR Additional Pumping Units, H.O. Banks Delta Pumping Plant.

Dear Mr. Potter:

We have noted several typographical errors in the comments we provided dated 1-29-83 and request substitution of the attached annotated copy prior to distribution.

Thank you,

Martin M. Seldon,
President

28

THE CALIFORNIA FISHERIES RESTORATION FOUNDATION

CFRF

1146 Pulora Court
Sunnyvale, CA 94087

1-29-83

Rev.A.

Robert G. Potter, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, CA 95816

REF: Comments, Draft EIR Additional Pumping Units, H.O. Banks Delta Pumping Plant

Gentlemen:

We have reviewed the Draft EIR and appreciate the opportunity to have our questions and comments reviewed.

1 The proposed project will increase water export by about 61%, more than 2.8 million af/year:
- How can anything but serious damage take place to the fishery from this very large increase in export completely separate from fish screens ?
- Has the impact of increased pumping at night vs daytime been evaluated ? What are the additional fishery losses that must be found ?
- Assuming installation of the San Luis Drain, what are the fishery effects od the additional export from this project ?

2 Page S-1 states that at peak flows 33% increases in diversions from the San Joaquin River will be allowed:
- What are the effects on the fishery from removing these peak flushing flows from going out through San Francisco Bay ?

3 Pages S-2, S-9 and elsewhere state that the Joint Agency Fish and Wildlife Agreement, a piece of paper, will save the fishery. These sections make the further statement that stocking striped bass and salmon will result in adequate mitigation for project losses. On page 2. the statement is made that detrimental effects have been minimized to a resonable extent:
- Why is this statement included ? SWRCB rulings on water have not addressed all the fishery impacts.
- What is the basis for the determination of adequate mitigation ? We take strong issue with the recent outrageous claims that historical striper populations were only at the 2-million level. We belive that striper populations were at the 5-10 million level during the early 1960's and request mitigation to the higher level. Will the numbers of stocked fish be increased until "adequate" mitigation is achieved ? Are their cost limits that might prevent "adequate" mitigation ?
- On what basis is it assumed that stocking salmon and striped bass will achieve mitigation for project losses ? In regard to salmon the EIR should be revised to analyze the data available over the past 20 year period on the main stem of the Sacramento River. Does the correlation of water export, salmon stocking levels and the serious decline of the fishery give any indications that stocking will work ? The data is all available. See attached graphs.

28

-2-

4 Page 9. In discussing the agreement states that the DWR and DFG must agree on operational constraints:
- What happens if the screens never meet standards ? Can the pumps be shut down completely ? What results if minimum pumping levels must be much lower than anticipated because of other presently unrecognized factors ?

5 Page 69, Figure 9. concerns us because it generalizes the migration patterns into envelop type curves that mask the true nature of year-round migrations in which individual unique strain of fish migrate at specific different times as short pulses or bars on a graph of this type not a generalized-averaged curve:
- What are the long term biological impacts on the unique strains of of fish not displayed on the graph by this project ? How many will be destroyed ?

6 Page 73. upper right section/elsewhere discusses juvenile fish in San Pablo Bay:
- What are the project effects on juvenile nursery fisheries in the other Bays ? Where they considered ? What are the effects on the juvenile fish in San Francisco Bay south to the San Mateo Bridge ?

7 Page 75, fourth paragraph right side states project mitigation will not offset project effects on the American shad:
- What are the expected losses and why can't something be done to mitigate for them ?

8 Page 76-77 includes statements such as: screens are not effective for catfish; no mitigation is provided for sturgeon because not flow changes are planned during the month of May; and factors controlling resident fish are not well understood or the effects are confined to winter :
- What are the project effects on sturgeon the other 11 months of the year neglecting May ? 2.8 million af/year will cause problems .

9 Page 78 and Appendix "B" discuss the problems of fish losses at screens and fish salvage:
- Has a study been done of the location Skinner Protective Facility that investigated the greater results from locating it on the OTHER SIDE OF Clifton Court Forebay ? The EIR must analyze Delta side fish screens for validity.
- Has a study been made about providing a similar facility south of Los Banos that would rescue fish from the canals and return them to the Delta ? The Fish and Wildlife Service has been runaing massive harchery facilities for striped bass and transporting fish around the south for many years. Has a thorough evaluation of how it can be done here been made ?

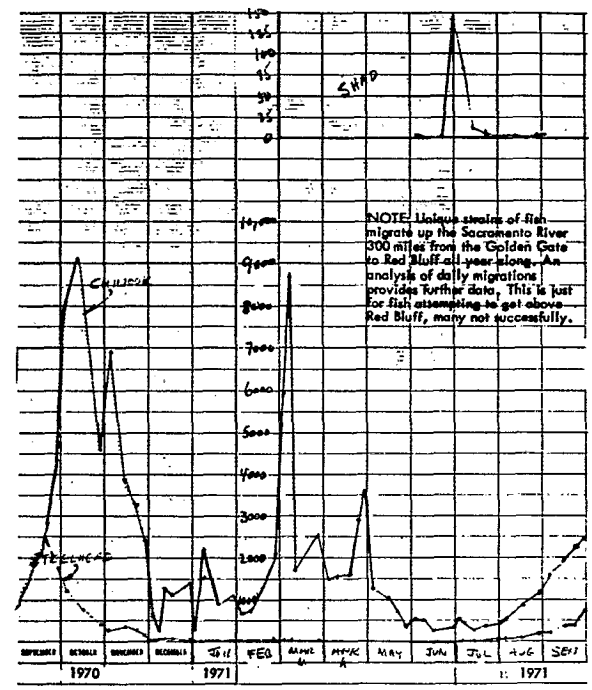
10 Page 89 discusses Cumulative Impacts:
- What are the full sources of the 2.8 million af/year in dry years ? Is it anticipated that any of our Northcoast Rivers including those protected by S.B.107 would have to be harnessed to provide project water under any circumstances ?

In general we are concered with the reams of paper produced by such projects and what seems like a lack of inovative solutions to the most serious problems our fisheries face. Your answer to these questions is requested.

Very truly yours,

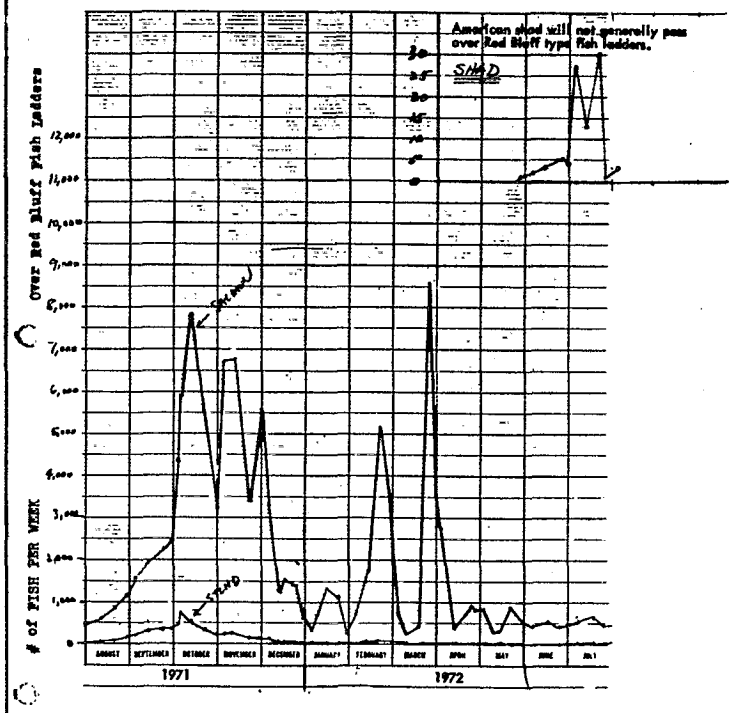
Martin M. Seldon
President, CFRF

28



NOTE: Unique strains of fish migrate up the Sacramento River 300 miles from the Golden Gate to Red Bluff all year along. An analysis of daily migrations provides further data. This is just for fish attempting to get above Red Bluff, many not successfully.

28



LETTER 29

CALIFORNIA WATERFOWL ASSOCIATION
555 VETERANS BOULEVARD • REDWOOD CITY, CALIFORNIA 94063 • (415) 365-5072

January 5, 1983

Mr. Wayne MacRostie, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, CA 95816

Subject: DEIR Proposed Additional Pumping Units, Harvey O. Banks Delta Pumping Plant

Gentlemen:

We have reviewed this DEIR with care and interest and have the following comments:

1 1. The DEIR does not discuss what effect, if any, the various increases in pumping levels would have on waterfowl usage of Clifton Court Forebay.

2 2. The DEIR does not discuss what effect, if any, the various increases in pumping levels would have on recreation opportunities - particularly duck hunting - on Clifton Court Forebay.

3 3. Page 83, "Impacts on Suisun Marsh" - this section contains a very serious shortcoming. It assumes that all the Suisun Marsh water distribution facilities described in the DWR Plan of Protection for the Suisun Marsh (1980) are in place and being operated to provide the water quality called for by D1485's post October 1, 1984 Suisun Marsh Standards. There is no certainty that any, let alone all, of these facilities will be built. There is also clear evidence that the Department will make strenuous efforts to have the post October 1, 1984 D1485 Marsh standards downgraded, at least in critical and dry years.

29

3 Accordingly, this DEIR needs to address the impacts of the various alternatives on the Marsh, assuming that the Marsh facilities are not fully built. A similar analysis is needed if the Marsh water quality standards are relaxed.

We appreciate the opportunity of commenting on this DEIR and hope that our input is helpful.

Very truly yours,

Don Chapin

D. Chapin, Chairman
Resources Committee

cc: E. C. Fullerton, DF&G
W. Ready, CWA

C-105520

LETTER 30

DELTA ENVIRONMENTAL ADVISORY COMMITTEE (DEAC)

Arliss Ungar, Chairman
517 Silverado Drive
Lafayette, CA 94549
415/283-3288

Mr. Howard Eastin
Director
Department of Water Resources
P. O. Box 388
Sacramento, CA 95802

February 3, 1983

SUBJECT: November 1982 Draft Environmental Impact Report
PROPOSED ADDITIONAL PUMPING UNITS Harvey O. Banks
Delta Pumping Plant.

Dear Mr. Eastin:

The Delta Environmental Advisory Committee has reviewed the subject report. We understand that the Department proposes installation of four new pumps to increase
1 the capacity of the existing plant by 61%, but that you intend to only use the new capacity on weekends to take advantage of lower offpeak power rates. We understand the desire to accomplish this, but we believe the November Draft EIR is a step backward.

The draft describes the only significant environmental effects as being an increased entrainment loss of striped bass by 101,800 "yearling equivalents" and the
2 possible loss of other species up to about 0.8% of American shad and white catfish. The mitigation offered is to artificially rear and stock striped bass.

The report ignores the effects of export pumping on the survival of the young bass before they are endangered by entrainment. It uses the old mathematical correlation between the mean June/July exports, June/July outflows, and the
3 abundance of young-of-the-year in mid-summer as evidence that no damage will be done--since mean June/July outflows will not be changed. Since 1976, these correlations have failed to predict the population and the resource is in danger. There is evidence that the export pumping is a root cause.

DEAC's job is to help you solve the Delta problem. We respectfully suggest that it is unwise for the Department
4 to attempt to install additional pumps or to increase export pumping until this fisheries problem is resolved. In our

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- 2 -

opinion, the November draft EIR is not a serious attempt to assess the effect of the proposed project on striped bass or any other fish. Efforts to proceed on the basis described in it will weaken DWR's credibility.

We believe the EIR is inadequate for the following reasons:

5 1. It does not address the real issue of how the present projects have influenced the striped bass populations and their habitat, how the four new pumps will modify that influence, or the Department's ability to solve the problem.

6 2. The assessments of the project impact on other fishes do not demonstrate knowledge of their environmental requirements or influence of the existing projects.

7 3. Some of the conclusions in the EIR are based upon an agreement for the operation of the project between the Department of Fish and Game and the Department of Water Resources. No such agreement exists.

8 4. In some cases, project effects are compared with the effects of future increases in export pumping which the report says will exacerbate existing problems anyway. These "no project" future increases in export pumping, and the Department's authority and ability to make them, are not clearly described in this report.

9 5. The only admitted environmental losses caused by the project are increases in entrainment, from an estimated 11.5 million to 12.7 million young bass. These estimates were made by the Department of Fish and Game, and include only fish larger than 30.1 mm in May, or 40 mm in all other months. Most fish lost are smaller. DWR has previously estimated that 100 million young are entrained at the Harvey O. Banks plant.

10 6. The mitigation proposed is to stock striped bass. The stocking being proposed is experimental. There is no evidence that it will succeed in saving the bass. Most biologists have serious doubts.

11 7. The DEIR merely addresses the operation of the pumps to provide increased pumping capacity using offpeak power. While this is the operation mode initially contemplated, it is not the long-term mode under which the pumps would be operating all the time. The DEIR does not address the impacts of full-time pumping operation which this project will make possible.

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- 3 -

In conclusion, we believe that the EIR is inadequate --and that it will not serve the Department or the State Water Project well. We urge you to withdraw it and to more vigorously pursue the experiments and studies that were recently recommended by the State Water Resources Control Board's Striped Bass Working Group. Until we determine how the existing project can be operated in a manner compatible with fisheries resources, we believe that the Delta exports should not be increased.

I enclose our detailed review and critique.

Sincerely,

A Ungar
ALK

Arliss Ungar
Chairman, DEAC

enclosure

30

Comments On: Draft Environmental Impact Report - PROPOSED ADDITIONAL PUMPING UNITS, Harvey O. Banks Pumping Plant, November 1982.

SUMMARY

Page S-2. Under the heading Related Fish and Wildlife Agreement, there is the statement that the detrimental effects of present diversions on the Delta fishery have "been minimized to the extent found reasonable by the State Water Resources Control Board in the Decision 1485 flow and quality standards and diversion restrictions during the most critical period May through July". This statement is false and misleading. The flow and quality standards of D-1485 were established with
12 a specific intent of maintaining striped bass levels at those approaching "without project conditions". Since they have been in effect, the striped bass has declined to extremely low levels and appears on the verge of collapse. The Board has not found that the continuing damage is reasonable nor did they ever find that greater restraints were "unreasonable". They expected D-1485 to save the bass from further damage.

The last section under this heading contains two inaccurate and misleading statements about the Two-Agency Agreement that is being considered by CF&G and DWR. They are:

"The proposed agreement contains several new concepts not covered by Decision 1485 including:

13
- o Mitigation for unavoidable losses caused by the State Water Project under present operations. This will be the stocking of striped bass and salmon.
- o Additional mitigation when the Department of Water Resources increases export pumping capacity within the limits of the Corps of Engineers criteria. This mitigation will increase stocking of striped bass."

The paragraph conveys the idea to readers that stocking will provide mitigation and that the agreement is evidence of that. The draft agreement provides "The SWP will finance hatchery produced striped bass and the studies to determine the feasibility of planting these fish to
14 mitigate losses caused by water export." It does not imply that stocking will work. These statements are very misleading and must be clarified. The draft should say that the value of stocking striped bass in an estuary is unproven, that it is offered in what biologists consider a last resort attempt to save the bass fishery.

The use of the term "unavoidable losses caused by the State Water Project" is also objectionable. The losses
15 are not "unavoidable". They are just incompatible with the current operation of the Projects. Promotion of the idea that the losses are unavoidable, and that we know they can be compensated for by planting striped bass and salmon is very objectionable.

Page S-7. In the section on environmental comparison of alternatives, Table S-5 indicates that all of the alternatives provide a striped bass index ranging from 79 to 81. This is not true. Since 1976 the index ranged from 14 to 49. How
16 can the installation of these four additional pumps cause it to more than double? The authors are evidently using correlations between data outflow/diversion and the striped bass index that greatly overestimate the striped bass index each year since 1976. This must be corrected.

CHAPTER 1. INTRODUCTION

Page 3. In the second paragraph under the heading Delta Water Quality Standards, referring to D-1485 standards, the statement is made that "These standards are for protection of all reasonable, beneficial uses of water in the Sacramento-San Joaquin Estuary, including municipal and industrial,
17 agricultural, and fish and wildlife. Decision 1485 is intended to provide the same level of protection to these beneficial uses that would have been available had the water projects not been constructed." It should be clearly stated that D-1485 has not accomplished this. Under its terms the striped bass population has declined to very low levels.

CHAPTER 5. ENVIRONMENTAL IMPACTS OF INSTALLING AND OPERATING ADDITIONAL PUMPS.

Page 71. Under the heading "Proposed Alternative there is the statement "With respect to the daily operational changes of Clifton Court, there will probably be some increased entrainment of juvenile migrants [salmon and steelhead] on weekends during spring. This would be offset with lesser effects during the week with no significant overall effect."
18 This kind of general statement is inadequate. The report contains no assessment of the relationship between various pumping rates and entrainment losses, provides no basis so the reader can assess entrainment losses, and does not make assessment itself. The statement that there will be "no significant effects" appears to be a guess. It needs substantiation with real evidence.

Page 73. Under the heading General Impacts on Striped Bass, the description that larval bass are "found mainly in the entrapment zone" and then move downstream to
19 San Pablo Bay in early winter is misleading. It does not provide the reader with the kind of information he needs to make an assessment of the effect of four new pumps on bass. Instead, it suggests that most are out of the pumps' influence.

The report should convey the idea that until the State Water Project came on line, more than half of the young bass spent the spring and summer in the Delta. A great deal of investigation has shown that since then the Delta has
20 become a less productive and a dangerous place for them. In the last ten or so years, the millions of bass eggs and young fish that are washed into the Delta have not survived well. The decision makers should ask, "will four more pumps affect this?"

It is important for the reader to understand that the distribution of young bass in the spring and early summer depends upon spring flow. In years of high outflow, more of them are found downstream out of the influence of the pumps and in years of low outflow, more begin their lives upstream where the pumps have much more influence. The fact that a
21 higher proportion of the young bass are found downstream in Suisun Bay (not necessarily in the entrapment zone) is primarily because those that wash into the Delta die for lack of food or are exported along with the diverted water. This is the kind of information that the reader must have to evaluate the risk of installing four additional pumps.

The statement that the number of bass that become adults depends largely upon "salinities during spawning in
22 the lower San Joaquin River" needs documentation. Salinities during spawning was not mentioned by the 1982 State Water Resources Control Board's Striped Bass Working Group as a major factor affecting the number of bass that become adults.

The last two paragraphs on page 73 are a very brief description of the index of the young-of-the-year striped bass abundance, and how they were correlated with outflow and diversions up until 1976. This correlation is subsequently used in the report to predict the striped bass indices with the four new pumps. The EIR fails to even mention the fact
23 that such predictions have overestimated the actual index by many times every year since 1976. There has been much concern expressed by many groups and agencies about this, and it has been well recognized that the correlation can no longer be used to predict the effect of pumping. These last two paragraphs are completely inadequate and misleading.

Page 74. The section headed No-Action Alternative does not describe the effect of present diversion on striped bass. It only describes operational constraints of D-1485
24 (without noting that they have been unsuccessful) and notes that the losses will increase "mainly due to higher exports from July through October". This seems a contradiction of the statement made on page 56 under the heading No-Action Alternative that "with the existing pumping units the present monthly export pattern would continue".

Under the heading Proposed Alternative, the statement is made that "under the proposed alternative no significant incremental effects on young striped bass survival is foreseen, . . . because monthly/weekly export patterns and Delta flows will not be changed during the April through October period." According to Figure 8, maximum diversion levels will greatly
25 increase in April, July, August, September, and October to take advantage of weekend offpeak power rates. There is evidence that current export rates cause severe problems that need to be addressed very soon if the striped bass resource is to be saved. This EIR contains no evidence that the proposed increases will not cause a significant increase in the losses of young bass.

Page 74 and 75. Under the heading Other Alternatives Table 18 describes the indexes of young-of-the-year striped bass at 1990 levels of export ranging from 101 to 59, largely depending upon the wetness of the year. What the authors of this report have evidently done, is to estimate projected indexes of young-of-the-year bass using the old correlations between young bass and exports and outflows. These correlations are no longer valid, and have not been since 1976. They cannot be used for this purpose. Since 1976, the index
26 has been much lower than predicted. Table 18 and the entire description of environmental impact here may delude the uninformed reader into believing that the bass populations are going to be satisfactory if the four pumps are installed. The truth is that the bass resource is in very serious trouble, that the Department of Fish and Game believes the trouble is primarily caused by the operation of the Water Project, and that no one knows what will be the effect of the four new pumps and the proposed change in pumping schedules. It is not even addressed here in a serious way.

Page 75. Under the headings General Impacts on American Shad and Proposed Alternative, the statement is made that ". .no significant incremental effect on the migration of the American shad is foreseen." The statement is evidently based on the previous statement that "Under the proposed alternative, weekly and monthly export patterns of Delta
27 flows would not be changed during the most critical period for young shad." The report contains no information defining

the most critical period for young shad but says the young are most numerous from July through November. According to the several graphs which are Figure 8, the proposed alternatives will cause major increases in the magnitude and duration
27 of the high diversion rates during weekends so that the project can take advantage of offpeak power rates. This will likely cause increased diversion of American shad at this time, and may cause a reduction in their food supply. The report provides no evidence or even reason to believe that the increases will not have a significant effect upon American shad.

Page 75. Under the heading Other Alternatives, the statement is made that these ". . .would have no known incremental effect on shad migration or fish screen exposure."
28 DEAC agrees that the effect is unknown, but to state it in this fashion implies that there will be no effect. That is not the case. There very well may be an effect and it may be serious. We simply do not know.

Page 76. Under the heading Impacts on Sturgeon, the statement is made that "Preliminary analysis suggests a relationship between white sturgeon year class strength, spawning stock size, and the percentage of May inflow to the estuary that is exported." That analysis is not shown
29 and there is no reference to it. This is inadequate. The statement is then made that "Because Decision 1485 limits exports in May, sturgeon populations under the no-action alternative should vary with May runoff conditions." The evidence of that is not shown or even referred to. What is its basis?

Following that, under the heading Proposed Alternative, there is the statement that "Because there would be no significant changes in exports during May under the proposed alternative, no effects on sturgeon populations are
30 anticipated." A similar statement is made under the heading Other Alternatives. This kind of conclusion based upon premises, the foundation of which is not provided here, has no place in an EIR on an important project affecting major resources.

Page 76. Under the heading Impacts on Resident
31 Fishes, the statement is made "Factors controlling resident fish populations in the Delta are not well understood, but requirements that are related to water operations are generally less demanding than those of anadromous species."

The Department of Fish and Game has been studying resident fishes in the Delta for many years and the monitoring program required by the State Water Resources Control Board
32 has collected a great deal of information on their food supply. That information should be used in making the assessment on the effects on resident fishes.

Under the heading No-Action Alternative, the statement is made that "Under the no-action alternative, losses of white catfish from the Delta will increase as
33 exports increase." I am unable to locate in the report any description of how exports will increase under the "no-action plan", or how that could occur without action by the State Water Resources Control Board and an EIR on such changes.

Page 77. Under the headings Impacts on Resident Fish and Proposed Alternative, the statement is made that "There would be no changes in spring and summer exports." That statement is refuted by Figure 8, which shows that the
34 maximum export levels which occur on weekends would be increased both in the magnitude and duration throughout April, July, August, September, and October. The conclusion that "Thus incremental effects on resident fish populations would be confined to winter.", has no apparent basis.

Page 77. Under the heading Impact on Aquatic Invertebrates, statements are made that "Normally, more than 60 percent of the Neomysis population of the estuary
35 is found in the Suisun Bay area. Much of the remainder is found in the Western Delta." The report should note that Neomysis populations are low in many Delta channels because the channels have been converted into a series of fast flowing canals used to carry water to the export pumps.

Under the heading No-Action Alternative, the statement is again made that ". . .losses. . .will increase as exports increase." We cannot find in this document a
36 description of how those exports will increase with the no-action alternative. Are increases likely to be permitted until the problems associated with using the Delta channels as conveyance facilities are resolved? If that is the contention, it should be explained.

Once again, under the heading Proposed Alternative, the statement is made that there will be no significant incremental effect ". . .because monthly operation during the spring and summer would not change." Figure 8 indicates
37 that it will change a great deal, that the period of higher exports will be prolonged and exports will be higher because of the desire to take advantage of offpeak power costs. Denial that this will harm Neomysis and other invertebrates that have been affected by pumping requires some evidence if it is to have any credibility.

Page 80. Table 19 estimates losses of young striped
38 bass ranging from 11.5 million to about 13 million a year with the various alternatives. Estimates provided the State Water

Resources Control Board's Striped Bass Working Group by representatives of the Department of Water Resources were closer to 100 million or about eight times as many. The EIR's estimates of entrainment losses are far too low.

Page 83. Under the heading Impacts on the Suisun Marsh, the report summarily dismisses any impact on the Suisun Marsh by claiming that the Marsh will be protected by the water supply facilities to be constructed there. There are two basic fallacies in this assumption. The first is that there is any assurance that all the necessary Marsh facilities will indeed
39 be built. Current negotiations between the Suisun Resource Conservation District and DWR are based upon the premise that only part of the needed facilities will be built unless the Bureau of Reclamation is authorized by Congress to participate. The second fallacy is that even if all of the facilities are built, their ability to protect the Marsh is contingent upon the availability of adequate quality water at Collinsville for distribution throughout the Marsh. There is no assurance that such quality water will be available.

Page 86. Under the heading Summary of Operational Impacts Under the Proposed Alternative, there is a list of "incremental environmental impacts" found "not to be significant". I have seen no evidence in this report to justify
40 finding that the changes in channel velocities and cross-Delta flows will not be significant. Salmon and steelhead migrations, striped bass migration, American shad migration, sturgeon, resident fish, aquatic invertebrates, San Francisco Bay fish are not "environmental impacts" but there is reason to fear they will be impacted by the changes that are predicted.

Page 87. Under the heading Significant Environmental Effects, there are two statements. One is that the loss of striped bass would increase by about 101,800 "yearling equivalents", and the other that loss of various other species could possibly increase during winter when they are least abundant. Those two statements are described as the total significant effects of the four new pumps on the fisheries resources. The estimate of striped bass loss is based on the assumption that the increased pumping will not affect
41 survival rates of eggs, larvae, or young fish less than 40.1 mm long in all months but May and below 30.1 mm in May (Appendix B-8). Screening efficiencies for fish larger than this have been calculated at various pumping rates and the changes in rates were then combined with the estimated abundance each month to estimate the increased loss. The calculated numbers lost each month were then multiplied by estimates of how well they might have survived to yearling size (i.e., 5% of those lost in June and 20% in October) to estimate "yearling equivalents".

The estimates do not include the bass larvae or
42 bass smaller than the size noted above. These smaller fish are much more abundant and screening efficiencies are much less. The losses estimated by entrainment should include these smaller fish.

A more serious deficiency is that the effect of the increased pumping rates on bass food production and survival is not addressed in a valid way. The SWRCB Striped Bass Working Group identified reduced food production in the nursery area as a probable cause for the decline in bass populations and spring CVP/SWP diversion as a good candidate for the root cause. The only major spring (phytoplankton) blooms that have occurred in the most important nursery area since 1976 occurred in May 1981 and June 1982, both immediately following the shutdown of the State Water Project pumps for repair. April is a particularly critical month for phyto-
43 plankton development needed to generate zooplankton food supply in May and June. Figure 8 indicates that the high export levels that have existed from Friday through Monday, will be increased by about 1000 cfs -- thus exacerbating an already bad problem. This matter of the effect of the new pumps on survival of young bass just as they begin to feed must be addressed in a scientific way. The mechanical use of the old export/outflow vs bass correlations to make such assessments is sheer nonsense. Mitigation efforts based on those correlations were in D-1485 and have failed. The striped bass population is at alarmingly low levels. While DEAC did not object to D-1485, it strenuously objected to the predictions of mitigation based on those correlations. Time has proven DEAC correct.

This report, on increasing DWR's ability to export water by 61%, ignores the problem and says the new pumps
44 will not exacerbate it other than increase striped bass entrainment by a small amount. There is no evidence presented to support the contention and there is much that it is not true.

Page 87. Mitigation Measures. To mitigate for the alleged "11% increase in losses", the report refers to the proposed Two-Agency Agreement that would require the State Water Project to finance hatchery production and
45 subsequent planting of striped bass and chinook salmon. The report should clearly state that there is no evidence that such stocking would mitigate even an 11 percent increase in losses, that the program will be experimental and is basically a last resort to saving this fishery.

This report should also describe the history of
46 chinook salmon spawning in the Sacramento River, and note that in spite of years of increasing plants of stocked fish the salmon run has continued to decline.

Page 88. Under the heading Relationship Between Short Term Uses of the Environment and Maintenance and Enhancement of Long Term Productivity, the intention here is obviously to convince the reader that long-term productivity
47 for fish can be maintained by stocking. There is no reason to believe that this is the case and the report should clearly describe stocking as the last resort experimental procedure and describe the experience that others have had elsewhere. In any case, stocking has little to do with productivity of the environment.

C-105523

LETTER 31

ENVIRONMENTAL DEFENSE FUND

February 10, 1983

Robert G. Potter, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, CA 95816

RE: Draft Environmental Impact Report: Proposed Additional Pumping Units, Harvey O. Banks Delta Pumping Plant

Dear Mr. Potter:

Enclosed are the Environmental Defense Fund's comments on the Draft Environmental Impact Report for the proposed expansion of the Delta Pumping Plant.

The proposal to expand the Harvey O. Banks Delta Pumping Plant presents the Department of Water Resources with the opportunity to lead the way in the program of "reason and realism" called for by Governor Deukmejian in his State of the State address. DWR can seize that opportunity, however, only if it significantly revises the Draft EIR on the proposed expansion. The present Draft EIR is woefully inadequate and is more likely to confuse than to inform anyone attempting to make a rational decision on the project.

We hope that our comments will help you improve the EIR so that it both complies with the legal requirements of the California Environmental Quality Act and provides the basis for a decision in this matter that is environmentally sound and economically justified.

Sincerely,

William D. Jeffery

Enclosure

WDJ:mjg

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31

ENVIRONMENTAL DEFENSE FUND

COMMENTS OF THE ENVIRONMENTAL DEFENSE FUND
ON THE DRAFT ENVIRONMENTAL IMPACT REPORT:
PROPOSED ADDITIONAL PUMPING UNITS
HARVEY O. BANKS DELTA PUMPING PLANT

The Draft Environmental Impact Report (Draft EIR) prepared by the Department of Water Resources (DWR) for the proposed additional units at the Delta Pumping Plant fails to address some of the most important issues surrounding the proposed expansion.

1. Diversion Capability

The Draft EIR should clearly explain DWR's intent regarding future pumping plant operations. Several comments, both by project proponents and project critics, at the February 4, 1983,
1 hearing suggested that the preferred alternative, designated 4-7.3, is only an interim step in a plan to increase export to the full 10,300 cubic feet per second (CFS) capacity of the expanded pumping facility.

If DWR does intend ultimately to operate the facility at full capacity, the Draft EIR should clearly state that intention. The Draft also should explain why DWR does not intend to apply to

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31

the U.S. Army Corps of Engineers for a federal permit to modify Clifton Court Forebay to allow operation above 7,300 cfs (Draft,
2 page 21). One possible explanation, that DWR is seeking to avoid the federal permit process to minimize the influence of the National Marine Fisheries Service, (NMFS), is neither legally justifiable nor sound public policy, but the Draft EIR offers no alternative justification.

If DWR does intend to operate the facility at full capacity, the Draft EIR should analyze in detail the cumulative impacts of
3 operation at that capacity. The Draft EIR also should contain a specific mitigation package describing in detail how DWR will mitigate the impacts of full operation.

2. Impacts on the Estuary

On August 1, 1980, NMFS recommended that the Corps of Engineers permit for four additional pumping units be held in abeyance until the existing pumping plant received the necessary federal permit to continue operations because the ". . . present operation of this unauthorized plant has been a major cause of
4 the decline in anadromous fishery resources in the Sacramento and San Joaquin Delta, San Francisco Bay, and the continental shelf." Subsequent studies, such as those by the Striped Bass Working Group of the State Water Resources Control Board and by the Department of Fish and Game have confirmed that conclusion. Expansion of the pumping facility, without appropriate mitigation, will only hasten this decline.

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The analysis of the impact of the four additional pumps continues to utilize the discredited correlations and assumptions used by the State Water Resources Control Board to develop D-1485. As several commenters forcefully noted during the
5 February 4 hearing, the tragic decline in fishery resources since adoption of D-1485 demonstrates that the D-1485 standards by themselves do not afford acceptable protection to the fishery with the present pumping facility and will afford even less protection if the facility is expanded without meaningful mitigation.

The analysis also consistently underestimates direct entrainment loss for the fishery. Previous DWR estimates for entrainment loss at the Harvey O. Banks plant place losses as
6 high as 100 million striped bass. The analysis also almost uniformly ignores indirect fishery loss through impacts such as reduction of necessary food supply at critical times during the striped bass life cycle. The Striped Bass Working Group has identified this indirect loss as one of the most likely causes of the rapid decline in the striped bass fishery.

Finally, the analysis fails to investigate the impacts of varied pumping schedules designed to maximize pumping when flows are high and exposure to fishery resources is low, and minimize
7 or eliminate pumping when flows are low or exposure to the fishery or its food supply is great. Adding the four units would create a potential for accomplishing such a benefit to the

C-105524

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fishery, but the Draft EIR provides no assurance that the plant would be operated in the future in such a way as to minimize fishery losses.

3. Alternatives

The Draft EIR analyzes eight alternatives to meet project objectives, including the "no-action" alternative and seven expansion alternatives with various maximum monthly diversion
8 rates ranging from 6,300 cfs to 10,300 cfs with either two or four additional pumps. DWR fails, however, to meet the CEQA obligation to discuss all reasonable alternatives to the proposed project. Particulars follow.

a. Pumping Schedules

The Draft EIR should be revised to include operation alternatives based on annual export volumes with pumping
9 schedules designed to minimize fishery impacts. If a low impact pumping schedule were combined with adequate storage south of the Delta and with proper safeguards, expansion of the present facility might provide both economic and environmental benefits.

b. NMFS Conditions

On March 30, 1981, NMFS proposed an alternative for modified
10 operation of the present facility. The Draft EIR describes a portion of that alternative but fails to analyze its impact.

c. Conservation and pricing

The Draft EIR identifies nine so-called "water supply and demand reduction alternatives . . . that could possibly balance

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demand and supply in the South Coastal service area in lieu of the additional pumps" (Draft, page S-5). Although labelled
11 alternatives, these are not considered or analyzed as project alternatives either by themselves or in various combinations with the proposed expansion alternatives. CEQA requires such an analysis.

Even worse, the Draft EIR totally ignores pricing reform, an alternative DWR itself has endorsed in its Recommended Water Management Plan for the Metropolitan Water District of Southern California (MWD). As recommended by DWR in that Plan, the Draft EIR should investigate the impact of alternative pricing mechanisms, including:

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1. adoption of peak demand (seasonal) pricing schedules;
2. elimination of minimum charges and service charges;
3. elimination of the use of property taxes as a revenue source; and
4. adoption of increasing block rate structures.

Similar alternatives should be developed and analyzed for agricultural users as well.

d. Water transfers

Among the alternatives mentioned, but not analyzed, by the Draft EIR is a proposal for a water transfer between Imperial Irrigation District and MWD that could yield up to 438,000 acre
13 feet of water. In the previously mentioned Water Management Plan for MWD, DWR itself recommended that this alternative be pursued as a means to reduce the need for State Water Project (SWP) Delta

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water supplies in the MWD service area. The Draft EIR must be revised to include a complete analysis of the water transfer alternative. EDF's own soon-to-be-released study of this alternative concludes that this alternative is viable and economically beneficial to both parties to the transaction.

e. Groundwater storage

To make full use of minimum impact schedule alternatives described above, adequate storage south of the Delta must be
14 available. Critical to any such storage plan is a groundwater storage/conjunctive use program. The Draft EIR mentions the need for groundwater storage in its discussion of the intermittent yield produced by the proposed expansion, but fails to analyze groundwater storage alternatives in the detail required by CEQA.

Bulletin 160-82 issued by DWR in December, 1982, finds promise in this alternative but identifies several issues that must be resolved before groundwater storage programs to augment SWP supplies can proceed, including ". . . the equitable sharing of basin storage space, allocation of costs and benefits, and
15 appropriate management procedures." (Bulletin 160-82, page III-14). In addition to resolving the issues DWR identified in Bulletin 160-82, the Draft EIR should analyze the full impacts of the groundwater storage/conjunctive use alternative in sufficient detail so that DWR and the public can evaluate the alternative. Among the questions which should be addressed are the following. Is storage available? If so, where? Will new or expanded

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facilities be required? Are they available? Are local users willing to contract to store the water for withdrawal only during dry periods? Is DWR prepared to require such contracts as a condition of delivery?

4. Mitigation

Many of the preceding "alternatives" recommended by EDF for further analysis should also be considered as mitigation options
16 if the pumps are approved and constructed. In fact, the preferred alternative required by CEQA may well turn out to be construction of the pumps, with a full mitigation package consisting of these alternatives and others which follow.

a. Present operational constraints

Throughout the Draft EIR various operational constraints, such as D-1485, are described and the analysis of the environmental impacts of the project assumes that those constraints will continue. Most observers agree that D-1485 is
17 not accomplishing its stated objectives, but there is less agreement about what constraints should take its place. Since the environmental analysis assumes the existing constraints, the mitigation baseline condition should be that operational constraints at least as protective of the estuary as those now in place will continue.

b. Two-Agency Agreement

Because the proposed agreement between DWR and Department of Fish and Game to manage fish and wildlife in the estuary was not

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signed, the analysis in the Draft EIR dependent on that agreement must be redone. The mitigation provisions for the project must
18 expressly state the obligations DWR will incur in the absence of that agreement. DWR's mitigation commitment cannot be limited to the stocking provisions of the Two-Agency Agreement as suggested on page 87 of the Draft EIR. The other protections DWR negotiated in the Two-Agency Agreement also should be included.

c. Conservation

The Draft EIR recognizes the need for additional conservation programs of SWP contractors as part of the mitigation package, but the conservation programs are not adequately described. At the very least, DWR should follow the precedent established recently in its certification of North Bay Aqueduct construction and require, as part of the expansion project, appropriate agreements and contract amendments that
19 commit the contractors to carrying out specific water conservation plans. As part of these plans, DWR should implement the reforms it endorsed in its Recommended MWD Water Management Plan and should require equivalent reforms in other service areas south of the Delta. Contrary to comments made at the February 4 hearing, this does not require that a police force be established to enforce shower-head and toilet conservation restrictions. It does require sensible pricing reforms, a commitment to implementing voluntary water transfers, and a groundwater storage program south of the Delta.

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d. Pumping schedules

As previously discussed, pumping of water exported from
20 Delta must be scheduled to minimize impacts on the estuary. Appropriate conjunctive use programs must be established to take advantage of the flexibility offered by such schedules.

5. Unavoidable Significant Environmental Effects

The Draft EIR identifies unavoidable significant environmental losses to the fishery that would result from the project. Those losses are unavoidable only because DWR has
21 failed to analyze the reasonable alternatives to the proposed project we have described. Similarly, the additional energy requirements identified in the Draft EIR are unavoidable only because of DWR's failure to give adequate consideration to conservation and nontraditional supply alternatives.

6. Economic Analysis

At a time when the State of California is projecting a very substantial budget deficit, any proposed new state expenditures, for whatever purpose, must be subjected to a rigorous economic
22 analysis. This should be as true for any SWP expenditures as it is for normal budget items. If an SWP expenditure is not warranted, loans made to the SWP by the people at large should be repaid at an earlier time so that the State can meet other more pressing budget needs.

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The Draft EIR demonstrates that by DWR's present analysis the addition of two pumps rather than four pumps is a more cost effective way of achieving the 7,300 cfs diversion rate preferred by DWR and it would involve less environmental damage. DWR's preference for the selected alternative is difficult to
23 understand except in the context of the statement that ". . . the four additional pumps are key elements of any plan to balance supplies and needs in the service areas." (Draft, page 89). If that is the prime justification for the four pumps, the cumulative impacts of the pumps must be analyzed in that light with the pumps seen as a key link in those plans.

Contrary to the statement in the Draft EIR, though, the additional pumps are not key elements to any plan to balance supplies and needs in the service area. The pumps only are key
24 elements to any traditional plan to balance supplies and needs. Nontraditional plans such as pricing methods, conservation, conjunctive use, water transfers, and the like do not require additional pumps and increased Delta exports to strike a balance.

7. Conclusion

EDF urges DWR to rethink its solution to the perceived problem and revise the Draft EIR to reflect the issues described in these comments. A sincere, objective analysis of the issues
25 may indeed show that the four additional pumps provide economic and environmental benefits, provided sufficient mitigation commitments are incorporated in the project plan. Without a

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proper analysis, however, DWR will not have satisfied its specific obligations under CEQA or its more general obligations to the people of California to administer the SWP in a rational, efficient manner.

LETTER 32

D. W. KELLEY & Associates aquatic biology

January 24, 1983

TO: All DEAC Members

SUBJECT: Draft Environmental Impact Report PROPOSED ADDITIONAL PUMPING UNIT Harvey O. Banks Delta Pumping Plant, November 1982

Here is my page by page critique of this report. It is summed up in a letter I have drafted for you to send to the Director of Water Resources if you choose.

The deadline for submittal is February 15. Please let Arliss know what you want to do.

Best regards,

Don LK

Don W. Kelley

enclosures

DWK:1

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32 DRAFT

DELTA ENVIRONMENTAL ADVISORY COMMITTEE (DEAC)

Arliss Ungar, Chairman
517 Silverado Drive
Lafayette, CA 94549
415/283-3288

Mr. Howard Eastin
Director
Department of Water Resources
P. O. Box 388
Sacramento, CA 95802

SUBJECT: November 1982 Draft Environmental Impact Report PROPOSED ADDITIONAL PUMPING UNITS Harvey O. Banks Delta Pumping Plant.

Dear Mr. Eastin:

The Delta Environmental Advisory Committee has reviewed the subject report. We understand that the Department proposes installation of four new pumps to increase
1 the capacity of the existing plant by 61%, but that you intend to only use the new capacity on weekends to take advantage of lower offpeak power rates. We understand the desire to accomplish this, but we believe the November Draft EIR is a step backward.

The draft describes the only significant environmental effects as being an increased entrainment loss of
2 striped bass by 101,800 "yearling equivalents" and the possible loss of other species up to about 0.8% of American shad and white catfish. The mitigation offered is to artificially rear and stock striped bass.

The report ignores the effects of export pumping on the survival of the young bass before they are endangered by entrainment. It uses the old mathematical correlation between the mean June/July exports, June/July outflows, and the
3 abundance of young-of-the-year in mid-summer as evidence that no damage will be done--since mean June/July outflows will not be changed. Since 1976, these correlations have failed to predict the population and the resource is in danger. There is evidence that the export pumping is a root cause.

DEAC's job is to help you solve the Delta problem. We respectfully suggest that it is unwise for the Department
4 to attempt to install additional pumps or to increase export pumping until this fisheries problem is resolved. In our

32 - 2 -

opinion, the November draft EIR is not a serious attempt to assess the effect of the proposed project on striped bass or any other fish. Efforts to proceed on the basis described in it will weaken DWR's credibility.

We believe the EIR is inadequate for the following reasons:

5 1. It does not address the real issue of how the present projects have influenced the striped bass populations and their habitat, how the four new pumps will modify that influence, or the Department's ability to solve the problem.

6 2. The assessments of the project impact on other fishes do not demonstrate knowledge of their environmental requirements or influence of the existing projects.

7 3. Some of the conclusions in the EIR are based upon an agreement for the operation of the project between the Department of Fish and Game and the Department of Water Resources. No such agreement exists.

8 4. In some cases, project effects are compared with the effects of future increases in export pumping which the report says will exacerbate existing problems anyway. These "no project" future increases in export pumping, and the Department's authority and ability to make them, are not clearly described in this report.

9 5. The only admitted environmental losses caused by the project are increases in entrainment, from an estimated 11.5 million to 12.7 million young bass. These estimates were made by the Department of Fish and Game, and include only fish larger than 30.1 mm in May, or 40 mm in all other months. Most fish lost are smaller. DWR has previously estimated that 100 million young are entrained at the Harvey O. Banks plant.

10 6. The mitigation proposed is to stock striped bass. The stocking being proposed is experimental. There is no evidence that it will succeed in saving the bass. Most biologists have serious doubts.

In conclusion, we believe that the EIR is inadequate --and that it will not serve the Department or the State Water Project well. We urge you to withdraw it and to more vigorously

32 - 3 -

pursue the experiments and studies that were recently recommended by the State Water Resources Control Board's Striped Bass Working Group. Until we determine how the existing project can be operated in a manner compatible with fisheries resources, we believe that the Delta exports should not be increased.

I enclose our detailed review and critique.

Sincerely,

Arliss Ungar
Chairman, DEAC

enclosure

C—105527

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Comments On: Draft Environmental Impact Report - PROPOSED ADDITIONAL PUMPING UNITS, Harvey O. Banks Pumping Plant, November 1982.

SUMMARY

Page S-2. Under the heading Related Fish and Wildlife Agreement, there is the statement that the detrimental effects of present diversions on the Delta fishery have "been minimized to the extent found reasonable by the State Water Resources Control Board in the Decision 1485 flow and quality standards and diversion restrictions during the most critical period May through July". This statement is false and misleading.
11 The flow and quality standards of D-1485 were established with a specific intent of maintaining striped bass levels at those approaching "without project conditions". Since they have been in effect, the striped bass has declined to extremely low levels and appears on the verge of collapse. The Board has not found that the continuing damage is reasonable nor did they ever find that greater restraints were "unreasonable". They expected D-1485 to save the bass from further damage.

The last section under this heading contains two inaccurate and misleading statements about the Two-Agency Agreement that is being considered by CF&G and DWR. They are:

"The proposed agreement contains several new concepts *not covered by Decision 1485 including:*

- o Mitigation for unavoidable losses caused by the State Water Project under present operations. This will be the stocking of striped bass and salmon.
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- o Additional mitigation when the Department of Water Resources increases export pumping capacity within the limits of the Corps of Engineers criteria. This mitigation will increase stocking of striped bass."

The paragraph conveys the idea to readers that stocking will provide mitigation and that the agreement is *evidence of that. The draft agreement provides* "The SWP will finance hatchery produced striped bass and the studies to determine the feasibility of planting these fish to
13 mitigate losses caused by water export." It does not imply that stocking will work. These statements are very misleading and must be clarified. The draft should say that the value of stocking striped bass in an estuary is unproven, that it is offered in what biologists consider a last resort attempt to save the bass fishery.

32 - 2 -

The use of the term "unavoidable losses caused by the State Water Project" is also objectionable. The losses
14 are not "unavoidable". They are just incompatible with the current operation of the Projects. Promotion of the idea that the losses are unavoidable, and that we know they can be compensated for by planting striped bass and salmon is very objectionable.

Page S-7. In the section on environmental comparison of alternatives, Table S-5 indicates that all of the alternatives provide a striped bass index ranging from 79 to 81. This is not true. Since 1976 the index ranged from 14 to 49. How
15 can the installation of these four additional pumps cause it to more than double? The authors are evidently using correlations between data outflow/diversion and the striped bass index that greatly overestimate the striped bass index each year since 1976. This must be corrected.

CHAPTER 1. INTRODUCTION

Page 3. In the second paragraph under the heading Delta Water Quality Standards, referring to D-1485 standards, the statement is made that "These standards are for protection of all reasonable, beneficial uses of water in the Sacramento-San Joaquin Estuary, including municipal and industrial,
16 agricultural, and fish and wildlife. Decision 1485 is intended to provide the same level of protection to these beneficial uses that would have been available had the water projects not been constructed." It should be clearly stated that D-1485 has not accomplished this. Under its terms the striped bass population has declined to very low levels.

CHAPTER 5. *ENVIRONMENTAL IMPACTS OF* INSTALLING AND OPERATING ADDITIONAL PUMPS.

Page 71. Under the heading "Proposed Alternative there is the statement "With respect to the daily operational changes of Clifton Court, there will probably be some increased entrainment of juvenile migrants [salmon and steelhead] on weekends during spring. This would be offset with lesser effects during the week with no significant overall effect." *This kind of general statement is inadequate. The report*
17 contains no assessment of the relationship between various pumping rates and entrainment losses, provides no basis so the reader can assess entrainment losses, and does not make assessment itself. The statement that there will be "no significant effects" appears to be a guess. It needs substantiation with real evidence.

32 - 3 -

Page 73. Under the heading General Impacts on Striped Bass, the description that larval bass are "found mainly in the entrapment zone" and then move downstream to
18 San Pablo Bay in early winter is misleading. It does not provide the reader with the kind of information he needs to make an assessment of the effect of four new pumps on bass. Instead, it suggests that most are out of the pumps' influence.

The report should convey the idea that until the State Water Project came on line, more than half of the young bass spent the spring and summer in the Delta. A great deal of investigation has shown that since then the Delta has
19 become a less productive and a dangerous place for them. In the last ten or so years, the millions of bass eggs and young fish that are washed into the Delta have not survived well. The decision makers should ask, "will four more pumps affect this?"

It is important for the reader to understand that the distribution of young bass in the spring and early summer depends upon spring flow. In years of high outflow, more of them are found downstream out of the influence of the pumps and in years of low outflow, more begin their lives upstream
20 where the pumps have much more influence. The fact that a higher proportion of the young bass are found downstream in Suisun Bay (not necessarily in the entrapment zone) is primarily because those that wash into the Delta, die for lack of food or are exported along with the diverted water. *This is the kind of information* that the reader must have to evaluate the risk of installing four additional pumps.

The statement that the number of bass that become adults depends largely upon "salinities during spawning in the lower San Joaquin River" needs documentation. Salinities
21 during spawning was not mentioned by the 1982 State Water Resources Control Board's Striped Bass Working Group as a major factor affecting the number of bass that become adults.

The last two paragraphs on page 73 are a very brief description of the index of the young-of-the-year striped bass abundance, and how they were correlated with outflow and diversions up until 1976. This correlation is subsequently used in the report to predict the striped bass indices with
22 the four new pumps. The EIR fails to even mention the fact that such predictions have overestimated the actual index by many times every year since 1976. There has been much concern expressed by many groups and agencies about this, and it has been well recognized that the correlation can no longer be used to predict the effect of pumping. These last two paragraphs are completely inadequate and misleading.

32 - 4 -

Page 74. The section headed No-Action Alternative *does not describe the effect of present diversion on striped* bass. It only describes operational constraints of D-1485
23 (without noting that they have been unsuccessful) and notes that the losses will increase "mainly due to higher exports from July through October". This seems a contradiction of the statement made on page 56 under the heading No-Action Alternative that "with the existing pumping units the present monthly export pattern would continue".

Under the heading Proposed Alternative, the statement is made that "under the proposed alternative no significant incremental effects on young striped bass survival is foreseen, . . . because monthly/weekly export patterns and Delta flows will not be changed during the April through October period." *According to Figure 8, maximum diversion levels will greatly*
24 increase in April, July, August, September, and October to take advantage of weekend offpeak power rates. There is evidence that current export rates cause severe problems that need to be addressed very soon if the striped bass resource is to be saved. This EIR contains no evidence that the proposed increases will not cause a significant increase in the losses of young bass.

Page 74 and 75. Under the heading Other Alternatives Table 18 describes the indexes of young-of-the-year striped bass at 1990 levels of export ranging from 101 to 59, largely depending upon the wetness of the year. What the authors of this report have evidently done, is to estimate projected *indexes of young-of-the-year bass using the old correlations* between young bass and exports and outflows. These correlations are no longer valid, and have not been since 1976.
25 They cannot be used for this purpose. Since 1976, the index has been much lower than predicted. Table 18 and the entire description of environmental impact here may delude the uninformed reader into believing that the bass populations are going to be satisfactory if the four pumps are installed. The truth is that the bass resource is in very serious trouble, that the Department of Fish and Game believes the trouble is primarily caused by the operation of the Water Project, and that no one knows what will be the effect of the four new pumps and the proposed change in pumping schedules. It is not even addressed here in a serious way.

Page 75. Under the headings General Impacts on American Shad and Proposed Alternative, the statement is made that ". .no significant incremental effect on the migration of the American shad is foreseen." The statement is evidently
26 based on the previous statement that "Under the proposed alternative, weekly and monthly export patterns of Delta flows would not be changed during the most critical period for young shad." The report contains no information defining

C—105528

C-105528

the most critical period for young shad but says the young are most numerous from July through November. According to the several graphs which are Figure 8, the proposed alternatives will cause major increases in the magnitude and duration
27 of the high diversion rates during weekends so that the project can take advantage of offpeak power rates. This will likely cause increased diversion of American shad at this time, and may cause a reduction in their food supply. The report provides no evidence or even reason to believe that the increases will not have a significant effect upon American shad.

Page 75. Under the heading Other Alternatives, the statement is made that these ". . .would have no known incremental effect on shad migration or fish screen exposure."
28 I agree that the effect is unknown, but to state it in this fashion implies that there will be no effect. That is not the case. There very well may be an effect and it may be serious. We simply do not know.

Page 76. Under the heading Impacts on Sturgeon, the statement is made that "Preliminary analysis suggests a relationship between white sturgeon year class strength, spawning stock size, and the percentage of May inflow to
29 the estuary that is exported." That analysis is not shown and there is no reference to it. This is inadequate. The statement is then made that "Because Decision 1485 limits exports in May, sturgeon populations under the no-action alternative should vary with May runoff conditions." The evidence of that is not shown or even referred to. What is its basis?

Following that, under the heading Proposed Alternative, there is the statement that "Because there would be no significant changes in exports during May under the
30 proposed alternative, no effects on sturgeon populations are anticipated." A similar statement is made under the heading Other Alternatives. This kind of conclusion based upon premises, the foundation of which is not provided here, has no place in an EIR on an important project affecting major resources.

Page 76. Under the heading Impacts on Resident
31 Fishes, the statement is made "Factors controlling resident fish populations in the Delta are not well understood, but requirements that are related to water operations are generally less demanding than those of anadromous species."

The Department of Fish and Game has been studying resident fishes in the Delta for many years and the monitoring
32 program required by the State Water Resources Control Board has collected a great deal of information on their food supply. That information should be used in making the assessment on the effects on resident fishes.

Under the heading No-Action Alternative, the statement is made that "Under the no-action alternative,
33 losses of white catfish from the Delta will increase as exports increase." I am unable to locate in the report any description of how exports will increase under the "no-action plan", or how that could occur without action by the State Water Resources Control Borad and an EIR on such changes.

Page 77. Under the headings Impacts on Resident Fish and Proposed Alternative, the statement is made that "There would be no changes in spring and summer exports."
34 That statement is refuted by Figure 8, which shows that the maximum export levels which occur on weekends would be increased both in the magnitude and duration throughout April, July, August, September, and October. The conclusion that "Thus incremental effects on resident fish populations would be confined to winter.", has no apparent basis.

Page 77. Under the heading Impact on Aquatic Invertebrates, statements are made that "Normally, more than 60 percent of the Neomysis population of the estuary
35 is found in the Suisun Bay area. Much of the remainder is found in the Western Delta." The report should note that Neomysis populations are low in many Delta channels because the channels have been converted into a series of fast flowing canals used to carry water to the export pumps.

Under the heading No-Action Alternative, the statement is again made that ". . .losses. . .will increase
36 as exports increase." I cannot find in this document a description of how those exports will increase with the no-action alternative. Are increases likely to be permitted until the problems associated with using the Delta channels as conveyance facilities are resolved? If that is the contention, it should be explained.

Once again, under the heading Proposed Alternative, the statement is made that there will be no significant incremental effect ". . .because monthly operation during the
37 spring and summer would not change." Figure 8 indicates that it will change a great deal, that the period of higher exports will be prolonged and exports will be higher because of the desire to take advantage of offpeak power costs. Denial that this will harm Neomysis and other invertebrates that have been affected by pumping requires some evidence if it is to have any credibility.

Page 80. Table 19 estimates losses of young striped
38 bass ranging from 11.5 million to about 13 million a year with the various alternatives. Estimates provided the State Water

Resources Control Board's Striped Bass Working Group by representatives of the Department of Water Resources were closer to 100 million or about eight times as many. The EIR's estimates of entrainment losses are far too low.

Page 86. Under the heading Summary of Operational Impacts Under the Proposed Alternative, there is a list of "incremental environmental impacts" found "not to be signi-
39 ficant". I have seen no evidence in this report to justify finding that the changes in channel velocities and cross-Delta flows will not be significant. Salmon and steelhead migrations, striped bass migration, American shad migration, sturgeon, resident fish, aquatic invertebrates, San Francisco Bay fish are not "environmental impacts" but there is reason to fear they will be impacted by the changes that are predicted.

Page 87. Under the heading Significant Environmental Effects, there are two statements. One is that the loss of striped bass would increase by about 101,800 "yearling equivalents", and the other that loss of various other species could possibly increase during winter when they are least abundant. Those two statements are described as the total significant effects of the four new pumps on the fisheries resources. The estimate of striped bass loss is based on
40 the assumption that the increased pumping will not affect survival rates of eggs, larvae, or young fish less than 40.1 mm long in all months but May and below 30.1 mm in May (Appendix B-8). Screening efficiencies for fish larger than this have been calculated at various pumping rates and the changes in rates were then combined with the estimated abundance each month to estimate the increased loss. The calculated numbers lost each month were then multiplied by estimates of how well they might have survived to yearling size (i.e., 5% of those lost in June and 20% in October) to estimate "yearling equivalents".

The estimates do not include the bass larvae or bass smaller than the size noted above. These smaller fish
41 are much more abundant and screening efficiencies are much less. The losses estimated by entrainment should include these smaller fish.

A more serious deficiency is that the effect of the increased pumping rates on bass food production and survival is not addressed in a valid way. The SWRCB Striped Bass Working Group identified reduced food production in the
42 nursery area as a probable cause for the decline in bass populations and spring CVP/SWP diversion as a good candidate for the root cause. The only major spring (phytoplankton) blooms that have occurred in the most important nursery area since 1976 occurred in May 1981 and June 1982, both immediately

following the shutdown of the State Water Project pumps for repair. April is a particularly critical month for phyto-plankton development needed to generate zooplankton food supply in May and June. Figure 8 indicates that the high export levels that have existed from Friday through Monday,
42 will be increased by about 1000 cfs -- thus exacerbating an already bad problem. This matter of the effect of the new pumps on survival of young bass just as they begin to feed must be addressed in a scientific way. The mechanical use of the old export/outflow vs bass correlations to make such assessments is sheer nonsense. Mitigation efforts based on those correlations were in D-1485 and have failed. The striped bass population is at alarmingly low levels. While DFAC did not object to D-1485, it strenuously objected to the predictions of mitigation based on those correlations. Time has proven DFAC correct.

This report, on increasing DWR's ability to export water by 61%, ignores the problem and says the new pumps will not exacerbate it other than increase striped bass
43 entrainment by a small amount. There is no evidence presented to support the contention and there is much that it is not true.

Page 87. Mitigation Measures. To mitigate for the alleged "11% increase in losses", the report refers to the proposed Two-Agency Agreement that would require the
44 State Water Project to finance hatchery production and subsequent planting of striped bass and chinook salmon. The report should clearly state that there is no evidence that such stocking would mitigate even an 11 percent increase in losses, that the program will be experimental and is basically a last resort to saving this fishery.

This report should also describe the history of
45 chinook salmon spawning in the Sacramento River, and note that in spite of years of increasing plants of stocked fish the salmon run has continued to decline.

Page 88. Under the heading Relationship Between ShortShort Term Uses of the Environment and Maintenance and Enhancement of Long Term Productivity, the intention here is obviously to convince the reader that long-term productivity
46 for fish can be maintained by stocking. There is no reason to believe that this is the case and the report should clearly describe stocking as the last resort experimental procedure and describe the experience that others have had elsewhere. In any case, stocking has little to do with productivity of the environment.

C-105529

LETTER 33

H. S. PETE FOWLER, PE.
5633 COLTON BLVD
OAKLAND, CALIFORNIA 94611
PHONE: (415) 339-1712

January 5, 1983

Mr. Wayne MacRostie, Chief
Central District
Department of Water Resources
3251 S Street
P.O. Box 160088
Sacramento, CA 95816

Dear Mr. MacRostie:

Re Harvey Banks Pumping Plant. Proposed additional pumping units. Draft EIR.

Thank you for yours of November 29, 1982, enclosing the draft EIR. Per your invitation to comment prior to January 14, 1983, I hope you will find the following of interest.

1 Obviously an adverse impact is the effect of peak flows toward the pumps. I see no point in discussing ideas likely to be raised by other parties. The following comments are made with little knowledge of many factors involved. My purpose is "brainstorming" with no evaluation of the problems I thus raise.

2 Therefore, I suggest that the dikes around the Clifton Court Forebay be raised and its bottom be lowered, each by say 20 feet. This would add roughly four days storage at peak pumping capacity. It could reduce maximum flows by one-third for say twelve days.

3 Assuming suitable material in the bottom, it could provide earth to raise the dikes plus say 50 million cubic yards that could be used to reinforce weak levees in other parts of the delta. Obviously this would require reversible flow pumping and consume say 400 hp per foot of differential head. Pumps could be in a pit between the forebay and the intake channel.

4 Another alternative is to use present flows to and from the Clifton Forebay, but add an auxiliary 700 acre raised storage between Kelso road and Byron road, west of the Tracy pumping plant. This would supply peak flows only to the Harvey Banks plant. Possibly this could even reduce the need for new pumps to three instad of four.

Sincerely,

CONSULTING ENGINEER • MINING • METALLURGICAL • CIVIL

LETTER 34

National Audubon Society
Western Regional Office
555 AUDUBON PLACE, SACRAMENTO, CA 95825 (916) 481-5332

February 9, 1983

Mr. Howard Eastin, Director
Department of Water Resources
P.O. Box 388
Sacramento, CA 95802

SUBJECT: November 1982 Draft EIR, Proposed Additional Pumping Units, Harvey O. Banks, Delta Pumping Plant

Dear Mr. Eastin:

1 On behalf of the National Audubon Society, I appreciate this opportunity to offer comments on the subject report. The Audubon Society is among California's oldest and largest conservation organizations with a long history of interest and involvement in water resource issues.

2 I would like to preface our comments with a general observation about the extent and timing of the proposed pump additions. The Sacramento-San Joaquin Delta is the setting for California's most heated resource debate. The passage of SB 200, its subsequent defeat at the polls, the failure of last November's water reform initiative Proposition 13, and the growing problem of levee failure all make for great controversy whenever the delta is discussed.

3 Against, this backdrop of controversy and confrontation, the California Department of Water Resources proposes to order, install, and operate four additional pumping units in the delta. The timing of this proposal could not be worse.

4 We have not yet begun to solve the thorny policy decisions of delta water transfers which meet existing contracts and protect instream uses and take into consideration existing dependencies (both economic and environmental) on water quality standards in the delta and San Francisco Bay.

AMERICANS COMMITTED TO CONSERVATION

34

February 9, 1983
Mr. Howard Eastin
Page Two

5 We have also not solved the problem of aging levees, impacted by among other activities, water conveyance. Who pays for the levee repairs? Who benefits? How much will it cost?

6 We have many questions, but few if any answers. Adding new pumping capacity may offer some benefits for energy cost savings and maintenance flexibility, but it only contributes to the overriding controversy surrounding the delta. With this proposal, we are putting the cart before the horse.

Our more specific concerns on the draft EIR include the following:

7 1. Operations of the State and Federal Water Projects in the delta have severely reduced anadromous fishery values. The proposed pump additions will further impact this resource, yet the draft EIR does not adequately address the problem.

8 2. The proposed fishery impacts appear lessened because the preferred alternative is compared to a no-project alternative which assumes increased pumping. We do not understand the nature or rationale for this key assumption.

9 3. Little information is included about the proposal's impact on delta water quality in the long term if and when full-time pump operations begin.

In summary, we must conclude that the draft is inadequate in certain key areas and should be withdrawn for greater study. Neither the state water project nor the delta environment are served by this draft analysis.

Sincerely,

DANIEL TAYLOR
Regional Representative

DT/bh

cc: Bay Area Audubon Chapter Presidents

LETTER 35

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December 10th 1982

Mr Wayne McRostie, Chief,
Department of Water Resources
P.O. Box 160088
Sacramento Cal. 95816

Dear Mr McRostie

We received a book before the election on this proposed Delta water plan and we have another one here now from you, over the 1982 date.

1 These plans appear, to us, to be the ones defeated in the last election.

2 We still believe, very strongly, that a salt water barrier, costing very much less, and still allowing the passage of the anadromous fish, is what is needed, and nothing more elaborate. This does not require [illegible] or big bond issues, and it will stop the influx of salt water under the fresh, up as far as Madera, this being most essential.

3 As for the needs of Los Angeles, they are going to have to come to salt water evaporation in the end, and also start saving water, instead of having a very obvious river flowing out to sea.

Yours very truly
G. Rosekilly
G. Rosekilly Machinery.

LETTER 36

SIERRA CLUB
Northern California/Nevada
Regional Conservation Committee 6014 College Avenue Oakland, California 94618

February 16, 1983

Mr. Wayne MacRostie, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, California 95816

SIERRA CLUB WATER COMMITTEE

Comments on: Draft Environmental Impact Report

PROPOSED ADDITIONAL PUMPING UNITS, Banks Pumping Plant

SUMMARY:

The DWR proposes to add four new pumps to the pumping station at the head of The California Aqueduct near Tracy. These pumps will bring the plant up to its full designed capacity. The DWR proposes to operate the expanded plant at present pumping levels, presumably in order to avoid additional review by the Corps of Engineers, at least, and to avoid storms of protests from environmental, fishery and delta interests. The DEIR is inadequate in several respects, but most fundamentally it does not deal with the basic questions of who will benefit from the additional water, where the water will come from, and who will subsidize the operation. Sierra Club objections focus primarily on the lack of specificity in several areas which are key to assessing the impacts of the project.

1

I. Cost Benefit Ratio: The EIR does not adequately explain why four pumps were the chosen alternative as opposed to two

2 pumps. The Cost Benefit ration is better with two pumps. The DEIR clearly states that two pumps can fulfill the anticipated

36

- 2 -

pumping needs. Until such time as a more fully developed rationale is present, the DEIR is inadequate.

II. Pumping Schedule: There is no proposed or existing plan to control pumping or to schedule pumping to minimize fishery impacts. The proposed additional pumps could be used to

3 mitigate, to some extent, the pumping impacts on fisheries. The DWR should carry out studies of pumping impacts on fisheries, and, if the studies indicate, take action to operate the pumps to improve fisheries and quality.

III. Delta Water Quality - Decision 1485: Since 1485 was promulgated, the major fisheries have continued their steep decline. 1485 is not a baseline to the extent that the goals stated

4 therein are not being met. Further protection is necessary, even if no further pumping is contemplated. The EIR should propose specific mitigation measures in this regard.

IV. Conjunctive Use and Ground Water Management: Though the DEIS repeatedly mentions ground water management and conjunctive use as ways to augment water supplies and increase firm yield, specific programs to implement these practices are not proposed.

5 Mandatory ground water management programs in areas of historical overdraft should be a condition of water deliveries at concessionary prices or in amounts over that which is contracted, or for lands not irrigated before State water was delivered.

36

- 3 -

Ground water overdraft has continued on the SWP Agricultural Service Area despite the delivery of 2.5 - 4.5 MAF/year. Agreements on ground water management must include restrictions on pumping innormal and wet years.

V. Service Area Impacts: The DEIR states that there are "no impacts" on State Service Areas. There will be impacts. Either the pumps will allow additional acreage to be brought

6 into production, or they will add firm yield to the SWP. These impacts must be discussed. Until they are discussed, the EIR is inadequate.

VI. Fish Agreement - Fishery Mitigation: The Two Agency Fish Agreement has not been signed. Unless this agreement is signed the EIR is inadequate and fatally flawed. How would the project be operated in the absence of this agreement? The EIR

7 should include mitigation proposals for all the alternatives the DEIR mentioned. It is conceivable that the additional pumps could provide greater flexibility in avoiding additional negative impacts on fisheries. There must be specific commitments by DWR to schedule the pumping to minimize the fishery impact.

VII. Bay Outflows: The DEIR is vague and contradictory regarding the additional pumps' impact on Bay outflows.

8 And one section of the DEIR claims that reductions in outflow

36

- 4 -

are "insignificant", while another part of the DEIR claims

8 that the impacts are unknown. The issue is of paramount importance to the San Francisco Bay, and undocumented assumptions are not sufficient. The EIR must make the impacts on Bay outflows clear and well documented.

VIII. Suisun Marsh Protection and Water Quality Protection: There is no assurance that the Marsh protection and water supply facilities will be built. If the Bureau of Reclamation does not participate, only some facilities may be built. There is no assurance of a specific water quality to be provided

9 even if all the facilities are built. A DWR official, in December 1982 negotiations on the Marsh, stated that during dry and critical years, even the minimal protections of D 1485 *could not be met. Because the DEIR states flatly that D 1485* provisions will be met, the DEIR is flawed. Clarifications of the expected effects and mitigations must be made in the final EIR.

IX. Water Conservation and Pricing: Water conservation should be considered as an alternative to the additional pumps.

10 DWR recommendations to MWD on pricing reforms should be considered as mitigation for additional pumping, not just as a conservation alternative.

Sierra Club applauds the DWR consideration of transfer of Imperial Irrigation District water in to the South Coastal Service Area through ditch lining and water conservation
11 methods. We urge top priority efforts to bring this proposal into being.

X. Agricultural Water Use and Conservation: DWR should formulate agricultural water pricing reform similar to the pricing reforms suggested to MWD. These reforms should be a mitigation to the additional pumps. These reforms would include:

- peak demand (seasonal) pricing schedules
- elimination of minimum and service charges
- elimination of use of property taxes as a revenue source
- adoption of increasing block rate structure

There are over 100,000 acres of alfalfa in the State Service Area. There are over 200,000 acres of cotton; most years a surplus crop. There are thousands of acres of almonds and
12 olives being grown by large tax-loss operations. Altogether, over 450,000 acres of new land have been brought into cultivation in Southern San Joaquin Valley with the advent of SWP water delivery. There is no reason not to question the use of State Water in these and other applications of questionable value. Charging agricultural water users the full water costs, including the marginal costs of new water developments built to fulfill DWR contracts, would be an appropriate market test of State Water contracts and their viability

in today's economic climate.

Conclusion: The Sierra Club finds the current DEIR inadequate, incomplete and flawed. DWR does not deal with the intent to meet its contractual obligations for firm yield by eventually
13 pumping at the full (10.3) design capacity. Either the State should formally declare its intention to modify its contracts, or the EIR should discuss in detail the impacts of the full-capacity pumping made possible by the installation of the four pumps.

The DWR should go back to the basic questions of who needs the water and who will benefit, keeping in mind that the SWP is subsidized by the people of California, and that the
14 project must be operated in such a way so as to serve all the peoples' needs, not just the predominate demands of the big water users of the Southern San Joaquin Valley.

Sincerely,

David Nesmith
DAVID NESMITH
Conservation Representative
San Francisco Bay Chapter

Alvin J. Greenberg
ALVIN J. GREENBERG
Chair, NCRCC
Water Committee

DN:jg

LETTER 37

TEHAMA FLY FISHERS

P. O. Box 224
Red Bluff, California 96080

January 25, 1983

Mr. Robert G. Potter, Chief
Central District
Department of Water Resources
P. O. Box 160088
Sacramento, Ca 95816

Dear Mr. Potter:

The Tehama Fly Fishers have reviewed the Draft Environmental Impact Report for the Proposed Additional Pumping Units at the Harvey O. Banks Delta Pumping Plant. The following comments are related mainly to project impact on salmon and steelhead resources of the Central Valley.

The report emphasizes the fact that the Department of Water Resources and the Department of Fish and Game have proposed an agreement to manage the fish and wildlife resources of the Sacramento-San Joaquin estuary. This is commendable and management proposals should be implemented. However, since the Bureau of Reclamation, a principal
1 water exporter, is not a party to the agreement nor is the Fish and Wildlife Service, the value of such a cooperative effort is diminished. The statement that Federal participation in the agreement has been actively sought raises the question as to how aggressive this effort has been. We believe that pressure from conservation organizations, A resolution from the State Legislature and assistance from the California Congressional Delegation could be of help in promoting Federal cooperation.

We are disturbed by the Table showing the estimated number of juvenile salmon lost at the screens under alternative proposals. In addition to these losses, predators take a significant toll of fingerlings in
2 Clifton Court Forebay and there is unrecorded but substantial mortality in the process of collecting, transporting and releasing salvaged fish. Only by a study involving large numbers of marked fingerlings and subsequent examination of adult fish can the salmon salvage program be evaluated and improved.

The salmon runs in the Upper Sacramento River have been declining in recent years. It has been suggested that pumping from the Delta is contributing to the decline. Presently, flows through the Delta Cross Channel or around Sherman Island into the San Joaquin System divert
3 downstream migrants from their normal route to sea. Any increase in pumping will aggravate this problem. In an effort to avoid exposure to the pumping plants and improve survival, we recommend an experiment whereby marked fingerlings from Coleman Hatchery would be transported

TEHAMA FLY FISHERS

P. O. Box 224
Red Bluff, California 96080

3 by barge from Red Bluff or the Princeton area to a release site in the Delta out of the influence of the pumps. An alternative would be to truck fish from the hatchery to Rio Vista for release. In either case a control group of marked fish would be planted in the usual manner. The cooperation of Federal Agencies in such a plan would be necessary.

4 Table 2, page 25, presents an economic analysis of alternative plans. We note that annual fish stocking costs associated with the alternatives range from $5,000 to $20,000. Assuming that both striped bass and salmon are to be reared and planted in significant numbers and at a desirable size, these cost figures appear to be extremely low.

5 To be consistent, only one name should be used to describe salmon throughout the report. Either king or chinook will do but not both.

Thank you for the opportunity to comment on the report.

Very truly yours,

George H. Warner
George H. Warner, for
Conservation Committee

A Member of Northern California Council of Fly Fishing Clubs

LETTER 38

UNITED ANGLERS OF CALIFORNIA
1360 Neilson Street
Berkeley, CA 94702

January 11, 1983

Wayne MacRostie, Chief
Central District
Department of Water Resources
P.O. Box 160088
Sacramento, CA 95816

Dear Mr. MacRostie:

Enclosed is our response to the DEIR for the Proposed Additional Pumping Units at the Harvey O. Banks Delta Pumping Plant.

1 I. On page 1, Chapter 1, the statement is made that the State Water Project and the federal Central Valley Project move water from area of surplus in Northern California to cities and farms to the south and west. Since the concept of "surplus water" is not a valid biological concept, we recommend that the word "surplus" be omitted. In terms of some human needs this water, which once flowed naturally in our rivers and streams, may be deemed "surplus." In the terms of the biological needs of instream ecosystems, estuaries, and the value these flows have for the ocean, however, they are not surplus.

2 II. On pages 8 and 9, concepts which are not covered in D 1485 but which are included in the Two Agency Agreement are discussed. Among these eight concepts are two which are not accurately stated. The fifth concept states that the proposed agreement will provide mitigation for existing SWP unavoidable losses by stocking striped bass and salmon. We feel this statement implies that the project will offset "unavoidable losses." This statement is only partially true for the following reasons:

3 1. The proposed mitigation does not take into account the many millions of eggs, larvae, and small bass which cannot be screened by the project and are lost from the fishery population of striped bass in the Bay/Delta.

UNITED ANGLERS OF CALIFORNIA

38

4 2. The actual number of fish lost in this manner is UNKNOWN. The only estimate of which we are aware is from the Striped Bass Study Group. The Group maintains that approximately 200 million eggs, larvae, and juveniles are lost each year to the CVP/SWP pumps. They maintain that this estimate is debatable because it is based on inadequate measurements. In light of this, and with knowledge of the fact that "compensatory factors" long ago ceased to operate in the Delta, we believe that the proposed mitigation is only partial mitigation.

5 3. We further maintain that such losses have a cumulative impact which is not taken into consideration in the proposed mitigation and EIR. The cumulative impact we speak of is the result of all losses caused by the project. This impact results from losing fish which are large enough to be screened, but which are not, due to screen inefficiency, and those which are too small to be screened. The cumulative impact results because not only are these fish lost, but so are the many generations that would have been created from these lost fish. Hence the cumulative impact is an on-going process which involves the loss of the original fish and its offspring, and the offspring of that offspring, etc. This cumulative impact may be to a significant degree responsible for the decline of the fishery.

Because of this, we contend that the estimates of losses due to the project are faulty, and as such, overlook the extent of the environmental impact to a significant degree. We recommend that the wording of this section be changed to say that the proposed agreement will provide some mitigation of unavoidable losses.

6 The seventh concept on page 9 is also faulty since it maintains that the proposed agreement will provide mitigation for unavoidable losses by the additional pumps operated under the Corps of Engineers criteria. Since this concept fails to take into account the cumulative

WORKING TO PRESERVE, PROTECT AND ENHANCE ALL SPORT FISHERIES IN CALIFORNIA

UNITED ANGLERS OF CALIFORNIA

38

impact as outlined above, we recommend that it be changed to say that it will provide some mitigation.

7 III. On page 56, under the Proposed Alternative, the statement is made that exports would be increased during the winter only, with corresponding reductions of high surplus Delta outflows. We recommend that the word "surplus" be removed for the same rationale as stated in comment #1.

8 IV. On page 80 the statement is made that the numbers of striped bass and chinook salmon that would be lost and salvaged annually were estimated for each of the eight alternatives. We recommend that a statement be included in this section which notes that the numbers of bass and salmon that would be lost and salvaged are based only on estimates of fish large enough to be screened.

9 V. On page 81, under Proposed Alternative, annual striped bass yearling equivalent losses are discussed. Since this analysis does not include losses due to cumulative impact, we feel it needs to be modified accordingly.

10 VI. On page 87, Significant Environmental Effects and Mitigation Measures are presented. Both of these sections should be modified to include a discussion of the increased cumulative impact that will occur from losses of striped bass. Since this analysis was omitted in the Two Agency Agreement, because operation studies included only losses based on fish which were large enough to screen, we find this section inaccurate. Certainly the cumulative impact should be mentioned under Significant Environmental Effects and Mitigation Measures.

General Comments:

We realize that this report may have been written prior to the findings of the Striped Bass Working Group which were published in

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UNITED ANGLERS OF CALIFORNIA

38

11 November of 1982. However, if there is still time to modify the EIR in light of this group's findings, we urge that it be done. Of special significance is the implicating evidence that the CVP and SWP are major factors affecting the food supply of young bass.

Previous studies have found a positive correlation between the abundance of this food supply and the residence time of Delta water. The study group also found that the spring blooms necessary to produce high zooplankton densities at the time when the young bass begin to
12 feed have been delayed until after the bass need them. This is a result of using the Delta channels to convey large amounts of water to export pumps. In fact, only two spring blooms have occurred in the western Delta since 1976, and both of these happened shortly after the SWP pumps were shut down for repairs to the system and CVP pumping reduced.

It seems likely that the timing of export and the amount of water exported may be critical factors in the striped bass decline. Since
13 the environmental impact analysis did not include these factors, and since the additional pumps will be installed in part to pump more water, further reducing the food supply, we feel that this impact should be noted in the EIR.

Sincerely,

John O. Beuttler, Jr.

John O. Beuttler, Jr.
Executive Director

JOB:em

WORKING TO PRESERVE, PROTECT AND ENHANCE ALL SPORT FISHERIES IN CALIFORNIA

Public Hearing
DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

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In the Matter of:

DRAFT ENVIRONMENTAL REPORT on Adding Additional Pumping Units to the Harvey O. Banks Pumping Plant

---o0o---

Held in
Resources Building
Sacramento, California

---o0o---

Friday, February 4, 1983
9:30 a.m.

ALICE BOOK
CERTIFIED SHORTHAND REPORTER
P O BOX 318, COLUMBIA, CALIFORNIA 95310
PHONES 916 533-7326 & 209 532 3018

A P P E A R A N C E S

Department of Water Resources' Personnel:

ROBERT POTTER, Hearing Officer

GERALD COX, Chief, Water Operations Branch

KATY STRIEMER, Counsel

KARL WINKLER, Chief, Central District Environmental Documentation Section

NORM MEADE, Engineer, Environmental Documentation Section

---o0o---

I N D E X

	Page
DAVID SCHUSTER	5
TOM GRAFF	12
RICHARD CLEMMER	18
DAN CHAPIN	23
JERRY JOHNS	26
DON KELLEY	28
BOB McKINNEY	34
JOHN BEUTTLER	34
DAVID NESMITH	39
THOMAS YOCOM	42
PETE CHADWICK	44

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FRIDAY, FEBRUARY 4, 1983, 9:30 A.M.

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MR. POTTER: Good morning. I would like to thank you all for coming here today. My name is Bob Potter. I am Chief of the Department of Water Resources' Central District and I will act as hearing officer here this morning while we take your comments on the Department's Draft Environmental Impact Report on adding additional pumping units to the Harvey O. Banks Delta Pumping Plant.

I'm sure you are all aware any plan for completion of the State Water Project will probably include some sort of Delta water transfer facility, and the four additional pumps discussed in our report here today. As a result of the rejection of Senate Bill 200, Proposition 9, by the voters last June, the configuration and timing of completion of the State Water Project is very uncertain.

However, the Department is presently convinced that the four pumps in question will provide sufficient benefits to warrant their construction even if the water project is never completed and the pumps must continue to be operated under the constraints outline in the U. S. Army Corps of Engineers' October 13, 1981, Public Notice No. 5820A as amended.

In the future, if the Delta water transfer issue is resolved and a decision is made to expand upon the use of these pumps, then additional environmental documentation

will be required.

The purpose of this meeting is to gain additional information to assist the Department in its decision-making process and in completing the necessary environmental documentation. Comments made today will be recorded and a copy of this transcript will be included or referenced in any final report.

If you don't wish to comment today or you wish to supplement what you say today, you may comment in writing up until February 15, 1983.

At the end of November about 700 copies of the draft report were mailed out to interested individuals and organizations, and the availability of the draft was advertised in newspapers statewide.

The written-comment period was initially proposed for a 45-day period ending on January 14, 1983. In response to several requests, this review period has been officially extended until February 15.

Also, some important information has become available since the initial printing of the draft report:

1. On December 30, 1982, the United States District Judge William W. Schwarzer, filed a supplemental memorandum of opinion in the case Sierra Club, et al., versus James G. Watts, et al. This decision considered the Corps' operational constraints for

C-105534

additional pumps and the judge ruled that the Corps should retain jurisdiction to evaluate effects on the navigational capacity of the Delta waters after the four additional pumps are installed.

The Corps will monitor the operations and enable public access to the results of such monitoring.

Evidence of significant effects on the course, location, condition or capacity of Delta waters from operation of the enlarged plant will be grounds for requiring the State to apply for a federal reulatory permit.

2. In November, 1982, the State Water Resources Control Board's striped bass working group presented their findings to the Board. Their conclusions described four possible factors that affect the striped bass fishery. They were: (1) Plankton food supply reduction; (2) Entrainment losses in diversion; (3) Toxic pollutants; and (4) Current low fish populations and resultant low egg production.

All this information is being considered in ongoing Department evaluations and will be reflected in any final

EIR.

The proceedings this morning will be informal. I will call on speakers from the sign-up sheet. When making your presentation, please state your name and any pertinent organization affiliation. Responses to all written and verbal comments will be published in any final EIR. I will limit questions to matters of clarification for the purpose of reserving as much time as possible for comments.

We are not here this morning to debate the issues, but rather, to collect information and receive comments. We will try to respond to any questions for clarification and understanding.

In addition, my staff is here this morning and will be available to discuss any lengthy technical questions after the hearing is over.

Before I call the first witness, I would like to make some introductions of people who may take part in the proceedings this morning:

Jerry Cox is Chief of the Department's Water Operations Branch; Katy Striemer, to my right, is an attorney from the Office of Chief Counsel; and here at the table is Karl Winkler, Chief of our Environmental Documentation Section in the District Office; and Norm Meade to Karl's right is an engineer with the Central District,

who was the primary author of this document.

I have had a couple of requests from people who wanted to get on the agenda fairly early. So, I have got my first two speakers selected. We are going to hear first from David Schuster with the State Water Contractors.

Incidentally, if anyone is here who has some sort of scheduling problem and wants to get on early, just holler and we will get you up.

MR. SCHUSTER: My name is Dave Schuster and I am here today on behalf of the State Water Contractors, Incorporated. I do have a prepared statement which I would like to submit for the record and I will then paraphrase for the purpose of brevity to make sure they get on by 1:30.

We appreciate this opportunity to comment on the draft EIR for the Department's proposal to add four new units to the Harvey O. Banks Delta Pumping Plant.

We have held our comments for today to more general or broader categories and do plan to submit more detailed comments by the February 15 deadline.

The comments that we place the most importance on today would be to make sure that the draft EIR is clear as to the Department's intentions, future intentions, for the operation of the Harvey O. Banks Delta Pumping Plant which I will call the Delta plant, which is much easier, after the four units are installed, and we believe the

Department's intentions are or should be to eventually operate the plant to the full 10,300 cubic-feet-per-second capacity when water is available in the Delta; and, of course, while still maintaining Delta water quality requirements in the Delta.

The Department apparently has chosen, from reading the draft EIR a two-step process, one which proposes to add four additional pumping units now and operate them to the Corps criteria that you referred to earlier in the public notice. We, the contractors, don't necessarily disagree with or even object to your decision to go to the two-step process, but we would like to have the EIR to be clarified and expanded in this area as to why the decision was made and make sure it is clear to the public and all those who are interested in how the project is going to be operated in the future that you eventually plan to go to the full 10,300 when technical, institutional and environmental questions that the Department may have are resolved.

So, again, that's our major comment and we would like to have it clarified, we would like to have that whole area expanded.

There are statements in the draft EIR that you do not intend to go for a Corps permit today and that's the major reason for not selecting the full 10,300 alternative. We would like to have that expanded.

C-105535

Again, we don't necessarily disagree with your decision. We would like to better understand it, and more importantly, make sure the public better understands it through your final EIR.

Our second question really relates to the first. Most of the information that's now presented in the draft EIR on the different alternatives would lead you to select the alternative of adding the four units and exporting to the full 10,300 second-feet. It shows increased yield capacity. Your yield increases are greater for that alternative.

If I read the document correctly, it looks like the loss of fish is less, stream losses are less with that alternative, and, in our opinion, reading the document, as I said before, I can't understand why the four -- 10.3 was not selected. Again, as stated, the main reason for not doing that is you do not intend to go for the Corps permit.

We would like to see that decision and that logic expanded. We believe that more than likely some of the major reasons, and I think they are in there, but it is hard to pull out, are, is that you are not sure yet what is the best methodology for increasing the channel capacity of the South Delta.

We agree with that and would like to see that expanded.

There are also probably some more questions that you have dealt with here in terms of fishery impacts. We would like to see those expanded also. Bob already related to part of that with the State Board's striped bass task force.

So, again, we do not necessarily object to your two-step process going for the four units now, operating them to the Corps permit, and later going to the 4-10.3.

We would like to see the document expanded in terms of explaining to us how you made that decision, and also, to the public in terms of how you made that decision.

As you talked about earlier, Bob, we are very supportive of your efforts to add the four units and move towards completion of the State Water Project. It was the intention of the original legislation to add the four units and have a minimum of 10,000 cfs capacity in the O'Neil Forebay. The reasoning at that time was to maximize the benefits or maximize the ability of the project to divert water in the wintertime which is surplus to Northern California's needs, and hopefully, the environmental needs in the Delta.

We think those intentions of the original legislation are still correct. Moving towards the 4-10.3 alternative as you are now is the right direction and hopefully, again, we can do that by taking surplus Northern flows during the wintertime and eliminating, if not minimizing,

and hopefully, eliminating any negative impacts to both Northern California water users and the environment.

Our third comment pertains to the reference within the document, or throughout the document, on the two-agency fish and wildlife agreement. It's our understanding, the State Contractors' understanding, that this agreement will not be executed in its present form, and for this reason, we would like to see those references deleted, and as referred to, if I remember right, on page 87 of the draft document, you state that if the two-agency fish and wildlife agreement is not executed, that you would establish a similar mitigation program.

We suggest that the Department do that at this time and redraft the draft Environmental Impact Report accordingly.

The mitigation for the four units that are discussed in the two-agency agreement and the draft environmental document in terms of the State Water Project financed hatchery augmentation of striped bass with fish stocks makes sense to us. We are not necessarily objecting to that. We don't believe the two-agency agreement as a whole will be signed, and it should be deleted in terms of being discussed in this draft document as if it would be signed in the future.

One frustration which I'm sure you understand we continue to have is that in this document the Department

continues to mix water demand reduction schemes such as toilet retrofit programs with what I would call water conservation augmentation plans. In the alternative section, both are talked about. It's our opinion, the contractors' opinion, that water reduction plans such as the water conservation programs should be assumed by the Department that they will be implemented to reduce the demand before we move forward in any kind of conservation program.

We do not disagree with the Department in that sense, but your own information within the draft Environmental Impact Report and in other documents shows that even with assumptions of water conservation, the Department has made in the past, we will need to augment that water supply. We are looking at shortages to water users in the near future and would like to see the alternative section changed so that you are comparing water augmentation programs with another water augmentation program which the four units represent, and we do not think it is appropriate to compare in an economical sense or a physical sense the four units with water conservation programs.

I think you should assume those would occur in the future.

We also question whether the Department really believes some of these programs such as the Imperial Valley desalting program which you estimate to be at a cost of roughly $650 an acre-foot, is feasible, and would like

C—105536

C-105536

you to again take a look at the list of your alternatives and add to that list such things as enlarged Shasta or some of the other projects you have worked on as a reasonable alternative to measure this against in an economic sense, and also, re-evaluate some of the alternatives that are there now as to your belief as to their feasibility in the near future.

One comment that I'm sure you expected us to make is that in the summary section and towards the conclusion, the Department in the draft EIR has submitted the two-agency fish agreement portions of the mitigation program, and also suggested that the Department will develop an enforceable water conservation program as part of the mitigation for the four units.

We, the contractors, have trouble understanding what an enforceable water conservation program would actually mitigate in terms of unavoidable impacts in the four units. We do not see the correlation between the two.

We would like to have the Department realize that each of the State Water Project contractors is purchasing very expensive water from the Department and from the project for areas of water deficiency, and unless it can be shown to the contrary, it is presumed, and we would like to see the Department presume the contracts are using their limited water supplies in a well managed and efficient manner, including water conservation, and in terms of

enforceable water conservation programs, we doubt seriously the Department has the authority to enforce, it does not seem to be appropriate in terms of a mitigation program for the four units, and we would like to see the entire section deleted.

Again, I would like to commend the Department's efforts to move forward in adding the four units. We are supportive of this. Our comments are meant to again provide as good a document to the public as possible so they know what your intentions are and ours are in terms of future operation of the project, and we will submit more detailed comments with the idea of making a better document, by the February 15 deadline.

MR. POTTER: Thank you, Dave. Those are stimulating comments and we will grapple with some of them.

I would like to hear from Tom Graff next.

MR. GRAFF: I am Tom Graff of the Environmental Defense Fund. Bill Jeffrey, to my right, has been working on the pumps' EIR, and we will be submitting detailed comments by the February 15 deadline as well.

It's really a little hard to know exactly where to begin in discussing the EIR, and more importantly, the question of whether the pumps themselves should be installed.

A few preliminary comments seem warranted. First, Dave Schuster's comment that the explanation for the two-

step process in the draft of installing pumps that are limited then to 7,000 cfs exports rather than the 10,000 eventually contemplated should be explained more clearly to the public, I think, is an interesting one. Our view of the matter is that the reason for that two-step process is the Department's misguided decision some time ago to try to avoid federal review at this time.

We are not exactly sure why that decision was made. It was made by a past administration. We would hope that the new administration would take another look at that question and realize that this really is a project which contemplates the 10,300 cubic-feet-per-second eventual pumping level, and forthrightly and honestly go to the Corps for the permit that would be required at that pumping level.

I suppose the principal reason that the old Department sought to avoid Corps review was that the Federal Fisheries Agency, particularly the National Marine Fisheries Service, in commenting on the final Environmental Impact Statement for the existing pumps, made some very constructive and positive proposals for mitigating the effects of project pumping on fish and wildlife values.

Really, those concerns, the concerns that the State and Federal Water Project and other projects have impacted the Bay-Delta environment negatively are not adequately addressed in this report, and I think the operational plans

that are forecast, at least at this time, for use of the additional pumps, aren't structured in such a way as to minimize the effects on the Bay and Delta.

I see other prospective witnesses here today who have a whole lot more expertise on the actual impacts on the fish and wildlife resources, and I will defer to them, particularly Don Kelley of DFAC, in describing some of those.

As far as the legalities are concerned, it seems to us, and we will be spelling this out in more detail in our written comments, that there should be very definable, very well defined, explicit and extensive commitments to Bay-Delta mitigation if this project is to go forward.

One of those potential commitments would have been the two-agency agreement which apparently the Department of Fish and Game Director has seen fit not to sign. If that two-agency agreement is not signed, and, of course, it's referred to frequently in the draft, as Dave Schuster said, then, it is even more critical that the mitigation commitments be spelled out in detail in the final EIR. I think that's required by the law.

And even more importantly, it seems to me it is incumbent, both on the project and the contractors who benefit from the project, to make the most comprehensive commitments to mitigation that is feasible under the

C-105537

circumstances.

The potential for havoc that these additional pumps might cause is so great that if these kinds of commitments aren't spelled out and agreed to, the environmental community, or at least the Environmental Defense Fund, I think, has no choice but to resist their installation by all means legal.

Similarly, on the alternative side, the impact report deals really in any significant way only with various configurations of pumping without need for a Corps permit, need for a full four permit under some circumstances after other projects that would have cumulative impact are included.

But in a serious sense, other than the no-action alternative, which is probably certainly inadequate, the EIR more importantly, the overall concept doesn't deal in sufficient detail anyway with alternatives to expansion of the State Water Project from a water supply augmentation point of view.

I suppose this is the flip side of Dave Schuster's earlier comment.

The other thing that we think is critical in terms of both the discussion of alternatives and probably in the long run more importantly in the discussion of mitigation, is that there be enforceable commitments to conservation-type alternatives made at the time the final EIR is

certified.

There's now a good precedent for doing that -- in the case of the North Bay Aqueduct final Environmental Impact Raport and proposed agreement that the Department has reached with the North Bay contractors, apparently, at least one of those contractors has signed such an agreement -- the agreement itself, from our point of view, is inadequate, but the methodology of requiring conservation alternatives and then simultaneously with the issuance of the final EIR committing to those alternatives and having the contractors commit to those alternatives is the appropriate way to go in connection with this project as well.

I must say, maybe it is good that Dave went first. I don't see how you cannot compare water augmentation plans and water conservation plans under CEQA. Both have similar potential for serving the people that the project is in the business of serving. If a water conservation measure produces an acre-foot of water at a lower cost, both economically and environmentally than the construction of a project of the type that the pumps are, or enlarging Shasta might be or Thomes-Newville, or the Peripheral Canal or whatever, then it seems to me that implementation of that water conservation measure is preferable for all concerned and ought to be compared.

There's some ambiguity in the EIR as to whether the cost-effective water conservation measures which are

identified are really an alternative to the pumps or to other supply augmentation schemes in the future. At the very least, those that are identified and that are in a sense viewed as better because they are cheaper and because they are less environmentally disruptive and damaging, those ought to be committed, not just mentioned and assumed to be taking place in the future, but committed to.

Again, the Department's recently issued plan under the Governor's executive order for the Metropolitan Water District of Southern California, in particular, has some very excellent proposals which ought to be implemented before, or at least contemporaneous with the approval of installation of the additional pumps.

Coming full circle, I guess I should say we are not opposed, indeed, we may even support the installation of the additional pumps under the appropriate set of conditions, namely, under a set of conditions that commit the project and the contractors to the conservation alternatives that are outlined, for example, in the Metropolitan Water District plan that commit the project and the contractors to the protection of the Bay and Delta resources that are described in the two-agency agreement, that are described in the striped bass task force working group report, and more importantly, perhaps taking it to one more level of generality, to an overall idea that the point of putting the additional pumps in, or at least one major

point is to be able to use them flexibly to deliver additional water when the impact on the Bay-Delta resources is less and to back off putting additional stress on those resources when the impact would be greatest, which leads me to another set of potential mitigations which are in connection with the groundwater storage need south of the Delta, which, if installed and implemented, and after institutional barriers are cleared away, contemporaneous with the installation of the pumps, would potentially have very positive impacts.

Again, though, we see from the contractors' from time to time resistance to those notions, it seems to me the Department ought to get a commitment to groundwater storage plans that will work south of the Delta to both firm up the additional yield that the pumps thereby would provide and to enable the Department to mitigate the impacts of the project as a whole and of the additional pumps on the Bay-Delta system.

MR. POTTER: Thank you, Tom, and Bill, thank you.

Next we will hear from Dick Clemmer.

Before Dick starts, is there an additional sign-up sheet? I'm sure I don't have it all here.

MR. CLEMMER: My name is Richard Clemmer and I represent the Metropolitan Water District of Southern California. I'm not sure it's fair to sandwich Mr. Graff in between Dave Schuster and myself, but I will try and read

C—105538

C-105538

my statement almost verbatim because I have some problems. I wrote it very carefully to try to express our views on the pumps and our feelings about the water conservation and all, so I will try and stick to it as closely as I can, but I will respond a little bit to some of Mr. Graff's comments.

We would like to express our support for the statements made by Mr. Schuster on behalf of the State Water Contractors, and we also commend the Department on its efforts to complete the Banks' Delta pumping plant, and again, we will make some just general comments today and we will submit our detailed comments by the 15th.

And like Mr. Schuster, I think possibly from some of the other people that are here in the room today, we also feel that the Environmental Impact Report should be modified to fully disclose the department's intention, in fact, its obligation to complete the Delta pumping plant and when required, to operate the plant up to its full 10,300 cfs capacity.

It was the desire of Northern Californians in 1959 when the Burns-Porter Act was enacted, as it is now, that water to be exported from the Delta should come primarily from high winter flows. To substantiate this, I would like to quote from the January 12, 1983, recommendation of the Assembly Water Committee's Emergency Delta Task Force referring to water for areas south of the Delta,

and I quote:

> "The design of the Delta water transfer facility should permit water to be provided to Southern California and to the San Joaquin Valley in a manner that better permits water to be taken when there is excess in the North. This should include more storage of water south of the Delta."

We fully concur with that statement, and prompt installation of the four additional pumps is essential to accomplishing that end.

The groundwater -- I will digress here just a little bit to mention groundwater storage programs. I'm sure Mr. Graff is aware, as most are, that the Department and Metropolitan Water District are jointly studying putting water in Chino groundwater basin in Southern California. We think that's a notable goal. Four pumps are essential to getting that done.

We also have water running out of our ears in Southern California right now. Our groundwater basins are full. If water had been stored in there by puming it over the Tehachapis in the past for use in some future dry year, much of that water would have been lost.

We also have a program for trying to put excess flows in Colorado River reservoirs. We are working on those things, but they are not independent and the four

pumps are essential in accomplishing that end.

We would like to comment further on the State's obligation to complete the entire State Water Project, not just the Delta pumping plant. The draft EIR does not clearly state the Department's plans for meeting this obligation. While we realize that the Department must reformulate its plans to meet that obligation in light of the failure of Proposition 9, the draft EIR is silent on this subject. Metropoligan pledges to work closely with the Department in its efforts to augment the State Project water supply in an economically and environmentally sound manner.

I would like to turn specifically to environmental matters. We would also like to discuss the two-agency fish agreement. Metropolitan is on record as opposing the agreement in the form that it was proposed last year. However, please understand that we do not oppose, but, in fact, support mitigation measures to protect fish and wildlife as they are impacted by State Project operations. To that end, we again pledge to work with the Department to meet the State Project's responsiblity.

I turn to water conservation now and this is the sort of thing that triggers me to try and read my statement as I wrote it, not what I would like to say possibly. But a matter that continues to concern us and is especially bothersome in the draft EIR is related to enforceable water

conservation plans. We at Metropolitan support voluntary workable water conservation programs in our service area. Numerous programs have been in operation for years and as responsible programs emerge they are added regularly. However, we look on water conservation as being essential to only diminish the shortages we can expect in the near future, not to make them go away as it implies; in fact, it even states or leads you to believe in the EIR in a few places.

These and future programs are independent from the installation of the four pumps and will occur irrespective of actions in the Delta. They should not be considered mitigation measures nor should they be labeled substitute water supplies. To even infer that water conservation is an acre-foot of water, I think, is not accurate. It reduces demand and I think it should be considered in terms of a demand reduction and not a water supply.

Anyway, putting that altogether, I think the references should be excluded from the EIR and I guess I would go to Mr. Schuster's comments.

Just before I conclude, I would like to go back to the water management plans of the Department of Water Resources and Mr. Huntley prepared for Metropolitan. A lot of good work went into those plans. Our water conservation coordinator, who is on my staff, went to every one of our member agencies, talked to them and discussed the

C-105539

things that were in them. A lot of good things came out of it, but I think that what rankles people in Southern California or people in New Jersey or people in the North Bay Aqueduct area, is to talk about enforceable things.

In our service area we probably, we collectively, agencies, probably have put some kind of devices for toilets in two-thirds of the 13 million people's hands in Southern California. I don't mean they got in their toilets, but they have been placed in their hands. All of the City of Los Angeles, virtually all of Orange County, and these are nice things, but when you talk about landscape irrigation, landscaping enforcement plans, you have to have somebody to enforce that, and right now, the State and California is really worried about enforcing the law. We are worried about crime and to think that somehow we could enforce water conservation plans that are somehow in the showerhead or in the toilet, it just can't be done.

We support them. We will compare our water use per capita with any place else in the State, and we really think that we have overdone it here in this report, and we think that should be corrected.

Thank you very much.

MR. POTTER: Thank you, Dick.

Dan, are you ready?

MR. CHAPIN: My name is Dan Chapin and I am representing the Suisun Resource Conservation District.

My comments today have to do with the adequacy of the draft EIR in one particular area. There are several other people here today whom I'm sure are going to discuss in much more detail than I will or I could what the implications of the pumps are as far as the fisheries are concerned. The area of the draft Environmental Impact Report which gives us difficulty is its rather casual treatment of the effect of the pumps on the Suisun Marsh.

Since the Marsh lies downstream from the Delta, anything, whether it be upstream from the Delta or in the Delta or exports from the Delta, which decreases Delta outflow at any time of the year in any amount affects the water quality available for the Marsh. The pumps, in particular, with their projected operating schedule of tapping off winter floodflows would have their impact at the time of the year when the water quality is most important to the Marsh. There are a whole bunch of other ramifications relative to the estuary downstream from the Marsh, San Francisco Bay, and I'm not qualified to talk about them, but the Delta Environmental Advisory Committee papers clearly identified the need for substantial floodflows into San Francisco Bay in order to take care of the environmental needs there.

I don't believe that the Environmental Impact Report can be considered complete and accurate unless it addresses the question of what water quality will be

available in the Collinsville area for potential use in the Marsh after the pumps are in operation.

For four years now, we have been trying to evaluate what water quality would be available at Collinsville and what effect it would have on the waterfowl habitat in the Marsh under a variety of conditions.

The Environmental Impact Report also assumes a series of Marsh facilities to distribute and redistribute water within the Marsh will be built.

At the time of Proposition 9, the wave length that everybody was working on was that a complete set of facilities would be built. Since the defeat of Proposition 9, the current planning is to only build part of the facilities, and in addition, the quality of the water which is in the Marsh which is currently being discussed is substantially or significantly lower than that required by D-1485's post-October 1984 standards. So, we are talking here about facilities don't get built and lower water quality in the Marsh.

What effect the construction of the pumps and in particular the pumping schedule have on the water quality seems to me very critical and very basic, and it is an issue which is just totally glossed over.

End of comments.

MR. POTTER: Thank you, Dan.

I'm not sure that it's appropriate to sandwich

Jerry Johns in between Ed Chapin and Don Kelley, but I think that's what I am going to do. Jerry.

MR. JOHNS: Thanks, Bob. My name is Jerry Johns. I am with the State Water Resources Control Board's Bay-Delta Program, and I am the Program Manager for that program.

Thank you for allowing us to comment here today on the four pumps. Open hearings like this, we think, provide a good forum to air the diversion ideas on this issue and to initiate discussions on possible solutions of the concerns raised.

The State Board has not yet had an opportunity to finalize its comments on the four pumps, but they have asked me to come here today to briefly outline some of our areas of concern. The Board will be submitting written comments by the February 15 deadline.

Some of the areas that the Board has some concerns about -- briefly, one of them is related to the striped bass. Mr. Potter's opening statement referred to the recent striped bass worker report prepared by the Resources Control Board. We are definitely concerned with the status of the striped bass fishery and the effect additional pumps may have on that and we agree that the possible effects the four pumps may have on the striped bass fishery should be more fully evaluated in the Environmental Impact Report.

Another concern relates to our July 1979 memorandum

C—105540

C-105540

of agreement with the Department of Water Resources and the Bureau of Reclamation regarding water development projects in an environmental impact review. The need to address the applicability of this memorandum agreement should be more fully evaluated as you move forward to the planning process.

Another area relates to the evaluation of alternatives.

Another is the confusion as to why the four pump alternative was chosen over some others, as has been discussed somewhat today. We feel this should be clarified.

There is also a need, we think, to clarify what the no-action alternative really is and what the goals of the project are.

Basically one of our concerns is, is the goal of the project simply to increase yield or is it to meet the water demand buildup schedule of the State Water Project contractors? A clear distinction should be made in the EIR on that aspect of it.

Regarding a Delta water transfer facility, if, indeed, this facility is part of a plan to enhance water movement across the Delta, we feel the Environmental Impact Report needs to address the applicability of the Board's policy guidance set forth in the 1978 Delta Plan as related to such a cross-Delta transfer facility.

That concludes our comments and I thank you again

for allowing us to come and we will look forward to working with you as you complete the EIR process on the four pumps.

MR. POTTER: Thank you.

Don Kelley.

MR. KELLEY: I have just hardly finished writing down Jerry Johns' comments.

I would like to start by saying that there's nothing personal. My name is Don Kelley and I represent the Delta Environmental Advisory Committee, and there's nothing personal in what I am going to say as far as Norm and others are concerned.

DEAC has completed its comments and I would like to give you the copies of them here now. We may want to submit some more before the 14th.

The comments are in the form of a page-by-page critique of the Environmental Impact Report along with a cover letter addressed to Director Eastin, which I will read and comment on as I go along.

Dear Mr. Eastin:

The Delta Environmental Advisory Committee has reviewed the subject report. We understand the Department proposes installation of our new pumps to increase the capacity of the existing plant by 61 percent, but that you intend to only use the new capacity on weekends to take advantage of lower off-peak power rates. We understand the desire to accomplish this, but we believe the

November draft EIR is a step backward.

The draft describes the only significant environmental effects as being an increased entrainment loss of striped bass by 101,800 earling equivalents and the possible loss of other species up to about .8 percent of American shad and white catfish. The mitigation offered is to artificially rear and stock striped bass.

The report ignores the effect of export pumping on the survival of the young bass before they are endangered by entrainment. It uses the old mathematical correlation between the mean June/July exports, June/July outflows, and the abundance of young-of-the-year in mid-summer as evidence that no damge will be done since mean June/July outflows will not be changed. Since 1976, these correlations have failed to predict the population and the resource is in danger. There is evidence that the export pumping is a root cause.

DEAC's job is to help you solve the Delta problem. We respectfully suggest that it is unwise for the Department to attempt to install additional pumps or to increase export pumping until this fisheries problem is resolved. In our opinion, the November draft EIR is not a serious attempt to assess the effect of the proposed project on striped bass or any other fish. Efforts to proceed on the basis described in it will weaken DWR's credibility.

We believe the EIR is inadequate for the following

reasons:

1. It does not address the real issue of how the present projects have influenced the striped bass populations and their habitat, how the four new pumps will modify the influence, or the Department's ability to solve the problem.

I would like to comment there and make sure you understand what we are talking about. You have used the old correlations that are not valid to predict that there will be no damage and that's simply got to be removed. It's improper, unprofessional and it just is a scandalous charade. Please take it out.

2. The assessments of the project impact on other fishes do not demonstrate knowledge of their environmental requirements or influence of the existing projects.

Our comments are that there is not enough known about the resident fishes in the delta to say anything about what is going to happen to them. Contractors have been spending millions of dollars to learn about those things. Let's use that information.

3. Some of the conclusions in the EIR are based upon an agreement for the operation of the project between the Department of Fish and Game and the Department of

C-105541

Water Resources. No such agreement exists.

4. In some cases, project effects are compared with the effects of future increases in export pumping, which the report says will exacerbate existing problems anyway. These no-project future increases in export pumping and the department's authority and ability to make them are not clearly described in this report.

Basically, there are a number of places in the report where you say four new pumps are going to cause some problems, but those problems would exist anyway. I don't think that's true. I think there are a lot of people that are going to make a big effort to try to see that things get better, not worse.

5. The only admitted environmental losses caused by the project are increases in entrainment from an estimated 11.5 million to 12.7 million young bass. These estimates were made by the Department of Fish and Game, and include only fish larger than 30.1 millimeters in May, or 40 millimeters in all other months. Most fish lost are smaller. DWR has previously estimated that 100 million young are entrained at the Harvey O. Banks plant.

6. The mitigation proposed is to stock striped bass. The stocking being proposed is experimental. There is no evidence that it will succeed in saving the bass. Most biologists have serious doubts.

7. The DEIR merely addresses the operation of the pumps to provide increased pumping capacity using off-peak power. While this is the operation mode initially contemplated, it is not the long-term mode under which the pumps would be operating all the time. The DEIR does not address the impacts of full-time pumping operation which this project will make possible.

In conclusion, we believe that the EIR is inadequate and that it will not serve the Department or the State Water Project well. We urge you to withdraw it and to more vigorously pursue the experiments and studies that were recently recommended by the State Water Resources Control Board's striped bass working group. Until we determine how the existing project can be operated in a manner compatible with fisheries resources, we believe that the Delta exports should not be increased.

I enclose our detailed review and critique.

And that is signed by Arliss Ungar, Chairman of DEAC.

I would like to add a comment on some of the suggestions that have been made by the speakers before me. I think DEAC basically believes that the EAR should be withdrawn and the present plans to use the pumps to save money, which is commendable, but those plans have got to be changed and we would like to see you take the plan back and let's see if we can't put together a plan which will provide for the installation of four more pumps so that you can pump more water in the wintertime and less during the critical period when the fish are being influenced.

Obviously, in order to do that, in order to proceed with that, we have got to work on some institutional guarantees that it will be done, that the four pumps won't be put in and then the environmental problems will not be solved.

Let's use this opportunity to go back to the drawing board and start that process all over again. DEAC worked very hard with the Department of Water Resources, the contractors and a lot of people to try to solve the Delta problem for years with the Peripheral Canal. We lost, and now we have got to start again. That's a dead issue.

There do appear to be some approaches that have merit and we would like very much to pursue them with you. We think this is an opportunity to start that process.

Thank you.

MR. POTTER: Thank you.

Bob McKinney indicated he would like to talk.

MR. McKINNEY: My name is Robert McKinney and I am here as Chairman of the Contractors' Audit Committee. In the interest of brevity, I would just say on behalf of our 26 members, we agree generally with the comments made by Dave Schuster and Dick Clemmer. We will be submitting written comments that will supplement theirs.

Thank you.

MR. POTTER: Thank you, Bob.

John Beuttler.

MR. BEUTTLER: For the record, my name is John Beuttler. I am the Executive Director of United Anglers of California. I don't come here in an adversary role. I like to view my comments today as a pro-resource role.

United Anglers of California, for many of you who don't know about it, is an organization that represents thousands of sports fishermen across the State of California.

I am here today because they are angry. They are hurt and they feel betrayed. They feel that way because they see things in very simple, very straightforward and sometimes possibly wrong conceptions. What they see is they once had a fishery of striped bass that numbered in the millions. It's not there anymore. What they see is that they had it before the State Water Project came on line. They don't have it today.

C-105542

Now, I understand, like many of you, that we have a very complex problem. It's hard to communicate the good intentions of the Department of Water Resources and the State Water Resources Control Board to fishermen, who, every day, year after year, turn around and watch their fisheries further depleted.

I am also speaking in this sense for a group of concerned fishermen who do understand that there are significant problems that must be addressed.

As I said earlier, we like to think of ourselves as pro-resource people because we are talking about public resources, public resources which are to be entrusted, protected, enhanced and maintained by the State of California and by the State agencies. We do not see that this EIR leads us in that direction.

So, what I have to say is not to be taken on a personal level, even though I speak from one, but with the hope that we can possibly prepare a better Environmental Impact Statement.

I will try to keep it brief.

The basic questions that we have are what guarantees are there that once the pumps are installed, they will be used in a positive way to help our resources instead of being used to increase water export at the additional expense of our natural resources? As we understand the State Water Project, it's fine for the water to be used

for other beneficial uses, but nobody has been given a blank check to destroy other public resources in the process.

We are quite concerned that once four pumps are installed, five years down the road, ten years down the road, at some point in time, what will happen is that because of the scarce nature of our water resources, those pumps will be turned on and all the natural resources of the Delta could be thrown out the window. We are not saying this is going to happen. We don't see anything in the EIR that convinces us that it can't all of a sudden be turned around as those pumps are used to deplete our resources instead of helping to perpetuate them.

An example, of course, is that there has been a lot of talk lately of three Delta facilities and California is going to have one whether we want it or not. We worry about guarantees which aren't part of the package. We would like to see more.

We can't support taking more water from the Delta until the current extended decline of our Bay-Delta fisheries is resolved. What you are telling fishermen, though, is well, we are sorry about the fish. People are more important than fish. People are more important than natural resources, people are more important than public welfare in terms of the future of our State's natural resources.

And what you are showing to them, in effect, is

probably not the message you want to get across, so I would urge you in that regard to think about how you can take care of the current extended decline with these four pumps and demonstrate, as you attempted to in some places in the EIR, how these pumps can be used to help mitigate the problems that we are having.

I also want to say at this point that fishermen are not going to support taking more water out of the Delta until the problems are resolved and their fisheries restored. It's our opinion that the EIR does not represent environmental reality. We feel that the current Environmental Impact Report does the Department of Water Resources a disservice and it will result in the loss of credibility.

As pointed out by the comments made by the Environmental Defense Fund and the comments made by Mr. Kelley on behalf of DEAC, for the reasons they illustrated, plus the detailed reasons that we have already submitted dealing with the cumulative impacts and the fact that the mitigation measures proposed are not adequate, we cannot support this Environmental Impact Report.

We will only support an Environmental Impact Report which is a valid reflection of what has happened, what the current conditions are, and what will happen or what is most likely to happen in the near future because of the pumps.

We could support the additional four pumps, but

we will not do this unless the Environmental Impact Report gives the people of this state a valid picture of what's going on.

For example, far too often in the EIR we see, well, this is going to perpetuate D-1485, and as we all know, D-1485 has been a great thing. D-1485 has serious modeling flaws. They are flaws that have, in our opinion, caused the extended decline of the fishery, and when you say you are not going to have an Environmental Impact Report because you are following D-1485, what you are really telling me is that you are going to extend the flaws that are in D-1485 and you are having an environmental impact.

So, we worry about these things and we would like to see them addressed in a clear and a better manner. We would hope that the suggestions that are made by DEAC are carefully listened to because we see a very strong possibility that more water can come out of the Delta. We would hope, and this is sincere hope, that downstream storage facilities can be created so that peak winter flows can be utilized so that the problems associated with water contracts and the problems associated with fisheries can both be worked on.

We see the pumps as a way to do this and unfortunately, we don't see that in this Environmental Impact Report, and we would urge you to go back and let's look at it again and hopefully do a job that's more reflective

C-105543

of reality and what can be achieved.

MR. POTTER: Thank you.

There were a couple of you out there that didn't indicate whether you wanted to speak or not. I have called on everyone who asked to make a presentation. If there's anybody who would like to talk or anybody who would like to supplement anything they said earlier --

MR. NESMITH: My name is David Nesmith. I am with the Sierra Club. I will just add a few comments to what I think are mostly very adequate comments that have been made by Tom and some others, on behalf of the Sierra Club.

We feel like the Environmental Impact Report is inadequate based on some of the points that have already been made. The major problems that we see with the Environmental Impact Report as currently written is the lack of specificity in certain key areas.

For intance, on the scheduling of the pumping there is no specificity which indicates how the pumping would be scheduled in order to minimize the environmental impacts and this has been already covered quite well.

Another part of the scheduling is how the pumping in dry years will impact especially the Delta and Suisun Marsh. I understand that some people within DWR have said that the water quality standards and the standards of maintenance of water quality in Suisun Marsh cannot be met during dry and critical years, and we are very concerned

about that.

I would like to see the Environmental Impact Statement come out more specifically as to how the years that are not like this year where there is not water running out of everybody's ears, how those years are going to be dealt and how the environment impacts of those dry years will be dealt with with the additional pumping capacity of the proposed pump.

We are very happy to see the discussion of the Imperial Valley deficiency as one of the possible ways of increasing water supply. We would like to see that rather significant potential source of new water followed up vigorously. We understand the institutional constraints and difficulties of that option, but the potential for new water from that source is very tempting.

We are concerned that the cost/benefit ratio that was talked about in the report shows that two pumps at the proposed pumping rate have a higher cost/benefit ratio than four pumps, and so the question obviously comes up whether the pumps are actually being installed to take the State up to its full design capacity in the State Water Project, and if so, what effect this is going to have on the Delta and on the upstream supply areas.

We are really concerned because I don't think that the current contract commitments are written on tablets of stone. I think they were written on paper and that

they are changeable, and we would like to see the contract commitments looked at again in light of not just toilet dams and showers, but in light of the fact that a lot of the land that has been brought into production under the State water supply contract is in crops that we may want to consider whether they should continue to be grown in as large an acreage with the potential for damage that the full contracted amount of water could bring to the Delta.

For instance, there's a lot of alfalfa grown in the state service area, and that's not a very high cash value crop. Now, I know that the farmers are going to stop growing it as soon as it becomes economically inefficient to do so, but in the meantime, we are going to be talking about the San Luis Drain and we are going to be talking about additional pumps and more water storage, both offstream and enlargement of Shasta, and other water reservoirs, so I think that these water supply questions have to be looked at in a way that the Environmental Impact Statement doesn't necessarily deal with.

The two-agency fish agreement has already been talked about, the fact that it does exist, which also makes the Environmental Impact Statement not adequate as far as how the fish are going to be dealt with.

And the final thing I should say is the fact that the Federal Government is pumping much more water than

the State is probably not an appropriate fact to be dealt with in this Environmental Impact Report, but we need to do more than the agreement that has currently been signed to bring the Federal Government's pumping and water program into congruence with the State concerns that we have as far as water quality and Delta management, and we would like to encourage the Department to continue to get the Federal Government on board as far as the environmental impacts of their program also.

MR. POTTER: Thank you.

Is there anyone else who would like to speak before I close the meeting?

MR. YOCOM: I am Tom Yocom, National Marine Fisheries Service. I purposely didn't mark one of your little boxes. I wanted to see what was going to be said.

I hate to come up and agree with Dave Schuster and Dick Clemmer, but I think it would be appropriate in the EIR if you do spell out what the intentions are of those pumps. I think that in agreeing with Don Kelley and John Beuttler, it is possible that the additional pumps is a good thing -- if fisheries biologists were given control of the valves when they were turned off and on, we could probably improve the fisheries.

I'm not suggesting that and I think that if the water contractors had their way and wanted to turn them on and off, they could maximize their use. I think it's

C-105544

C-105544

also conceivable that both parties can win, but I don't think they can without additional storage south of the Delta.

I don't know enough about the whole operation of the system to know what you need in addition to Los Vaqueros and the capacity of the aqueduct system in terms of taking advantage of some of the really high winter flows in terms of actually moving that water and having a place to put it.

I think one of the problems in the EIR is that everything is evaluated in terms of mean monthly pumping rather than looking at the annual volumes and that if you were to take a look at alternatives in terms of how much water you plan to move in a year with the additional pumps. Under those circumstances, a no-action alternative might be pumping the same amount of water that's pumped now, but scheduling it differently, and by scheduling it differently we could take a look at what can be done relative to fishery impacts.

Under a no-action alternative, we have four pumps but you are not moving any more water annually than you are presently, and then, to evaluate additional alternatives in terms of how much more water you are moving on up to the 4.23 million acre-feet, and under those conditions, take a look at what the impacts are on fishery resources, but to do it under a mean monthly average is, in my personal

opinion, just a way to get out of having to deal with an Environmental Impact Statement and the Corps at this point, and I think it's clear to everybody in this room that somewhere down the road you are going to be going into the Corps for a Section 10 and 404 permit, and why not do it now?

The National Marine Fishery Service has a bunch of comments that were signed off on yesterday, is my understanding, so you will be receiving those in the mail.

Thank you.

MR. POTTER: Thank you, Tom.

Anyone else?

MR. KELLEY: Bob, I think the Department of Fish and Game should make a statement about the way they feel about this Environmental Impact Report.

MR. POTTER: We don't disagree with you, Don.

MR. KELLEY: They presumably helped write it and I would like to hear what they have to say. I'm sure a lot of other people here would, too.

MR. CHADWICK: Obviously, I didn't check your box. My name is Pete Chadwick, Department of Fish and Game.

We have a variety of concerns with the Environmental Impact Report that we will be expressing to you. We also do not feel it is adequate. I don't think there's anything in our comments that will differ from the variety of comments that you have received today, but we do feel

that the Environmental Impact Report needs to be improved and we do feel that the mitigation needs to be spelled out and improved, and we will be working with you toward that end.

But at this time, we don't have any comments beyond that.

MR. POTTER: Pete, I can't resist chiding you just a little over one of the major deficiencies in our mitigation package. Your agency certainly had an opportunity to do something with the agreement referred to in the Environmental Impact Report and you elected not to. That has come up over and over again today, and that's clearly something we are going to have to deal with between now and --

MR. CHADWICK: Correct.

MR. POTTER: Anybody else?

I think that from what you have heard here and what I have heard here, it's pretty obvious that we have a lot of work to do. I thank you for coming and commenting.

If you didn't sign the attendance record, we would like to have you do that before you leave the room just so we have an idea of who was here.

So, with that, we are through.

(Thereupon the hearing was closed.)

REPORTER'S CERTIFICATE

---oOo---

THIS IS TO CERTIFY that I, ALICE BOOK, a Certified Shorthand Reporter, was present during the public hearing of the DEPARTMENT OF WATER RESOURCES, STATE OF CALIFORNIA, held in Sacramento, California, on Friday, February 4, 1982; that as such reporter I took down in stenographic shorthand writing the proceedings therein had in the matter of the DRAFT ENVIRONMENTAL REPORT on Adding Additional Pumping Units to the Harvey O. Banks Delta Pumping Plant; that I thereafter caused my stenographic shorthand writing to be transcribed into longhand typewriting and that the preceding 45 pages constitute said transcript; that the same is a true and correct transcription of my stenographic shorthand writing for the date specified.

Dated: February 11, 1983

Alice Book

ALICE BOOK, CSR #43

C—105545

C-105545

Letter 1
Commenting Entity:
U. S. Department of Commerce
National Marine Fisheries Service
February 2, 1983

Response 1

Many factors affect the complex environment of the Bay-Delta estuary, as discussed in the response to General Issue 11 in this chapter under "General Issues and Responses".

The Department of Water Resources believes recent data that show a decline in striped bass population in the Delta are important and should be investigated. The Department has funded and participated in various studies and programs to understand more fully the needs of the Delta environment. To date, no conclusive determinations have been made in connection with the striped bass decline.

The Department has participated in the Cooperative Striped Bass Study and the Striped Bass Working Group, and has provided about $20 million to fund the interagency ecological studies since 1970. The Department also provides funds for monitoring under provisions of Water Right Decision 1485.

As discussed in Chapter 5 (General Impacts on Striped Bass), in November 1982, the Striped Bass Working Group reported the following findings to the State Water Resources Control Board.

The production of young striped bass has suffered an unsteady, but persistent, decline from population levels that were high in the middle 1960s. The decline was particularly severe in 1977, and production of young bass has been low since then. In the last decade the decline became apparent in the adult population. The adult population is now about one-quarter of its former size, and there is little sign of recovery. The bass population, and the fishery it supports, is in serious danger. The cause is most likely one or more of the following factors:

- The plankton food supply of young striped bass in the western Delta and Suisun Bay has been greatly reduced each spring. Export pumping of water by the Central Valley Project and State Water Project is a prime suspect.
- Large numbers of young fish are lost by entrainment in diversions.
- Additional stresses are placed on the population by toxic substances such as petrochemicals and pesticides.
- The adult population is so low that egg production may be inadequate.

If toxic pollution is a major reason for the decline, then it is possible that present regulations are reasonably mitigating State Water Project impacts.

While some of the factors relating to the decline in anadromous fish in the Sacramento-San Joaquin Delta, San Francisco Bay, and the continental shelf may be due to causes unconnected with the project, the Department recognizes that operation of Banks Pumping Plant is an important factor to study in connection with the decline. This operation was the subject of public hearings that resulted in protective standards that regulate operation of the State Water Project. These standards, set forth in Decision 1485 issued by the State Water Resources Control Board, were designed with the principle of providing Delta conditions that would have existed without the projects and protecting the estuary fish, wildlife, and beneficial water uses by mitigating project effects. They include restrictions on both the timing of pumping and the quantities of water to be exported.

Decision 1485 conditions were based on information and planning available just before the decision was adopted. The

decision recognizes that the conditions would not fully mitigate impacts of the project on fish, since to do so would seriously affect project operations. Through its balancing process, it established what it considered reasonable conditions. These conditions will govern operation of Banks Pumping Plant and the State Water Project with or without installation of additional pumping units. The Department will comply with valid existing and future State Water Resources Control Board protective standards for operation of the State Water Project in the Delta.

In addition to the protective standards established by the State Water Resources Control Board, the preferred alternative is to operate the additional pumps in accordance with restrictive diversion criteria set forth in U. S. Army Corps of Engineers Public Notice 5820A, Amended*. This Public Notice restricts the quantities of water to be exported with the new pumps by limiting amounts of water that can be diverted into Clifton Court Forebay. Also, the Department has recently spent about $5 million to improve fish screens at the Skinner Fish Protective Facility in coordination with the Department of Fish and Game.

In conjunction with these two sets of State Water Project operational restrictions and improved fish screens, the Final Environmental Impact Report on the Proposed Additional Pumping Units evaluates fish impacts based on more efficient operation of the State Water Project, which also acts to maximize diversions during periods of low fish abundance and minimize diversions during regulated flow periods of high abundance. Operation in this manner with additional pumping units would reduce impacts on striped bass.

The final report also presents alternative methods of constraining operations of the Banks Pumping Plant to benefit Delta fish. These other operational mitigation constraints would also regulate timing and amounts of water exported. These mitigation options are:

- Further reductions of May, June, and July exports below the present limits established by Decision 1485.
- Limitations on daily variations in pumping rates to increase fish screen efficiencies for striped bass.

Both of these options are analyzed as Mitigation Option 2 in Chapter 5 (Table 5-27). Both would reduce benefits to the project from the proposed additional pumps and further reduce adverse impacts on fish.

More details about these operational constraints are discussed in the response to General Issue 4 in this chapter, under Mitigation Option 2.

Response 2

The permit process included a review by the U. S. Army Corps of Engineers that included public input and the input from a letter, dated March 30, 1981, from the National Marine Fisheries Service. This process developed diversion limits, and the Department of Water Resources is committed to these limits by letter dated August 1981. These limits were published in Public Notice 5820A, Amended, which is on page 7 of the draft report. Diversion limits for the State Water Project are essentially keyed to historical levels and under these conditions no additional permit is required. It is the Department of Water Resources'

*In this report these criteria are referred to as "Corps constraints".

intent under the preferred alternative to operate to these diversion constraints. In addition, the preferred mitigation, the proposed fish protective agreement, would most likely incorporate operating constraints similar to the Corps constraints.

With regard to recommendations presented in this comment:

1. Limitations on annual export pumping are discussed in the "Regulatory Permits for Banks Pumping Plant, and Related Environmental Documentation" section, Chapter 1. They would help meet one of the Department's management objectives, which are to improve conditions in the Delta. It would create problems in meeting other objectives, which specify protecting the long-term water supply and financial integrity of the State Water Project. Reduction in export rates were discussed in the introduction to Chapter 3. Limitations on exports, which would still provide a benefit with the pumps, are discussed in Chapter 5 (Mitigation for Impacts on Fish, Mitigation Option 2).

2. Studies concerning screening agricultural diversions show that great numbers of fish are diverted by these pumps, but they have not provided sufficient evidence as to the effectiveness of screening. Screening agricultural diversions would be one of the measures considered in the fish protective agreement, which is the preferred mitigation option.

3. Hatchery production and habitat restoration are addressed in mitigation options contained in Chapter 5 under "Mitigation for Impacts on Fish" (Mitigation Options 1 and 3).

4. No specific plan for a Delta water transfer facility has yet been formulated by the Department. A Delta water transfer facility would require additional environmental documentation and would involve the Corps of Engineers permit process. The Department expects that permit conditions would be acted on by the Corps at that time and that the State Water Resources Control Board would also reassess its conditions on project operations.

Response 3

The Department agrees that Delta outflow is important to marine, estuarine, and anadromous fish. With or without installation of the additional pumps, Decision 1485 or other valid Delta outflow standards would be met.

With the additional pumps, Delta outflow could be reduced in months when (1) flows in excess of Decision 1485 protective requirements were available for pumping at Banks Pumping Plant and (2) when diversions and corresponding carriage water releases were reduced. Delta outflow would be increased in some winter and spring months because of more frequent filling of San Luis Reservoir. Average outflow reductions of the preferred alternative are minimal, averaging 0.4 percent annually for early 1990s conditions.

Additional operational alternatives and screening have been studied and are discussed under "Mitigation for Impacts on Fish", in Chapter 5.

The Department is still reviewing the draft of a report on studies regarding nonproject, unscreened agricultural diversions in the Delta. Considerable numbers of young striped bass and some salmon are entrained in the numerous unscreened agricultural diversions in the Delta. In general, it does not seem technically or economically possible to prevent these losses by screening individual diversions. It may prove worthwhile to screen those where consol-

C—105548

C-105548

idation results in one larger diversion, such as proposed for Sherman Island and Tom Paine Slough, and as now exists on Ryer Island. Even with these large intakes, it will not be possible to screen the eggs and larvae of striped bass. Screening these large intakes is being considered as a means of mitigating direct losses of striped bass and salmon at the Skinner Fish Protective Facility under the preferred mitigation option.

Response 4

Updated operation studies used in the final report included more effective export operations. The more effective operations would shift the timing of exports away from summer periods of high fish abundance toward winter months of unregulated flow conditions when most fish species are lower in abundance. Operations evaluated with the additional pumps showed that the pumps, with added capacity to store unregulated winter flows, would accentuate this shift. Striped bass, American shad, and white catfish are important species that would benefit from this operational change. The incremental effect of the additional pumps under the preferred operation would reduce direct losses at the Delta Complex for 23 fish species, including striped bass, when compared to the no-project alternative. It is true that full operation of the additional pumps could benefit both fish and the project. However, uncertainty about future options now precludes permit application for full operation.

See response to General Issue 2 in this chapter under "General Issues and Responses" regarding the Department's future intentions.

Response 5

The more efficient operation of the State Water Project with additional pumps discussed in Response 4 can decrease direct impacts on most fish species. Exceptions are chinook salmon and certain other species that are more abundant during the winter.

The four mitigation measures presented in the final report include restricted operational modes to benefit fish, such as reduced pumping in May, June, and July (see Chapter 5, "Mitigation for Impacts on Fish").

Response 6

The alternative operational plans evaluated in the draft report did evaluate alternative operations based on annual export volumes rather than average monthly pumping rates. In the draft report (pages S-4, 21, and 22), operational alternative plans labeled 0-6.3, 2-6.3, and 4-6.3 all maintained the same annual export volumes, but the additional pumps enabled on-peak power savings. The other alternative operational plans involved increased winter pumping.

The final report evaluates similar operational plans, based on more efficient operation of the State Water Project to maximize pumping during "low impact" periods, both within and beyond the diversion limits set by the Corps of Engineers. All the operational alternatives would minimize pumping during times when potential impacts on most fish are greatest. See Response 4 to this letter.

Response 7

The draft environmental impact report on the additional pumping units did discuss environmental changes resulting from related past, present, and reasonably foreseeable and probable future projects. Impacts of future storage south of the Delta and of a Delta water transfer facility are discussed in Chapter 6, under "General Impacts of Additional Pumps with Potential Related

Projects", as is other water resources planning. Given current planning uncertainties regarding future storage and transfer facilities, more quantified impacts are not possible at this time.

A Department of Water Resources report, Alternatives for Delta Water Transfer (November 1983), was intended to help focus on possible solutions to water transfer problems in the Delta. It presents an interim technical review of what now seem to be the most practical water transfer alternatives.

The Department is also investigating storage south of the Delta. Table 21 of the draft report and Table 6-1 of the final report show that additional storage south of the Delta in conjunction with the additional pumping capacity could potentially reduce fish screening losses. Additional storage could also reduce Delta outflows during unregulated flow periods. This potential appears greater with surface water storage projects than with ground water storage. The Department agrees that the combination of the additional pumps and additional storage south of the Delta could be beneficial to fish. This combination may allow greater pumping of unregulated flows during periods of low fish abundance and decreased pumping during regulated flow periods of high abundance. The potential for fish benefits would be even greater with an improved Delta water transfer system that eliminates or reduces reverse flows in the lower San Joaquin River.

Impacts on fish will be evaluated further in environmental documents concerning a Delta water transfer facility and additional storage south of the Delta if such projects are proposed.

Future planning for a specific surface water storage facility south of the Delta will consider measures to reduce fish screening losses by investigating specific operational plans developed to maximize benefits and minimize costs.

With regard to the comment about including fishery resources in the benefit/cost analysis, no generally accepted method for such a process has been developed. However, the final report does include fishery benefits in its analysis of alternatives and mitigation options.

Response 8

The water pricing policy of the Department of Water Resources in delivery of State Water Project water is set forth in the standard provisions in the water supply contracts. The water rate is a two-part rate, consisting of the Delta Water Charge and the Transportation Charge. The water charges, determined yearly, reflect the actual cost of delivering the water, and is not subsidized by the State or Federal Government. Information on water supply contracts is presented in Chapter 1, pages 2 and 3, of the draft report.

The comment discusses a personal communication with economist B. Delworth Gardner, in which he postulates a relationship between price increases for agricultural water users and subsequent water use reductions. The Department of Water Resources is not aware of any studies that confirm this. In fact, water prices for State Water Project agricultural water users in the San Joaquin Valley increased by more than 10 percent after 1983 due to increased energy costs. At the same time, agricultural use in this service area, based on State Water Project contractor requests, did not decrease and are expected to continue to increase. With the increased costs, water shortages are still expected under the capabilities of present project facilities.

The water management policy of the Department provides that:

- Water shall be reused to the maximum extent feasible.

C—105550

C-105550

- Water resources already developed shall be used to the maximum extent before new sources are developed.

Options for achieving substantial savings in agriculture are limited. The most recent comprehensive Department report covering the potential for water conservation (Bulletin 160-83) identified only a 150,000 acre-foot per year potential for State agricultural water conservation savings outside Imperial Valley.

The Department has developed recommended water management plans for all State Water Project service areas. Recommended plans for Kern County Water Agency and Tulare Lake Basin Water Storage District discuss efficient use of agricultural water supplies. Measures discussed in those plans, as well as other possible measures, are expected to be used by the contractors in achieving the water conservation saving built into the State Water Project water needs.

Kern County Water Agency is the largest agricultural water user of the 30 State Water Project contractors. The report for that agency had the following findings and recommendations concerning agricultural water conservation:

- Some of the most efficiently operated farmlands in the Nation are in the agency's service area.

- All applied water in excess of evapotranspiration returns to a usable supply, except in those areas overlying high perched water tables and moisture-deficient soils.

- Proven methods for reducing crop evapotranspiration are already practiced throughout the agency.

- The plan recommends measures to reduce percolation to perched water tables and moisture-deficient soils by improved irrigation management, tailwater recovery, and seepage control in about 25 percent of the service area. The annual net water savings are estimated to be 53,000 acre-feet annually by 2010.

- Reduction in applied water in the remainder of the service area would not result in net savings, but could save fertilizer costs and 4,300,000 kilowatt-hours per year in ground water pumping energy for each 1 percent increase in irrigation efficiency.

Various methods of agricultural water conservation were considered, under two general headings:

- Those that would reduce evapotranspiration (drip irrigation, weed control, moisture stressing, antitranspirants, crop changes).

- Those that would reduce percolation to perched water tables and moisture-deficient soils (irrigation management, land leveling, tailwater recirculation, seepage control, irrigation methods).

The recommended plan for Kern County Water Agency consisted of:

- Measures to reduce evapotranspiration.

- Measures to reduce percolation to perched water tables and moisture-deficient soils.

- Studies and programs to test conservation methods and increase knowledge of factors related to agricultural water conservation.

The recommended plan for Tulare Lake Basin Water Storage District similarily reviewed the use of agricultural water supplies. This district's service area is in the closed Tulare Lake basin, which has no natural outflow. The only water that leaves the district's area of the basin is that which evaporates or is used consumptively by plants or animals. The underlying clay strata also prevent

C—105551

C-105551

applied water from readily returning to usable ground water basins. Therefore, irrigation water in excess of the evapotranspiration requirements of the crops percolates to the perched water table and may become unusable. The need to meet leaching requirements prevents reducing applied water to only the quantity needed for evapotranspiration. Water savings might be possible if the leaching requirement were exceeded and the over-application were controllable. Examination of farming practices in the district determined that no such potential exists.

Existing agreements between the Department of Water Resources and the Bureau of Reclamation provide for wheeling of Central Valley Project supplies by the State Water Project to increase the efficiency of existing projects and water supplies by improved water management. Current wheeling of Central Valley Project water is for outages, makeup for Decision 1485 export constraints, and deliveries to the Cross Valley Canal. Operation studies analyzed in the draft and final reports considered these existing wheeling agreements. The Department recognizes that water management improvements can and should continue, including possible new agreements for wheeling operations that consider the suggestions in this comment and operational capabilities of future water development. Any such agreement must be the product of a negotiation process.

The Coordinated Operation Agreement, discussed in Chapter 1 under "State Water Project Operation", requires negotiation for additional wheeling for the Central Valley Project, purchases of excess Central Valley Project supplies by the State Water Project, and other provisions to maximize the efficiency of project operations and California's water supply. This agreement and any related negotiations for wheeling and purchase contracts will take into account the operations of the additional pumps and relevant water developments such as storage south of the Delta; however, any agreement or contract would be an action separate from installation of the pumps and subject to its own environmental review.

Such environmental reviews would ensure that impacts and mitigation pertaining to action taken on wheeling are addressed.

The potential cumulative impacts of the additional pumps and additional supplies from Northern California (which could include purchases of Central Valley Project supplies) are shown in Table 6-1 of this final report. Mitigation measures for cumulative impacts are discussed in Chapter 6.

Response 9

The analysis of fish impacted at the Delta Complex has been expanded to include points brought out in this comment regarding predation, entrainment losses, and overall (general) impacts on fisheries. For striped bass large enough to be screened and for all chinook salmon, loss estimates in the revised analysis incorporate what are considered appropriate factors (based on available data) for mortality in Clifton Court Forebay and the handling and hauling process. The factors and the manner in which they were applied in the analysis are described in Appendix B. In addition, estimated entrainment of striped bass eggs and larvae has been included in the revised impact analysis. (See Table 5-15 in Chapter 5. See response to General Issue 3 in this chapter under "General Issues and Responses" for discussion of changes in fishery analysis.)

Response 10

See Response 9 to this comment letter on estimated mortality in Clifton Court Forebay caused by predation and other factors. Not all fish entering Clifton

C—105552

C-105552

Court Forebay are lost. The fact that large numbers of many species are salvaged at the fish protective facility shows that not all die. Fish screening efficiencies are based on field testing of the existing louver screens and are adjusted to reflect improvements with the enlarged and improved facility.

The Department of Water Resources and the Department of Fish and Game are studying the problem of predation losses and predation control in Clifton Court Forebay.

Response 11

The estimates of fish salvage losses and losses of eggs and larvae generated from different pumping alternatives provide the best assessment of absolute direct losses attributable to operation of the Delta Complex. The analysis shows the incremental increase or decrease in impacts on fish due to operation of the additional pumps and the impacts associated with existing State Water Project pumping capacity. As stated in the draft report, the conversion of loss estimates to "yearling equivalents" accounts for normal mortality rates for the various sized fish exposed to the export system each month. See Response 9 to this comment letter and the response to General Issue 3 in this chapter.

Response 12

General (indirect) impacts of the pumping plant and reservoir operation were discussed in Chapter 5 of the draft report for important species or groups of species. Many of these sections have been revised in the final report, based on comments received and on updated operation studies. (See response to General Issue 3 in this chapter.) The incremental impacts associated with operating additional pumps in various ways have been updated. Assessment of the environmental impact of the additional pumps considered alternative methods of operation and mitigation options to enable thorough evaluation of both the indirect and direct impacts on Bay-Delta fish. These alternatives and options included:

- Alternative Operational Plans -- These were discussed in Chapter 3, pages 21 to 24, of the draft report. These alternatives reviewed the installation of two or four pumps operated at up to 10,300 cubic feet per second capacity.

- Mitigation Options -- Two restrictive operational modes are discussed in the final report on the additional pumps. These were added as a result of comments on the draft report. These restrictive operational modes were designed to further reduce impacts on fish, mainly striped bass. A discussion of these restrictive operational modes, along with estimates of the magnitude of fish impact reductions, is presented in response to General Issue 4 in this chapter and in Chapter 5 of the final report (Mitigation for Impacts on Fish). In addition, some measures that would be implemented as a result of the fish protective agreement (the preferred option) would probably result in reductions in general (indirect) impacts of the project on fish.

In addition, operation of ground water facilities to benefit fish was discussed in the draft environmental impact report for the proposed agreement between the Department of Water Resources and the Department of Fish and Game to manage fish and wildlife resources in the Sacramento-San Joaquin estuary. This report was cited in the draft report on the proposed additional pumps, and should be regarded as important supplemental material.

Response 13

See response to General Issue 5 (General Issues and Responses) in this chapter. Hatchery production is not the "sole

means of mitigation" preferred in the environmental impact report. It is true that habitat suitable for survival of artificially reared fish must be available if the program is to succeed. The proposed agreement, which is preferred in the final report, includes a variety of measures that are not hatchery related.

The final report includes evaluations of the updated operation studies and restricted operational modes with the additional pumps to reduce direct impacts on fish. See Responses 4 and 12 to this letter.

Response 14

Uncertainty regarding authorization of the proposed December 1982 agreement between the Department of Water Resources and the Department of Fish and Game to manage fish and wildlife resources in the Bay-Delta estuary is discussed in the response to General Issue 4 in this chapter and in Chapter 5 (Mitigation for Impacts on Fish).

Four mitigation options were developed for impacts in the estuary in connection with the additional pumps. These options provide a wide range of mitigation possibilities for all operational alternative plans, consisting of a modified agreement to protect Delta fish, a reduction in on-peak power use, a further reduction in project exports during periods of fish abundance, a fish stocking commitment, and a potential reduction in export buildup rates resulting from water conservation agreements. The preferred mitigation is an agreement for the preservation of fish in relation to the Banks Pumping Plant.

Response 15

The 4-10.3 alternative does have the highest net benefits. That alternative also makes best use of high Delta outflow conditions, thus providing the least impacts on striped bass and greatest economic benefits to the project. Impacts on striped bass would be reduced by exporting more during fall and winter. Economic benefits would be derived from higher project yield.

Other important factors concerning the 4-10.3 alternative should also be considered. Salvage and loss estimates for striped bass and chinook salmon have been revised in the final report. The estimates account for predation in Clifton Court Forebay, screening, eggs and larvae, and handling and hauling losses. These revised estimates still show the 4-10.3 alternative to result in the lowest striped bass losses; however, estimated chinook salmon losses are somewhat higher than for the no-project alternative. This alternative could slightly aggravate conditions for adult salmon migration.

The 4-10.3 alternative would not eliminate reverse flows in the lower San Joaquin River, even with southern Delta modifications. The final determination has not been made for specific southern Delta channel and Clifton Court Forebay modifications needed to allow an increase in State Water Project monthly export rates to 10,300 cubic feet per second. Reconnaissance level studies have been completed; however, impacts would result from one or more of the following southern Delta modifications.

- Dredging existing channels.
- Adding a new intake channel.
- Enlarging Clifton Court Forebay.

The description of the 4-10.3 alternative in the final report contains more information on southern Delta modifications, as does Chapter 6, under "Alternatives for Delta Water Transfer", which further discusses Delta transfer hydraulics.

Use of the additional pumps for further reduction of fish impacts is discussed in Chapter 5, under "Mitigation for

C—105554

C-105554

Impacts on Fish". Two cases of pumping restrictions were reviewed.

Response 16

The economic analysis for the additional pumps has been revised to account for the Department's increased operating experience as a utility and other factors. The 4-pump options have higher net benefits than do the 2-pump options. See Chapter 3 "Economic Analysis" and the response to General Issue 8 in this chapter.

Response 17

The additional conditions have been added to the final report. Also, the name of the agency has been corrected.

Response 18

Concerns regarding mitigation are addressed in response to General Issue 4 in this chapter and in Response 14 to this comment letter. Discussions of mitigation measures in Chapter 5 (Mitigation for Impacts on Fish) have been expanded.

Response 19

The Department of Water Resources will continue to incorporate water conservation and reclamation studies in water resources planning programs. Work has been completed on water management plans, and recently published preliminary reports are discussed in the final report. The Urban Water Management Planning Act, Water Code 10610 et seq., is a recent law that promotes statewide water conservation. Governor Deukmejian, in his State of the State message, said that water conservation and salvage of wasted water are some of the most economical ways to meet our needs. Use of water conservation is discussed in response to General Issue 9 in this chapter.

Response 20

Outflow requirements to protect Suisun Bay and Honker Bay are contained in Decision 1485, and these requirements are included in all alternative operational plans for the pumps. Also, the Department has prepared a plan of protection and final environmental impact report for Suisun Marsh.

Findings of the Striped Bass Working Group are discussed in Chapter 5 (General Impacts on Striped Bass). They do not include specific flow requirements. A variety of studies have, however, been carried out by the Department and others to advance information on flow requirements for striped bass. This information will be used in upcoming hearings on Bay-Delta standards.

The Department participating in appropriate experiments with interested organizations to advance knowledge of the environment. See the responses to General Issues 1 and 11 in this chapter and Responses 4, 8, and 12 to this comment letter.

Response 21

Estimates of impacts are based on the best data now available. To date, State and Federal agencies have spent nearly $50 million on one important program, the Interagency Ecological Study Program. Over $5 million annually is projected to be spent in upcoming years. The Department of Water Resources and Department of Fish and Game believe adequate estimates can be made for provisions included in the proposed agreement, which is the preferred mitigation in this report. This new agreement or the proposed agreement of December 1982 would not preclude future adjustments. The preferred mitigation option for the additional pumps includes annual adjustments for fish stocking that take into account varying future exports and corresponding variations in annual fish

impacts. Also, the proposed agreement includes provisions and funding for evaluations and improvements for estimates of screen efficiency, Clifton Court Forebay losses, and handling and hauling losses.

The estimated impacts of the alternatives in the draft report were based on assumptions and operation studies that over-estimate summer and fall exports at Banks Pumping Plant and the resulting direct fish losses. The updated operation studies analyzed in the final report represent more effective operation of the State Water Project and less impacts on most fish species.

Response 22

Concerns relating to the Suisun Marsh facilities are addressed in the final environmental impact report for the Suisun Marsh Plan of Protection (February 1984) and the agreement recently negotiated regarding the marsh.

The sections on Suisun Marsh in Chapters 4 and 5 of the final report on the additional pumping units have been updated, and the response to General Issue 7 in this chapter describes the relationship between the additional pumps and the marsh plan of protection. The additional pumps will have no significant impacts on the marsh, since it is protected by Delta outflows, physical facilities, and a monitoring program.

Response 23

Better estimates of the relationship between State Water Project operation and San Francisco Bay resources would indeed be beneficial; however, data upon which to base such an assessment are not yet available. Before the pumps become operational, the State Water Resources Control Board will conduct water right hearings, which will include this subject. Any new valid water right criteria will be met by the State Water Project. The Department is funding various studies to advance knowledge of these resources. Incremental effects due to additional pump operation are expected to be minimal if resource levels are related to the amount of fresh water flowing through the lower bays. This was presented under the topics, "Impacts on Delta Outflows", page 58, and "Impacts on Delta Outflow Surges", page 62, of the draft report. (See response to General Issue 11 in this chapter.)

Response 24

The discussion of mitigation options has been expanded to include additional options and is included in Chapter 5 (Mitigation for Impacts on Fish) of the final report. (See response to General Issue 4 in this chapter.)

Response 25

The discussion of planning and cumulative impacts including a Delta water transfer facility in Chapter 6 (Alternatives for Delta Water Transfer) has been expanded. A summary of cumulative impacts with future related projects can be found in Table 6-1. Until more is known about future projects, it is not possible to give quantified impacts. Any new facility would require a separate environmental analysis.

Letter 2
Commenting Entity:
U. S. Department of the Interior
Bureau of Reclamation
February 23, 1983

Response 1

Operation studies basic to the analysis in the draft report were described in the operational impacts section of

C—105556

C-105556

Chapter 5 and in Appendix B. Updated operation studies analyzed in the final report incorporate the draft Coordinated Operation Agreement. The updated yield estimates are similar to those used previously. Appendix B of the final report presents a summary comparison of the updated and the previous operation studies.

Response 2

A water conservation agreement as a mitigation measure is discussed in Chapter 5 of the final report under "Mitigation for Impacts on Fish" (Mitigation Option 4). See responses to General Issues 4 and 9 in this chapter, under "General Issues and Responses".

Response 3

The final report refers to the Delta Cross Channel as a Bureau of Reclamation facility.

Response 4

Yield figures in the final report do reflect related aspects of the draft Coordinated Operation Agreement.

Response 5

The final report states that releases from San Luis Reservoir are made during late spring, summer, and early fall.

Response 6

See Response 20 to Comment Letter 26 concerning May, June, and July exports in the previous and updated operation studies.

Response 7

For an explanation of June outflow in below normal years, see Response 21 to Comment Letter 26. Decision 1485 agricultural water quality standards were met at Emmaton on the Sacramento River and Jersey Point on the San Joaquin River, which are controlling in June of dry years. Decision 1485 fish and wildlife water quality standards at Chipps Island for striped bass survival, which are controlling in June of critical years, were met both in the operation studies used in the draft report and in the updated operation studies for this final report.

Response 8

Department of Water Resources operation studies use 27,000 cubic feet per second for closure of the Delta Cross Channel. This is an approximation of historical flow conditions when the gates have been closed.

Response 9

The cross-Delta flow changes for June shown in Table 15 of the draft report reflect changed releases from upstream reservoirs under regulated flow conditions. In the final report, the discussion of cross-Delta flow changes has been expanded. The changes are minor.

Response 10

The discussion of Delta Cross Channel operational constraints on page 74 of the draft report was general; it has been updated to be more specific and to include the information in this comment.

Response 11

Operation studies used for evaluating impacts in the draft report assumed Central Valley Project exports in 1990 to be 3,580,000 acre-feet per year, which includes representative deliveries for San Felipe. The updated operation

studies analyzed for the final report assumed Central Valley Project exports in 1990 to be 3,399,000 acre-feet per year. This is consistent with assumptions for the draft Coordinated Operation Agreement.

Response 12

The discussion of the water hyacinth problem has been updated to reflect the current status of the control and eradication program. Because of the apparent success of the program, future operations with the existing or additional pumps should not aggravate the hyacinth problem at Tracy Pumping Plant or elsewhere in the Delta.

Table 5-6 in the final report shows the drawdown effects from both State Water Project and Central Valley Project export pumping. The table shows little change in drawdown effects on high-high tides at Clifton Court Ferry during the main irrigation season for the preferred alternative. During winter, drawdown is a function of flows in the San Joaquin River, and no change is expected when operations are in accordance with diversion limitations established in U. S. Army Corps of Engineers Public Notice 5820A, Amended. Limitations of this public notice are a part of the preferred alternative operational plan; the notice is shown on page 7 of the draft report.

The daily operational and water level changes for maximizing off-peak pumping were estimated for all the alternative operational plans and are presented in Table 5-6 of the final report. The higher drawdown rates would occur primarily on Sunday, when off-peak power rates are available.

As explained in Chapter 5, "Impacts on Delta Agricultural Uses and Water Levels", operation of Banks Pumping Plant and Clifton Court Forebay under the Corps constraints is not expected to reduce water levels significantly at Clifton Court Forebay. Therefore, no significant effect on operation of Tracy Pumping Plant is foreseen. When the additional pumps are installed, the Corps of Engineers will monitor operations and water levels according to the Federal District Court decision issued in December 1982.

Letter 3
Commenting Entity:
U. S. Fish and Wildlife Service
February 11, 1983

Response 1

Impacts of additional pumping capacity evaluated in the draft report were expanded and revised in the final report. Some fish, including striped bass, will be benefited by the additional pumps under the preferred alternative. Incremental impacts on salmon were found, but these impacts would be mitigated with the proposed agreement.

With regard to the decline of the fishery, see Chapter 5 (General Impacts on Striped Bass) and the response to General Issues 1 and 3 in this chapter under "General Issues and Responses".

Cumulative impacts associated with potential State Water Project development, including a Delta water transfer facility, were addressed in Chapter 6 of the draft report. Details on a Delta facility are not necessary, since it is not a necessary or integral part of the proposal to operate the pumps independent of other facilities. Given the uncertainty of future planning over an appropriate facility, it is not possible to give more details.

Chapter 6 of the final report includes a discussion of a report released in November 1983, which provides the latest information on water transfer. The report, Alternatives for Delta Water Transfer, is an interim technical review

C—105558

C-105558

of what now seem to be the most practical Delta water transfer alternatives. This report identifies four basic alternative water transfer systems. All the alternatives require continued use of existing State and Federal pumps and installation of four additional pumps at Banks Pumping Plant.

Response 2

The economic analysis for the additional pumps has been revised to account for the Department's increased operating experience as a utility and other factors. The 4-pump options have higher net benefits than do the 2-pump options. See Chapter 3 "Economic Analysis" and the response to General Issue 8 in this chapter.

Response 3

In the final report, analysis of chinook salmon losses at the State Water Project export facilities takes into account numerous factors, such as monthly exports, monthly abundance, predation in Clifton Court Forebay, screening efficiencies, and handling and hauling losses. The revised estimates are 361,000 yearlings with the existing pumps and 378,000 yearlings (a 5 percent increase) with four additional pumps operated under the Corps constraints (see Table 5-15). The final report states that most losses occur to San Joaquin River salmon, that such impacts are significant, and that the proposed agreement would provide mitigation.

These factors were discussed qualitatively in the draft report; important spring runs were shown on page 69, Figure 9 (Figure 8 in the final report). Mid-December to mid-March pumping uses San Joaquin River flows as a control to specify export increases; actual water being pumped includes sources other than the San Joaquin River. Chapter 5 (Impacts on Channel Velocities, Scour, and Siltation) and Chapter 3 (Hydraulic Constraints and Banks Pumping Plant Capacity) contain more information on this subject.

The preferred mitigation for San Joaquin River salmon consists of habitat improvement, barriers, predation control, stocking, and other measures. These measures are for both San Joaquin and Sacramento River salmon populations. The discussion of salmon mitigation has been expanded in Chapter 5 (Mitigation for Impacts on Fish) of the final report.

Response 4

See response 8 (last 3 paragraphs) to Comment Letter 1 on the Coordinated Operation Agreement.

Response 5

The State Water Project diversion into Clifton Court Forebay (where salmon are entrained from the Delta) operates in conjunction with the tidal cycle, not on an off-peak basis. Pumping draws fish from the forebay into the Skinner Fish Facility, where they are collected and trucked to the release site. Increased off-peak pumping with the additional pumps and the enlarged fish facility may increase survival of juvenile salmon by removing them from the forebay faster and by increasing screening efficiencies. Removing salmon as quickly as possible from the forebay reduces their chance of being eaten by predators, because once they enter the forebay there is no escape except when they are pulled to the fish screens. The analysis of salmon losses accounts for velocity changes from increased off-peak pumping and for operation of the enlarged fish protective facility.

Response 6

Construction of Auburn Dam and associated increased diversions for the Folsom South Canal undoubtedly will

be delayed until after 1990. The updated operation studies used for the final report do not assume Auburn Dam at the early 1990s condition. Chapter 5, "Operational Impacts, Conditions During the Early 1990s", and Appendix B discuss the updated operation studies and the impact analysis.

Response 7

Mitigation for fish losses has been updated for the final report. Chapter 5 (Mitigation for Impacts on Fish) describes the mitigation options, which include mitigation for striped bass and salmon. The mitigation is for preservation of fish at the Banks Pumping Plant, and will add to other mitigation now in place for present fish losses. These losses are being partially mitigated (and have been since project operation began) by fish screens at the John E. Skinner Delta Fish Protective Facility (recently enlarged at a cost of $4.5 million) and by Decision 1485 standards for outflow, diversion limitations for May, June, and July, water quality standards, and a monitoring program. In addition, the Department has spent over $20 million to improve knowledge about estuary fish for better protection.

If it is concluded that the State Water Project is seriously affecting species other than striped bass and chinook salmon, actions could be taken to protect fish and wildlife resources.

Table 5-17 of the final report shows annual salvage estimates for species other than striped bass and chinook salmon, based on salvage records at the Skinner Fish Facility and the updated operation studies. For most species, the salvage estimates decrease for the alternatives with additional pumps. This is because exports and entrainment would be reduced during the months of high abundance with more efficient operation of the State Water Project. As salvage decreases, losses should also decrease.

For five species that are more abundant during the winter, salvage estimates do increase. As discussed in Chapter 5 (Direct Impacts of the Delta Complex on Other Fish Species), these impacts were determined to be minimal and to have no adverse effect on populations of these species.

The Department is participating in several ecological studies to determine how Delta habitat may be improved. (See Chapter 1, "Ecological Studies".)

Response 8

Concerns relating to the Suisun Marsh facilities are addressed in the final environmental impact report for the Suisun Marsh Plan of Protection (February 1984) and the agreement recently negotiated regarding the marsh.

The sections on Suisun Marsh in Chapters 4 and 5 of the final report on the additional pumping units have been updated, and the response to General Issue 7 in this chapter describes the relationship between the additional pumps and the marsh plan of protection. The additional pumps will have no significant impacts on the marsh, since it is protected by Delta outflows, physical facilities, and a monitoring program.

Response 9

In the final report, Table 5-2 monthly exports show exports at Banks Pumping Plant only. These exports are from the updated operation studies. Exports at Tracy Pumping Plant are shown in Appendix B. Table 5-4, showing Delta outflows, also reflects the updated studies.

C—105560

C-105560

Response 10

Export pumping can continue without a signed agreement between Department of Water Resources and Department of Fish and Game. Water Right Decision 1485 contains the authority to export water from the Delta, as well as protective measures for fish. The mitigation discussion has been updated to include the status of the 1982 agreement and expanded to include other measures. See response to General Issue 4 under "General Issues and Responses" section of this chapter.

Response 11

A complete discussion of the studies of salmon smolt/flow/temperature relationships is contained in the Final Environmental Impact Report on the Agreement to Manage Fish and Wildlife Resources of the Sacramento-San Joaquin Estuary, December 1982. This report was cited on page 37 of the draft report, and is important supplemental information. Treatment of that subject is limited in this environmental impact report on additional pumping units, because none of the alternative operational plans discussed would cause significant change in Sacramento River and cross-Delta flows (see "Impacts on Cross-Delta Flows and on Levees" in Chapter 5) or water temperatures (see "General Impacts on Salmon and Steelhead" in Chapter 5).

Response 12

Losses to predation in Clifton Court Forebay have been included in the revised estimates of fish salvage losses. For chinook salmon, the final report cites a 75 percent loss in Clifton Court Forebay and a 43 percent loss for handling and hauling, using Department of Fish and Game estimates. This is discussed in Chapter 5, under "General Impacts on Salmon and Steelhead". Predation studies in Clifton Court Forebay are discussed in Chapter 1, under "Fish Facilities and Related Studies". Also see response to General Issue 3 in this chapter.

Response 13

As explained in the draft report (pages 71 and 72) and under "General Impacts on Salmon and Steelhead" in Chapter 5, no significant incremental impacts are expected relating to salmon migration for the preferred alternative operational plan. Table 16 pertained to the 8.5 and 10.3 alternative operational plans and indicated a minor effect on salmon migration.

The final report shows additional tables on general and direct impacts on salmon based on the updated operation studies (Tables 5-15, 5-16, 5-18, 5-19, 5-22, and 5-26).

Response 14

The impact sections on striped bass (Chapter 5 "General Impacts on Striped Bass" and "Direct Impacts of the Delta Complex on Striped Bass, including Eggs and Larvae") have been updated to include findings and recommended experiments developed by the Striped Bass Working Group.

Response 15

Striped bass index calculations were not used for the final report, as discussed in response to General Issue 3 in this chapter and in Chapter 5 under "General Impacts on Striped Bass".

Response 16

Handling and hauling losses have been incorporated into the revised estimates of salvage losses discussed in Chapter 5

C-105561

C-105561

(Direct Impacts of the Delta Complex on Chinook Salmon) and shown in Table 5-15. See also Response 12 to this comment letter and the response to General Issue 3 in this chapter.

Response 17

Pesticide impacts on fish and wildlife in the Delta are not well documented. The State Water Resources Control Board has the responsibility to monitor waste discharged into waters of the Delta. Pesticide use and occurrence north of the Delta and in the Delta itself are not related to the State Water Project.

In Chapter 5 of the final report, the section "Impacts on State Water Project Service Areas" discusses general regulations on pesticide uses and addresses the impacts of increased dry year deliveries for agriculture in the San Joaquin Valley service area. Pesticide use would probably increase, but the potential for increased problems is considered minimal. Since the service area lies in a closed basin, pesticide use there should not affect toxic buildup in the Delta.

Response 18

The list of incremental impacts found not significant when operating with four additional pumping units under Decision 1485 and Corps constraints was reviewed and revised. San Francisco bay fish have been removed from the list, with acknowledgment that such impacts are unknown. Other conclusions have not been changed. Data to support conclusions of insignificance are found in the relevant subsections in Chapter 5.

General Issue 11 in this chapter also contains a discussion on outflow.

Letter 4
Commenting Entity: State of California, Governor's Office Office of Planning and Research
January 14, 1983

Response 1

Responses to comments of the Department of Fish and Game are contained in Letter 4A. Specific concerns are addressed in the Final Environmental Impact Report on the Proposed Additional Pumping Units.

Response 2

Response to the Department of Parks and Recreation is contained in Letter 4B.

Responses 3, 4, and 5

Noted.

Response 6

Noted; a Notice of Determination will be filed with the State Office of Planning and Research, if a decision is made to proceed.

Letter 4A
Commenting Entity: Department of Fish and Game
February 15, 1983

Response 1

The operation studies used in the Draft Environmental Impact Report for the Proposed Additional Pumping Units have been updated for the final report. The

updated studies incorporate the most recent and realistic water development and operation assumptions, including factors "a" through "g" presented in this comment. They represent more efficient operation of the State Water Project, less fish impacts, and about the same yield.

Details of the updated operation studies used for the final report on the additional pumps are discussed in Chapter 3 (Physical and Operational Comparison of Alternative Operational Plans), Chapter 5 (Operational Impacts, Conditions During the Early 1990s), and Appendix B. The impact analysis in Chapter 5 reflects data from these updated studies.

Response 2

The discussion of service area impacts in Chapter 5 (Impacts on State Water Project Service Areas) has been expanded. In addition, the discussion on potential mitigation for service area impacts related to growth inducement now includes:

- Land acquisition for habitat protection.
- Development of an environmental management plan.
- Local implementation of water conservation plans.

Recovery plans for the San Joaquin kit fox and the blunt-nosed leopard lizard also provide environmental protection.

Service area impacts for this project are secondary. To the extent they are significant, they should be mitigated by local agencies implementing the above measures.

Response 3

The item "San Francisco Bay Fish" has been removed from the list of incremental impacts found insignificant (Chapter 5, Summary of Impacts Under the Preferred Alternative), and has been reclassified as an unknown impact.

Response 4

Three of the four mitigation options discussed in Chapter 5 (Mitigation for Impacts on Fish) do not require a specific agreement between the Department of Water Resources and the Department of Fish and Game. However, an agreement is the preferred option. This agreement would include compensation for all direct incremental impacts on fish caused by additional pumps and some or all direct impacts caused by the existing pumps. (See also response to General Issue 4 in this chapter under "General Issues and Responses".)

Response 5

Chapter 5 (Mitigation for Impacts on Fish) reflects new negotiations for an agreement between the Department of Water Resources and Department of Fish and Game to manage fish and wildlife resources. The discussion outlines new agreement provisions and objectives.

Response 6

The export and outflow changes shown in the draft report (Tables S-2, 10, and 11) were all attributed primarily to changes at Banks Pumping Plant. For all alternatives, Central Valley Project diversions at Tracy Pumping Plant were not changed significantly. These tables (5-2 and 5-4) have been revised to reflect data from the updated operation studies. Table 5-2 shows exports at Banks Pumping Plant only. Exports at Tracy Pumping Plant are shown in Appendix B.

Response 7

Table S-3 has been so corrected.

Response 8

All the impacts on fish shown in the final report include existing wheeling agreements for the Central Valley Project. See "Coordinated Operation Agreement" sections in Chapters 1 and 6, and Response 8 (last 3 paragraphs) to Comment Letter 1 concerning additional wheeling and the Coordinated Operation Agreement.

Response 9

Text on the environmental setting of the Sacramento Valley and the San Joaquin Valley has been updated and expanded in Chapter 4 under "Sacramento Valley" and "San Joaquin Valley" sections. See Chapter 5, "General Impacts on Salmon and Steelhead", for description of salmon resources.

Response 10

The final report refers to the final environmental impact report on the proposed agreement (December 1982) for a detailed description of Delta fish and wildlife.

Response 11

In the final report, a sentence has been added to this paragraph on resident warmwater fish.

Response 12

Acreages in this paragraph have been changed to include recent acquisitions by the Department of Fish and Game.

Response 13

The discussion of negotiations on Suisun Marsh facilities has been expanded and updated, and now includes this information. (See Chapter 5, "Impacts on Suisun Marsh", and General Issue 7 in this chapter.)

Response 14

The statement about increased rates of rising storage levels during the spring spawning period having beneficial effects on warmwater fish has been deleted in the final report.

In most years, reservoir levels rise during spring because inflows exceed releases and requirements for flood control space are relaxed. Thus, reservoir storage peaks about June 1 to meet downstream needs during summer and fall. Average and extreme changes in storage at Lake Oroville during April and May, from the updated operation studies, are shown below (values in 1,000 acre-feet).

April				
Alternative	57-Yr. Avg.	Low-est	High-est	10-Yr. Avg.
No Project	295	-319	1002	583
Preferred	291	-337	1002	582

May				
Alternative	57-Yr. Avg.	Low-est	High-est	10-Yr. Avg.
No Project	143	-159	569	388
Preferred	137	-154	569	389

The lowest storage changes occurred in 1959 and 1964; the highest in 1935. The average is for the 10 highest years of storage change.

In the storage range of the flood control pool, the surface elevation at Lake Oroville changes about 0.07 foot per 1,000 acre-feet of storage change. Following are corresponding daily surface elevation changes at Lake Oroville based on the 57-year average storage changes (values in feet per day):

C—105564

C-105564

Alternative	April	May
No Project	0.68	0.32
Preferred	0.68	0.31

There is no significant difference between water level changes under the no-project and preferred alternatives.

Response 15

The draft report evaluated project operation changes and corresponding impacts on fish. Tables S-2 and 11 showed Delta outflows and outflow changes for the alternative operational plans. No significant change would be made in outflows by the preferred alternative. Tables 14, 15, and 16 summarized changes in seasonal exports and Delta flows and related impacts on salmon. Appendix B presented information on the operation studies used to evaluate the alternative operational plans. The plots in this appendix showed detailed Delta flow information.

Discussion of State Water Project operations has been updated in the final report to describe impacts further, based on analysis of the more efficient updated operation studies.

Response 16

See Response 8 to this comment letter.

Response 17

Discussion of the relationship between salmon survival and flows in the San Joaquin River has been revised and expanded in Chapter 5, "General Impacts on Salmon and Steelhead". No change is expected for the preferred alternative.

Response 18

The paragraph cited in this comment now reflects the fact that juvenile salmon need adequate water temperatures and net downstream flow of homestream water.

Response 19

Downstream migration during October through December has been added to the fall run salmon figure.

Response 20

In Chapter 5, the section "General Impacts on Striped Bass" now incorporates information regarding the Striped Bass Working Group findings and the Striped Bass Index. (Also see response to General Issue 3.)

Response 21

The draft report (page 86) quantified the increased winter losses for American shad and white catfish, based on available information. The section on resident fish has been expanded. Annual salvage estimates for other resident fish (game and nongame), based on the updated operation studies, are now included (see Table 5-17 in Chapter 5 and "General Impacts on Resident Fish" and "Direct Impacts of the Delta Complex on Other Fish Species").

Response 22

Additional losses for the three factors mentioned are included in calculations for striped bass and chinook salmon in Chapter 5 (Overview of Direct Impacts of the Delta Complex on Fish). (See also response to General Issue 3 in this chapter.) Such losses cannot be determined for other fish, and the fact that these are not absolute losses is identified.

Response 23

The revised loss calculations for chinook salmon incorporate high mortality

estimates in Clifton Court Forebay (75 percent) and for handling and hauling (43 percent). Thus, the calculations show increased annual salmon losses for alternatives with increased winter exports and exposure. (See Table 5-15 in the final report.)

The proposed new agreement would provide compensation for increased salmon losses during winter with the additional pumps. Compensation would consist of habitat improvement, barriers, stocking, predation control studies in Clifton Court Forebay, and possibly other measures. These are discussed in Chapter 5 of the final report under "Mitigation for Impacts on Fish" and "Unavoidable Significant Effects".

Response 24

The section on mitigation measures has been updated and now includes mitigation options. Information presented in this comment has not been included in the final report, because the proposed agreement of December 1982 was not executed. However, this information has been recognized in developing a modified agreement, which is discussed in Chapter 5 (Mitigation for Impacts on Fish) and in response to General Issue 4 in this chapter.

Response 25

The discussion of "Delta Water Transfer Facility" now includes more information on this potential facility and cumulative impacts. Chapter 6 discusses studies on water transfer alternatives under "Alternatives for Delta Water Transfer". Also see "Planning Perspective" in Chapter 1.

Response 26

Chapter 6 (Other Cumulative Impacts) now presents additional information on cumulative environmental impacts, including wildlife impacts. Mitigation measures for cumulative impacts are also discussed in Chapter 6.

Letter 4B
Commenting Entity:
Department of Parks and Recreation
December 22, 1982

As discussed on page 16 of the Draft Environmental Impact Report on the Proposed Additional Pumping Units, the pumps would be installed in the existing building, in space provided during original construction. This would not affect cultural resources; therefore, no cultural resources assessment report was prepared. This information is confirmed by a letter from the Office of Historic Preservation to the Department of Water Resources, dated May 16, 1983.

Letter 5
Commenting Entity:
State of California, Governor's Office
Office of Planning and Research
January 19, 1983

The letter from the California Regional Water Quality Control Board, San Francisco Bay Region, dated January 13, 1983, was not late. The Department extended the period for written comments to February 15. Responses are presented under Comment Letter 5A.

Letter 5A
Commenting Entity:
California Regional Water Quality Control Board-San Francisco Bay Region
January 13, 1983

The State Water Project is required to meet the protective flow, quality, and export limits of Decision 1485, with or without installation of additional

C—105566

C-105566

pumping units. The Department is actively involved in studies of the Bay-Delta estuary to determine State Water Project impacts. (See Chapter 1, "Ecological Studies", and Chapter 4, "San Francisco Bay Area.") In Chapter 5 (Impacts Evaluated with Insufficient Information to Determine Significance), bay impacts were identified as unknown.

As new information becomes available regarding outflows and protection of the estuarine environment, the Department of Water Resources will use such information to make operational changes that are consistent with other project purposes. Any new information will also be considered in future water right decisions by the State Water Resources Control Board; the Department will meet any valid requirements of such decisions.

The Department participated in the State Water Resources Control Board hearings on the Water Availability Study, discussed in Chapter 1 (Water Availability Studies). The constraints and protective regulations governing operational planning for the additional pumping units are discussed in response to General Issue 10 in this chapter under "General Issues and Responses".

In the final report potential modifications to operation are discussed in Chapter 3 (Hydraulic Constraints and Banks Pumping Plant Capacity). These modifications are based on updated operation studies that reflect efficient operation of the State Water Project and show a reduction of direct losses for many fish species with the additional pumps. Also, mitigation options involving restricted operations are discussed in Chapter 5, Mitigation for Impacts on Fish (Mitigation Option 2). (Also see response to General Issue 4 in this chapter.)

Letter 6
Commenting Entity:
Public Utilities Commission
January 21, 1983

Response 1

On-peak power cost savings could be achieved with additional units for deliveries within present export capabilities. Improved load management that four new pumps would provide is independent of other improvements to the State Water Project system.

Response 2

Estimated load management is shown in Table S-1 of the Draft Environmental Impact Report on the Proposed Additional Pumping Units and in Table 3-2 of the final report and explained further in Appendix B. Load management investigations were conducted for each alternative.

Power optimization studies were made to determine on-peak energy savings for two and four additional pumps operated under the Corps criteria. The results of these studies, shown in Table C-1, page C-3, demonstrated a savings of 149 million kilowatt-hours per year for the two-pump alternative and 248 million for four pumps. A like amount of savings in on-peak energy was assumed for the other alternatives, depending on the number of additional pumps and disregarding intake capacity. This is a reasonable and conservative assumption.

For the final report, the power operation studies and the power economics have been updated. Appendices B and C have been revised.

None of the alternatives involve modification of San Luis Reservoir. However, San Luis storage can be maintained at higher levels if export capacity is increased.

Response 3

As stated on pages S-7 and 21 of the draft report, the Department of Water Resources has no intention at this time of modifying Clifton Court Forebay under this action for the additional pumps. If the Department should opt to modify the forebay in the future, a Federal permit would probably be necessary. The Corps of Engineers would distribute a public notice and a Federal environmental document would be prepared. (See "Planning Perspective" in Chapter 1 and response to General Issue 2 in this chapter under "General Issues and Responses" section.)

No modifications at San Luis Reservoir are suggested for operation with the additional pumps.

Response 4

The differential of 5 mills per kilowatt-hour (draft report, page 13) was considered sufficient incentive to maximize off-peak pumping at Banks Pumping Plant and other system pumping plants. The updated power studies show further incentive. If water deliveries were increased with additional pumps, more on-peak and off-peak energy use would be required from power resources available to the State Water Project.

Response 5

The power operation studies described in Appendix B of the final report are considered adequate to evaluate the load management effects of additional pumps on the State Water Project.

Letter 7
Commenting Entity: State Water Resources Control Board
February 17, 1983

Response 1

The issues surrounding the Bay-Delta striped bass fishery are important, and they have been addressed in both the draft and final environmental impact reports. Information in this letter and others provided valuable assistance in updating the final report. In addition, more specific information is presented in the final report than was presented in the draft, since findings of the Striped Bass Working Group were not available when the draft was published.

The striped bass fishery was: (1) discussed in introductory and background material and by other documents incorporated by reference; (2) evaluated in connection with present project impacts and incremental impacts for the additional pumps; and (3) included in mitigation measures. Also, the final report explains that the Department, in cooperation with other agencies, is studying and conducting experiments for a solution to this problem of uncertain cause.

Even though studies and the work groups have not been able to ascertain the specific cause of the decline, they do indicate that project operations could be part of the cause. The environmental impact report focuses on the project effects by evaluating direct impacts at Banks Pumping Plant and overall general impacts in the estuary. These impact types were evaluated for project conditions with the additional pumps. Direct impacts at the pumping plant do not correlate to equivalent estuary losses, since natural mortality is also a factor.

C—105568

C-105568

The analysis in the draft report did use traditional relationships with Delta outflow and export rates to determine project impacts on striped bass in the estuary. The use was qualified for purposes of incremental comparison of effects between alternatives. The analysis assumed that the error causing variations between computed and predicted values, as noted in the comment, would cancel when comparing alternatives, because the error is equally present in both evaluations. This caused some confusion to readers, because they were using the absolute value of the calculations for each alternative rather than the incremental difference.

For the final report, this method was changed and the statistical relationship was omitted. Instead, a rating system was used that incorporated all the important factors affecting striped bass in the estuary. Selection of the factors and the rating process was coordinated with the Department of Fish and Game, and these factors include direct impacts at Banks Pumping Plant. This rating is shown in Table 5-20. In both cases, the effects of additional pumps on striped bass general impacts were found to be not significant.

Further analysis was also done to determine potential significant direct impacts. The direct impacts to striped bass, an important part of the analysis, was in the draft and has been updated for the final report. This analysis evaluates mortality of striped bass fish, eggs, and larvae in Clifton Court Forebay, Skinner Fish Protective Facility, and Banks Pumping Plant and mortality during handling and hauling of salvaged fish.

The analysis in the final report reflects updated operation studies and shows a reduction of about 9 percent of direct impacts on striped bass with the preferred alternative, when compared to the no-project alternative. This is because of more efficient operations that shift exports toward winter periods of low fish abundance and away from summer periods of high fish abundance. See responses to General Issues 1 and 3 in this chapter under "General Issues and Responses".

Even though the analysis of general and direct impacts shows no significant effects on striped bass from operation of the additional pumps, the Department recognizes that positive action is needed for existing conditions. The Department is negotiating with the Department of Fish and Game an agreement for mitigation to assure protective measures, including stocking, for striped bass. Considered in these negotiations is the effectiveness of Decision 1485 protection, impacts from operations with the existing and proposed additional pumps at Banks Pumping Plant, and impacts to species other than striped bass.

Response 2

Findings of the Striped Bass Working Group are discussed in Chapter 5, under "General Impacts on Striped Bass". (Also, see responses to General Issues 1, 3, 4, and 11 in this chapter and response 1 to this comment letter.)

The final report discusses information and conclusions in the report of the Striped Bass Working Group. As stated in the comment, these experts did not determine any single cause or combination of causes responsible for the decline of striped bass. The findings did indicate several likely causes, including pollution and project operations. Nonproject causes affecting the Delta are also discussed in Chapter 6 under "General Impacts of Past and Present Development".

The Department agrees that studies recommended by the group can provide important information and is participating in and funding studies to advance knowledge of young striped bass survival

and of export operations. Any revised State Water Resources Control Board export limits will apply with or without the additional pumps, and the Department will comply with valid future standards. Another important point is that analysis of the updated operation studies shows direct impacts on striped bass will be reduced with the additional pumps.

The sections on phytoplankton and aquatic invertebrates in Chapter 5 (Overview of Fish Food Supply Impacts) discuss current knowledge about the food supply for young striped bass.

Response 3

The Department has approached the striped bass problem from several directions in its planning for the additional pumps. As explained in the final report, these are: (1) studies to advance knowledge about striped bass impacts, (2) positive steps to increase fish populations that will be defined in the agreement for mitigation, and (3) efficient use of winter Delta flows to shift diversions toward periods of low striped bass abundance, thereby reducing impacts. (See responses 1 and 2 to this comment letter.)

The Department's reasons for proceeding with the additional pumps are discussed in the responses to General Issues 1 and 11 in this chapter. Mitigation measures are based on current knowledge. Installation of the additional pumps will not preclude a different operation, if new information becomes available.

Response 4

The preferred mitigation in the final report includes a modified agreement for preservation of fish at Banks Pumping Plant. Even if an agreement is not entered into, other mitigation measures may be adopted (discussed in Chapter 5, under "Mitigation for Impacts on Fish").

It is also important to note that the fish protective standards of Decision 1485 apply to operation of the existing pumps and the additional pumps, with or without an executed agreement. Also, should the State Water Resources Control Board adopt valid new standards applicable to the Department's operations in the Delta, the Department would be responsible for meeting those standards. It is not possible, however, to predict how future State Board decisions would alter operation of the enlarged pumping plant or affect the economic analysis. The preferred alternative does not involve substantial increases of export and even with modified operations to further benefit fish, there would still be a positive benefit/cost ratio.

Terms of the July 1979 Memorandum of Understanding primarily pertain to planning for facilities needing new water rights. The Department of Water Resources has, nonetheless, properly coordinated with the State Board and other agencies throughout preparation of the draft report. The State Board was included in the preliminary planning and preparation of the environmental impact report in several ways. The Board:

- Was sent a copy of the Notice of Preparation in July 1980.
- Was represented at a scoping meeting in February 1981.
- Commented on the administrative draft.
- Attended an interagency meeting on January 25, 1982, to discuss fish needs in connection with the additional pumps.
- Was sent a copy of the draft report.
- Was represented at a public hearing on the additional pumps in February 1983.
- Submitted comments on the draft report.

C—105570

C-105570

Response 5

The subject of conservation alternatives and economics is complex, and information has been added to the final report to better explain these matters. A summary discussion of these subjects is presented in response to General Issue 9 in this chapter under "General Issues and Responses". The specific items mentioned of toilet dam and showerhead retrofit and free residential landscape design are alternatives because they can be implemented independent of the additional pumps. Under the conditions presented in the economic assessment in Appendix C, it was found that these measures do not compete with the yield of the additional pumps because the yield of all these measures would be needed to meet some of the shortages that would occur before the additional pumps could become operational in 1990. Continuing shortages would still justify installation of the additional pumps. For the final report, mandatory nonresidential landscape design is considered an item that is part of ongoing water management planning. It is no longer an alternative.

The five measures available for direct acre-foot yield cost comparisons to the pumps are the water supply augmentation alternatives (Alternatives 5 through 9 in Table C-6 of the draft report). These measures are assumed to be achievable under conditions of significant State Water Project deficiencies, and all are more costly than the additional pumps.

For the final report, the demand reduction and the water supply alternatives have been updated. The toilet dam and showerhead retrofit alternatives have been combined as one program that would supplement device distribution methods in the water management plans. Mandatory nonresidential landscape design has been eliminated as an alternative, since it is included in the water management plans. Imperial Valley conservation and transfer has been split into an ongoing planned supply and an alternative.

With respect to selection of the four-pump option, see response to General Issue 8 under "General Issues and Responses" in this chapter. See also response 13 to this comment letter. The net benefits of the 4-pump option are higher than for the 2-pump option. This shows an economic advantage to the preferred alternative. This updated information for the final report was obtained by reviewing off-peak and on-peak energy costs and adding capacity savings to the State Water Project in the economics.

Response 6

Department planning regarding a Delta water transfer facility is discussed in Chapter 6, Cumulative Impacts. Also see "Planning Perspective", Chapter 1.

Response 7

The proposed additional pumps, operated under the Corps criteria in Public Notice 5820A, Amended, do not require a Delta water transfer facility or upstream project facility to provide the protection against outages, water supply, and power cost saving identified. They are proposed to fulfill these three purposes as discussed in the draft report (page S-1 and page 13). The monthly amounts of water pumped under the preferred alternative would be increased slightly during winter months of unregulated flow conditions. At other times, the monthly amounts would be limited to that which could be pumped with the existing pumps, or would be less.

As emphasized in the comment, the policy guidance quoted from the 1978 Water Quality Control Plan is for any future Delta water transfer facility or upstream project facility. This policy

guidance does not apply to the proposed pumps. Department planning for a Delta transfer facility will consider this policy guidance. (See Chapter 6 and response to General Issue 2 in this chapter. Also see "Planning Perspective", Chapter 1.) The State Board can, of course, change the conditions under which the project operates. See response to comment 4 of this letter.

Response 8

Concerns about Suisun Marsh facilities are addressed in the final environmental impact report for the Suisun Marsh Plan of Protection (February 1984) and the agreement recently negotiated regarding the marsh.

Sections on Suisun Marsh in Chapters 4 and 5 of the final report on the additional pumping units have been updated, and the response to General Issue 7 in this chapter describes the relationship between the additional pumps and the marsh plan of protection. The additional pumps will have no significant impacts on the marsh, since it is protected by Delta outflows, physical facilities, and a monitoring program.

Response 9

The report has been corrected.

Response 10

The final report clarifies that pumping capacity with the four additional units would be limited to 10,300 cubic feet per second, the design capacity of the California Aqueduct. See "Hydraulic Constraints and Banks Pumping Plant Capacity" in Chapters 1 and 3.

Response 11

The final report includes plans for a different agreement for mitigation. See response to General Issue 4 under "General Issues and Responses" in this chapter and "Mitigation for Impacts on Fish (Mitigation Option 1)" in Chapter 5. Also see discussions on Suisun Marsh in Chapters 4 and 5, and General Issue 7 in this chapter.

Response 12

See Response 11 to this comment letter.

Response 13

The paragraph in question pertained to the nine water supply and demand reduction alternatives, not just the four extraordinary conservation measures (see response to General Issue 9 in this chapter). It is true that the estimated unit costs of the mandatory nonresidential landscape design, toilet dam retrofit, showerhead retrofit, and free residential landscape design conservation options presented in the draft report are less than those of the additional pumps. However, the yield from the pumps never competes with that from the conservation measures in the benefit/cost analyses, because those measures are assumed to be implemented prior to initial operation of the additional pumps in about 1990. This assumption is based on future operations with existing State Water Project facilities and implementation of extraordinary conservation measures under conditions of shortages. Because the least costly extraordinary conservation measures are implemented first, the yield from the pumps does compete with a portion of the yield from the more costly water supply augmentation alternatives. This is explained in Appendix C.

In addition to displacing a portion of these more costly alternatives, the additional pumps can reduce on-peak power requirements for State Water Project pumping and provide standby capacity for outages. These benefits

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C-105572

and accomplishments cannot be duplicated by the water supply and demand reduction alternatives.

See also response 5 to this comment letter.

Response 14

The Bureau's plans for delivering San Felipe water were mentioned for informational purposes. Since delivery is through the Delta-Mendota Canal, it is not particularly relevant to the additional pumps for the State Water Project. The final report states that the water allocated to San Felipe is presently used elsewhere (Westlands Water District).

Response 15

The economic analysis for the additional pumps has been revised to account for the Department's increased operating experience as a utility and other factors. The 4-pump options have higher net benefits than do the 2-pump options. See Chapter 3 "Economic Analysis" and the response to General Issue 8 in this chapter.

Response 16

As explained in the draft report (pages 26 and 27), the toilet dam and showerhead retrofit programs include devices, installation, publicity, and management. The one-time cost was estimated at $90 million. The cost per household in the 1977 demonstration program in the Ventura County community of Oak Park was $23.64. The $33 per household cost in this analysis accounts for inflation. The unit costs of $74 per acre-foot for toilet dam retrofit and $110 per acre-foot for showerhead retrofit were annual equivalent costs, accounting for the initial cost, the 15-year life, the discount rate of 7-5/8 percent, and the estimated water savings over time, as shown in Table C-6. These measures are presented as a combined program in the final report and the cost estimates have been raised to 1985 price levels.

The 1990 State Water Project and local energy savings for the four conservation options are different from the long-term shifts from on-peak to off-peak energy that would be realized with the additional pumps.

The costs, yields, and energy advantages of these extraordinary conservation measures were considered in the economic analysis for the additional pumps. As stated in response 13 to this comment letter, these conservation measures were alternatives to, but did not compete with, the additional pumps because it is expected that they will have to be implemented before the additional pumps would become operational. Both the additional pumps and the extraordinary conservation measures will be needed to meet project needs.

Response 17

Concerns relating to the Suisun Marsh facilities are addressed in the final environmental impact report for the Suisun Marsh Plan of Protection (February 1984) and the agreement recently negotiated regarding the marsh.

The sections on Suisun Marsh in Chapters 4 and 5 of the final report on the additional pumping units have been updated, and the response to General Issue 7 in this chapter describes the relationship between the additional pumps and the marsh plan of protection. The additional pumps will have no significant impacts on the marsh, since it is protected by Delta outflows, physical facilities, and a monitoring program.

Response 18

The extent of water level depressions (drawdowns) caused by project operations has been determined by a series of field tests conducted by the Department. The tests have shown that effects on water levels rapidly diminish with distance, and that at 10 miles, the effects were negligible. This is discussed on page 64 of the draft report.

Impacts on velocities and scour potential in nearby channels were addressed on pages 66 and 67 of the draft report, and were not significant. These impacts have been reassessed based on the updated operation studies and new hydrodynamic model studies in Chapter 5, "Impacts on Channel Velocities, Scour, and Siltation". The impacts were still found to be insignificant.

Impacts on water levels in the southern Delta were addressed on pages 64 to 66 and in Table 13 (now Table 5-6) of the draft report. In the final report, the discussion and assessment have been updated and expanded. See Chapter 5, "Impacts on Delta Agricultural Uses and Water Levels". Under the preferred alternative, no significant incremental effects were found.

The findings in the final report for the preferred alternative water levels and velocities are based on:

- Analysis of operational constraints and procedures for the Clifton Court Forebay gates.
- The Corps constraints.
- Channel velocity estimates.
- Drawdown estimates.
- Analysis of forebay computer simulation studies.
- Analysis of the updated operation studies.
- New hydrodynamic studies.

Localized operational effects with the additional pumps will probably be monitored by the Corps of Engineers, in accordance with requirements of the U. S. District Court decision of December 1982.

Also, the Department and South Delta Water Agency recently signed a letter of intent to establish a program for ameliorating water level and water circulation problems in the southern Delta (see Chapter 4 "Southern Delta").

Response 19

The discussion has been expanded and now mentions the July operational constraint of Decision 1485. Since unregulated flow conditions seldom occur in July, State Water Project diversions in July are generally less than the Decision 1485 limits, and would be decreased with additional pumps with present State Water Project facilities.

Response 20

In the final report, the table on outflows (Table 5-4) reflects data from the updated operation studies.

Response 21

The report has been corrected.

Response 22

The preferred alternative should not aggravate the agricultural water supply problem in the southern Delta. The no-project and preferred alternatives have nearly the same estimated drawdown effects on high-high tides at Clifton Court Ferry during the irrigation season because there would be no significant increase in export during April to September. In fact, the updated operation studies used for the final report show some export decrease for the preferred alternative during the irrigation

C—105574

C-105574

season, when compared to the no-project alternative. The final report includes this finding (see Table 5-6 and response 18 to this comment letter).

Response 23

The report has been revised. See response 19 to this comment letter.

Response 24

Supporting data are shown in Table 19, page 80, and in Appendix B of the draft report. In Chapter 5 of the final report, "General Impacts on Salmon and Steelhead" has been revised in coordination with the Department of Fish and Game. Some revisions have also been made in the tables to reflect data from the updated operation studies. No significant change in Sacramento and San Joaquin River flow ratios was found for operations with the additional pumps. This lack of change was the basis for finding no significant impact on juvenile salmon migration, since flow ratios are an indicator of displacement of juvenile salmon and steelhead from normal migration routes.

The section "Impacts on Fish Salvage Operation" has been revised to account for comments on the draft report. (See response to General Issue 3 in this chapter.) As in the draft report, significant incremental direct impacts to salmon were found for the preferred alternative. The proposed new agreement with the Department of Fish and Game would compensate for salmon impacts of existing and additional pumps.

Response 25

The section "General Impacts on Striped Bass" has been revised in coordination with the Department of Fish and Game. The expanded discussion explains the conclusions of the Striped Bass Working Group and the ongoing experiments. (See Chapter 5 of the final report and response to General Issue 4 in this chapter.)

Response 26

The statement in the draft report about no significant incremental effect on young-of-the-year striped bass survival is for general impacts that did not include salvage operations and was based on calculations of the Striped Bass Index from traditional statistical relationships with Delta outflow and export rates as input. This relationship is based on actual records that account for the effects of project diversion on fish. Also in the draft report, a separate evaluation was performed for direct losses for salvage and loss estimates shown in the section, "Impact on Fish Salvage Operation" (page 78 of the draft report). Direct fish impacts from operation of the additional pumps were found to be significant; however, this is not a one-to-one correlation with estuary impacts because of natural losses during the life cycles of fish.

In the final report, the Striped Bass Index has been eliminated because of the Department of Fish and Game's recent determination that the index, as presently computed, is no longer valid. However, the final report still considers exports and outflows in May, June, and July as an important factor in young-of-year abundance. This factor is incorporated qualitatively as part of the general fish impacts. The assessment of direct entrainment impacts for striped bass now includes predation losses in Clifton Court Forebay, handling and hauling losses, and entrainment of striped bass eggs and larvae, based on the updated operation studies. No significant impact on striped bass has been found. In fact, losses may be reduced, because reduced exposure of striped bass during summer when striped bass are abundant outweighs their increased exposure during winter when

they are less abundant. (See response to General Issue 3 in this chapter and response 1 to this comment letter.)

Response 27

With respect to participation in experiments and studies related to the striped bass decline, see response to General Issues 1 and 3 in this chapter and Response 3 to this comment letter.

Response 28

The final report considers the two points in this comment, as well as other information on the effects of export pumping on aquatic invertebrates and phytoplankton (see Chapter 5, "Overview of Fish Food Supply Impacts"). These factors are especially important for the fish food chain and, even though many facts are known, the overall complexity of this matter does not allow a determination of impacts. The final report classifies impacts on aquatic invertebrate phytoplankton and fish food supply as unknown.

The final report discusses the possible link between the peak spring phytoplankton bloom in the central Delta with the total water exports at the Central Valley Project and State Water Project pumps. The most significant time period was 7 days before the bloom. The final report also discusses the timing of spring blooms in the central Delta after 1976 with the shutdown of the State Water Project pumps for repairs on two occasions. It further discusses export management experiments.

Previous operation studies did not show a significant increase in pumping with the new pumps during spring (April, May, and June). The new operation studies show decreases in April and June.

Significant change in 7-day average diversions due to off-peak and on-peak pumping shifts is not expected. If the relationship found by the Striped Bass Working Group between 7-day average exports prior to the blooms and peak phytoplankton levels is valid, then the additional pumps would have no incremental effect on spring development of phytoplankton.

The Department has no evidence that increased winter diversions would affect spring development of phytoplankton. The Department has considered the mid-March termination of increased diversions in relation to the 7-day average exports/bloom correlation found by the Striped Bass Working Group, and the 14-year record for phytoplankton levels and blooms. This record shows that no bloom started within 15 days after the mid-March reduction in exports.

With or without the additional pumps, the Department will comply with any valid water quality standards adopted by the State Water Resources Control Board as a result of evidence collected during experiments.

Responses 29 and 30

Concerns relating to the Suisun Marsh facilities are addressed in the final environmental impact report for the Suisun Marsh Plan of Protection (February 1984) and the agreement recently negotiated regarding the marsh.

The sections on Suisun Marsh in Chapters 4 and 5 of the final report on the additional pumping units have been updated, and the response to General Issue 7 in this chapter describes the relationship between the additional pumps and the marsh plan of protection. The additional pumps will have no significant impacts on the marsh, since it is protected by Delta outflows, physical facilities, and a monitoring program.

C—105576

C-105576

Response 31

Fish mitigation options are discussed in response to General Issue 4 under "General Issues and Responses" and Chapter 5 (Mitigation for Impacts on Fish).

Response 32

Previous plans of the U. S. Bureau of Reclamation for the San Luis Drain were for discharge at Chipps Island. The State Water Resources Control Board would have established discharge requirements for the drain after further studies. However, discharge to the estuary is no longer probable as a long-range solution to drainage problems in San Joaquin Valley. A discussion of drainage problems and studies in San Joaquin Valley has been added to Chapter 4 of the final report.

It is true that screening losses for eggs, larvae, and food organisms may not be decreased with a Delta water transfer facility. Table 6-1 reflects this uncertainty by noting that screening losses may be reduced. This is a major consideration in the study of Delta water transfer alternatives, discussed in Chapter 6.

Response 33

Decision 1485 velocity standards for the Skinner Fish Facility from May 15 through October are conditional and are to be compatible with water export rates. Maintaining a velocity as close as possible to 1.0 foot per second is desirable for optimal salvage, but not always compatible with pumping rates. Approach velocities shown in the draft report in Table B-6 for existing pumps and in Table B-7 for four additional pumps were based on maximum off-peak pumping and the previous operation studies. In both cases, the optimal 1.0 foot per second approach velocity would have been exceeded during off-peak periods. With four additional pumps, the maximum increase in off-peak velocity would have been 1.0 foot per second in August and September, or about a 48 percent increase over the no-project alternative.

Approach velocities during off-peak and on-peak periods are one of several factors affecting striped bass salvage and loss estimates. The revised estimates in the final report, based on the updated operation studies, show about a 9 percent incremental decrease in average annual losses of striped bass yearlings with the preferred alternative. This is due mainly to more efficient operations in capturing winter flows and reducing exports in June, July, and August. (See Appendix B for a discussion of updated operation studies and revised direct impact analysis.)

The updated operation studies with more efficient operations and with reduced summer exports show a significant decrease in the effects of off-peak pumping when compared to the operation studies in the draft report. Striped bass were the primary fish that benefited. Approach velocities and screening efficiencies for striped bass during May 15 to October 31 are shown in Table B-12 for the no-project alternative and Table B-13 for the preferred alternative. During this period, approach velocities would be increased only in October for the preferred alternative.

The final report also evaluates a mitigation option involving restrictions on off-peak pumping (see response to General Issue 4 under "General Issues and Responses" in this chapter).

Letter 8
Commenting Entity:
Alameda County Water District
February 15, 1983

See responses to Comment Letters 26 and 27.

Letter 9
Commenting Entity:
Antelope Valley-East Kern Water Agency
February 9, 1983

See responses to Comment Letters 26 and 27.

Letter 10
Commenting Entity:
Casitas Municipal Water District
February 10, 1983

See responses to Comment Letters 26 and 27.

Letter 11
Commenting Entity:
Coachella Valley Water District
February 14, 1983

Response 1

Comment noted.

Response 2

The Draft Environmental Impact Report on the Proposed Additional Pumping Units outlined specifically the need for the units on page S-1 and in Chapter 2, page 13. These needs were to:

- Alleviate scheduling problems for maintenance of the existing units.
- Minimize the on-peak power requirements and energy costs of the State Water Project.
- Increase reliability of State Water Project deliveries.

The economic analysis for additional pumps determined that they had independent utility for the State Water Project (see page 25 of the draft report). The relationship between additional pumps and future water resources planning is discussed in the responses to General Issues 1 and 2 in this chapter under "General Issues and Responses".

Response 3

The final report was written to best meet the basic purposes of the California Environmental Quality Act. These purposes are to:

- Inform governmental decision-makers and the public about the potential significant environmental effects of proposed activities.
- Identify ways that environmental damage can be avoided or significantly reduced.
- Prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible.
- Disclose to the public the reasons why a governmental agency approved the project in the manner the agency chose.

These basic purposes are listed in Title 14, California Administrative Code, Section 15006.

Responses 4, 5, and 6

Comment noted. See Responses 2 and 3 to this comment letter.

Letter 12
Commenting Entity:
Contra Costa County Water Agency
February 14, 1983

Response 1

Title 14, California Administrative Code, Section 14132d, requires that

C—105578

C-105578

the specific alternative of no project always be evaluated, along with the impact. The no-project alternative represents the existing method of State Water Project operations without installation of additional pumps and is used to evaluate incremental impacts. While several parties, such as Contra Costa County Water Agency are pursuing legal challenges to Decision 1485 and its environmental impact report, Decision 1485 is still the water right decision applicable to operation of the State Water Project.

No conclusions have been reached in connection with the striped bass decline. The Department has and is continuing to spend millions to advance knowledge about the Delta fishery. One potential cause of the present decline is toxic pollution, which is beyond the control of the State Water Project and beyond the intended protective criteria of Decision 1485. If toxic pollution is the cause of the striped bass decline, it is possible that the protective flow and quality criteria provided by the State Water Project, in compliance with Decision 1485, are mitigating project impacts.

The State Water Resources Control Board closely reviews all information regarding the striped bass decline. The Board has reserved jurisdiction to modify water right standards. Future information on the relationship between State Water Project operations and the Bay-Delta environment could lead to new water right standards. The Department will operate the State Water Project to meet valid standards. (See response to General Issue 3 in this chapter under "General Issues and Responses".)

Response 2

Contra Costa County Water Agency comments on the draft environmental impact report on the Water Quality Control Plan, dated June 15, 1978, and the Board's response to those comments were published in an appendix: "Summary of Public Comments on the Draft Water Quality Control Plan and Environmental Impact Report, Sacramento-San Joaquin Delta and Suisun Marsh", August 1978, and this report is incorporated herein by reference.

Response 3

The draft report did discuss environmental damage that has already taken place in the Bay-Delta system due to project pumping and other factors (see Chapter 6, page 91, of the draft report).

Background information on Bay-Delta impacts was discussed in Chapters 4 and 5 of the draft report. Information in those chapters has been expanded and updated. In addition, impacts associated with the no-project alternative (current operating conditions) are now evaluated separately in Chapter 5.

The draft and final reports also incorporate, by reference, three environmental documents that provide information about impacts that have already taken place in the Bay-Delta system. All three documents were distributed to the public. These documents are:

- Final Environmental Statement, Operation of the Delta Pumping Plant, U. S. Army Corps of Engineers, September 1980 (summarized in Appendix A of the draft report).
- Final Environmental Impact Report, Agreement to Manage Fish and Wildlife Resources, Department of Water Resources and Department of Fish and Game, December 1982 (discussed in Chapter 1 of the draft report).
- Final Environmental Impact Report for the Water Quality Control Plan and Water Right Decision, Sacramento-San Joaquin Delta, State Water Resources Control Board, August 1978 (discussed in Chapter 1 in the draft report).

The final report discusses the Department's concern and commitment toward understanding the problems of the Bay-Delta system. This includes extensive funding of programs, studies, and monitoring. (See response to General Issue 11 in this chapter.)

Response 4

The draft report evaluated the impacts of alternative operational plans for the 1990 level of development, including pumping at 10,300 cubic feet per second capacity. The impacts associated with the 4-10.3 alternative were discussed in Chapter 5 of the draft report, under "Other Alternatives"; the discussion has been updated in the final report. The economic analysis showed an economic and operational advantage to installing the additional pumps even if no other project facilities were built. Potential transfer facilities are discussed in a 1983 report, Alternatives for Delta Water Transfer. This and operation of the additional pumps in conjunction with possible future State Water Project development is discussed in Chapter 6 in connection with cumulative impacts. Water resources planning and its relationship to the additional pumps is also discussed in response to General Issues 1 and 2 in this chapter, under "General Issues and Responses".

Response 5

The fish impacts differ in the final report from those in the draft report because updated operation studies were used, which included more effective export operations. These operations shifted the timing of exports away from summer periods of high fish abundance toward winter months of unregulated flow conditions when many fish species are less abundant. Operations evaluated with the additional pumps accentuated this shift. Striped bass, American shad, and white catfish are important species that benefited from this change. Only chinook salmon were found to be adversely affected. The incremental effect of the additional pumps under the preferred operation would reduce direct losses for 23 fish species and increase direct losses for salmon at the Delta Complex when compared to the no-project alternative. (See responses to General Issues 1, 3, 4, and 5 in this chapter, and "Planning Perspective", Chapter 1.)

Comment letter 30 contains the comments of the Delta Environmental Advisory Committee on the draft report. The Department's responses (which have been coordinated with the Department of Fish and Game) are presented later in this chapter.

Response 6

The Department has expanded the discussion on mitigation to account for the uncertainty of the proposed agreement and various comments on the draft report. The expanded discussion, which includes mitigation options, is presented in Chapter 5 (Mitigation for Impacts on Fish) of the final report and in response to General Issue 4 in this chapter.

Impacts of the Central Valley Project are discussed in Chapter 6. Decision 1485 applies the same water quality protection terms and conditions to both the Central Valley Project and the State Water Project by amending the permits for both projects. The State Water Resources Control Board did this because it determined that separating the effects of the two projects on the Delta was not possible.

The Department has been actively seeking Federal participation in agreements related to joint operation of the two projects and management of fish and wildlife resources. Efforts toward this goal have resulted in a negotiated Coordinated Operation Agreement (discussed in Chapter 1 of the final report) and a draft environmental impact statement/report on the agreement distributed in September 1985.

C—105580

C-105580

Response 7

Impacts of existing and additional pumps, including full capacity, were discussed for all flow conditions in the draft report. The discussion has been updated in the final report (see Chapter 5, "Operational Impacts, Conditions During the Early 1990s"). See also response to General Issue 11 in this chapter concerning the additional pumps and biological resources of San Francisco Bay.

Response 8

The draft report did address the energy impacts of pumping the additional yield to the State Water Project contractors. Costs in the economic analysis of additional units include marginal energy costs to the State Water Project for pumping the water to five service areas. The economic analysis was summarized in Chapter 3, page 25, Table 2 of the draft report, with details in Appendix C.

In the final report, the economic analysis has been revised to account for the Department's increased operating experience as a utility and other factors. See Chapter 3 "Economic Analysis" and Chapter 5 "Energy and Capacity Impacts".

Response 9

Noted.

Letter 13
Commenting Entity:
Crestline-Lake Arrowhead Water Agency
February 15, 1983

See responses to Comment Letters 26 and 27.

Letter 14
Commenting Entity:
Desert Water Agency
February 10, 1983

See responses to Comment Letters 26 and 27.

Letter 15
Commenting Entity:
Devil's Den Water District
February 17, 1983

See responses to Comment Letters 26 and 27.

Letter 16
Dudley Ridge Water District
February 14, 1983

See responses to Comment Letters 26 and 27.

Letter 17
Commenting Entity:
Kern County Water Agency
February 15, 1983

See responses to Comment Letters 26 and 27.

Letter 18
Commenting Entity:
The Metropolitan Water District of Southern California
February 14, 1983

Response 1

Comment noted. Comments in this letter have provided information to improve the final report.

Response 2

The Department has reviewed Report 947 on availability of Colorado River water. The estimates of supply from the Colorado River were compared to recent Department studies and were not significantly different. The Department has used its recent studies to revise the supply and demand projections as a basis for economic analysis of the proposed additional pumping units. The revised supply and demand projections are in Appendix C, Table C-5, of the final report.

Response 3

See Response 130 to Comment Letter 18B regarding concerns about the specific generation figures used for Metropolitan Water District energy generation.

The Department agrees that unit costs assigned as benefits to municipal and industrial water could be higher in the future; however, based on the status of planning for future facilities, these costs are the highest that could be justified at the time. In the final report, they have been raised to 1985 price levels. Even with the low estimates provided in the report, the benefit/cost ratio is favorable for the additional pumps. If, as is likely, actual costs are higher than estimated, the benefits for the pumps would also be higher.

Use of these unit costs is to determine costs of alternative ways of meeting service area needs and does not contradict the revised guidelines for funding local water supply projects.

The $167 per acre-foot value is the unit cost for water from the next available extraordinary demand reduction alternative that could provide an alternative supply to the pumps, based on the projected time of installation of the pumps. This is shown in Table C-6 of the draft report. It is based on a reasonable demand-supply relationship and on the potential condition of major deficiencies in the State Water Project system. The $267 per acre-foot value is the 1980-1981 average vendability price of residential water, taken from a survey of four Southern California cities. This is discussed on page C-12 of the draft report.

Response 4

Table 21 in the draft report was designed to note relative changes in future State Water Project operations with each related project added to the State Water Project. The outflow and export descriptions for the ground water projects indicate the effect on operation that could occur with a ground water program versus future State Water Project development without the program. Some of the wording in Table 21 (6-1 in the final report) has been changed to clarify the effects. These descriptions are not for a Department plan to reduce exports. Future efforts by the Department to develop ground water would have an objective of producing yield. It is possible that a ground water program south of the Delta would provide both yield and environmental benefits in the Delta by decreasing State Water Project stress on the Delta by offsetting the need for increased exports, increased upstream storage, and potential outflow reductions.

Response 5

Water conservation is discussed in response to General Issue 9 in this chapter, under "General Issues and Responses". Also, see response 12 to comment letter 18B.

Response 6

The discussion of mitigation for impacts on fish in Chapter 5 has been expanded and updated to cover the areas raised by this comment. (See responses to General Issues 4 and 5 in this chapter).

Letter 18B
Commenting Entity: The Metropolitan Water District of Southern California
February 14, 1983

Response 1

The format of the Final Environmental Impact Report on the Proposed Additional Pumping Units has been changed, and the report incorporates the thoughts expressed in this comment.

Response 2

San Joaquin River flows govern winter operation under the Corps constraints. Delta flow conditions in general (Delta outflows) govern operation under State Water Resources Control Board water right permits. From March 15 to December 15, Decision 1485 export limits for May, June, and July and outflow requirements would be met. From December 15 to March 15, added exports are allowed under Corps constraints when flow in the San Joaquin River at Vernalis exceeds 1,000 cubic feet per second. An amount up to one-third of that flow can be diverted into Clifton Court Forebay. Decision 1485 protective criteria and unregulated Delta flows will also control diversions during this period. The final report clarifies these points.

Response 3

In the draft report, "pursuant to" referred to a 1975 Federal District Court ruling. This ruling is detailed in Chapter 1 of the final report, in the section "Regulatory Permits for Banks Pumping Plant, and Related Environmental Documentation".

Response 4

In the final report, the "Other Litigation" section includes the U. S. District Court's December 30, 1982, decision.

Response 5

The final report incorporates this comment.

Response 6

The referenced surface water storage program in the Southern California service area is the Colorado River Banking Plan. Ground water storage programs referenced are a combined Chino and San Bernardino Valley-San Gorgonio Pass ground water storage program in the Southern California service area and the Kern River Fan ground water storage program in the San Joaquin Valley service area. These ground water storage programs are described in Bulletins 132-82 and 132-83.

Response 7

The intermittent deliveries to ground water shown in the draft report were based on 50-year operation studies, described in Appendix B. These studies are different than the Department of Water Resources-Metropolitan Chino Basin Ground Water Storage Feasibility Study. The studies have different assumptions for constructed facilities and, therefore, have different inflow to the Delta. The study for the additional pumps was for 1990, and did not include the major development called for in Senate Bill 200. The cooperative study on Chino basin ground water storage feasibility had many major water development facilities, such as Cottonwood Creek and Thomes-Newville in the Sacramento River basin, and a Peripheral Canal. With these facilities, the Delta inflow is quite different and it is not possible to predict reliably whether these or similar facilities will be built.

Ground water storage projections in the draft report are conservative by estimating on the high side to maximize the service area and Delta impacts due to diversion. Updated operation studies

used in the final report show less potential for ground water storage. (See the summary comparison of previous and updated operation studies in Appendix B.)

Response 8

Delta outflows would decrease in May to July because of modified releases from upstream reservoirs. This was discussed on page S-5 of the draft report (see Table 5-4 and accompanying discussion in final report).

Response 9

In general, demand reduction and water supply projects that substitute for the firm yield developed by the additional pumps do qualify as alternatives to the water supply advantages of the pumps for purposes of determining economic advantages or disadvantages of proceeding with the additional pumps. A water supply or demand reduction alternative will not duplicate the operational advantages of the additional pumps for power and outages.

The point of the economic study assumptions was that the alternatives would be able to balance supply and demand within the study period.

It is because water supply and demand reduction alternatives are independent of the additional pumps that they can be considered alternatives. Under the study assumptions, the first four, least costly, demand reduction alternatives do not compete directly with four additional pumps because project shortages expected before operation of the additional pumps will exceed the yield reduction provided by these four alternatives. They might be used to offset the shortages and, because they can be implemented before the pumps are operational, benefits from these alternatives could be realized in addition to the benefits of the pumps.

Surface water storage facilities, such as Cottonwood and Shasta, are not independent; they would require the additional pumps. Therefore, they cannot be considered alternatives. Cottonwood and Shasta are facilities that would be in addition to, not an alternative to, the pumps. They are discussed in Chapter 6 under "Onstream Storage North of the Delta".

Response 10

See response to comment 9 of this comment letter.

Response 11

The statement that "water conservation options that would not impair the maintenance of present esthetic, convenience or health conditions" was based on Department experience and studies by the Office of Water Conservation. It is true that such a determination is somewhat subjective. The final report recognizes this.

Response 12

See response to General Issue 9 in this chapter, under "General Issues and Responses". The water conservation alternatives proposed have not been double-counted.

The urban conservation measures totaling 250,000 acre-feet by 1990 used in the operation studies to evaluate potential impacts of the operational alternatives of the additional pumps are a part of Department planning and local planning by State Water Project contractors; they are assumed to be implemented independent of the pumps. Other water management measures such as waste water reclamation and agricultural conservation are projected to reduce contractor demands as outlined in the Departments recommended water management plans. These measures are, therefore, likely

C—105584

C-105584

to occur and are included in the basic determination of State Water Project needs. Thus, they are not alternatives to the additional pumps.

Water conservation measures were also included in the water supply and demand reduction alternatives. These are extraordinary measures in addition to the specific conservation measures developed by the recommended water management plans. The extraordinary measures do not duplicate the measures used in the operation studies. They are assumed to be achievable under conditions of significant State Water Project deficiencies. These extraordinary measures generally meet the same criteria used to judge the conservation measures incorporated into the recommended water management plans; however, they are considered to be at a lower level of public acceptability.

As stated in response to comment 9 of this comment letter, the final report analysis shows that even if the measures are implemented, additional pumps will still be needed to increase the reliability of project water supply deliveries to partially offset the frequency and severity of shortages from lost supplies due to upstream development, lost Colorado River supplies due to the Arizona Project, and increasing service area urban demands in excess of supplies provided after conservation efforts.

Response 13

In the final report, Table S-3 has been revised to eliminate the absolute "yes" or "no" ratings of the institutional and environmental problems for alternatives in the Metropolitan Water District service area (see Table 3-3). The ratings have been changed to low, medium, or high. The rating system was based on Department experience and studies by the Office of Water Conservation. Also, these alternatives have updated to reflect recent advances in water conservation planning and negotiations for use of Imperial Irrigation District supplies.

Response 14

The final report incorporates this comment.

Response 15

Commitment to water conservation goals through contractual agreement has not been dropped from consideration as a mitigation option for the final report. According to the California Environmental Quality Act, mitigation options for an environmental impact report must consider many factors, including those not necessarily within the power of the agency writing the report. Any agreement between the Department and project water users, which was the proposed format for commitment to goals, would have to be negotiated. See responses to General Issues 4 and 9 in this chapter under "General Issues and Responses".

Response 16

Chapter 5 of the final report discusses a proposed agreement to replace the December 1982 Two-Agency Fish Agreement as a fish mitigation option. The other mitigation options are also discussed. Also, see response to General Issue 4 in this chapter.

Response 17

This comment has been incorporated into the final report.

Response 18

These comments have been incorporated into Chapter 1. The Burns-Porter Act did authorize construction of the California Aqueduct to a capacity of 10,000

cubic feet per second, and it has been built to that capacity.

Response 19

The final report incorporates the basic thoughts expressed in this comment.

Response 20

Chapter 1, "Planning Perspective", and Chapter 6, "State Water Project Planning and Related Projects", in the final report discusses Department planning. Also, see responses to General Issues 2 and 6 in this chapter.

Response 21

To be consistent with Decision 1485 language, the word "all" was removed in the final report.

Response 22

The final report incorporates this comment.

Response 23

The final report states that the fish agreement, as presented in the draft report, was not executed. New negotiations are proceeding. The discussion has been revised to be consistent with the most recent activities.

See response to General Issue 4 in this chapter regarding the Two-Agency Fish Agreement and water conservation as mitigation options. Also see response to General Issue 9 regarding water conservation.

Response 24

Reference to the 100,000 acre-feet of storage has been deleted from the final report.

Response 25

Ground water management, water supply management, and interbasin and intrabasin transfers of developed water supplies are of statewide interest, are usually a local responsibility, but may on occasion be a State responsibility. For example, any transfer of appropriative water is subject to the jurisdiction of the State Water Resources Control Board.

The final report incorporates the concept of local responsibility.

Response 26

The Department of Water Resources Energy Division made this estimate; the method was explained in Appendix C, page C-7, of the draft report.

The economic analysis for the additional pumps has been revised to account for the Department's increased operating experience as a utility and other factors. The 4-pump options have higher net benefits than do the 2-pump options. See Chapter 3 "Economic Analysis" and the response to General Issue 8 in this chapter.

Response 27

The footnote to Figure 3 covers this concern. The magnitude of State Water Project energy demands is discussed under "State Water Project Power Operations", in Chapter 1.

Response 28

The discussion of State Water Project shortages in Chapter 2 of the draft report has been expanded and shifted to "Available Water Supply, State Water Project Demands, and Delivery Capabilities", in Chapter 1 of the final report. This incorporates the suggestion in the comment. Also, in Appendix B, State Water Project

deficiencies for agricultural and municipal and industrial purposes are shown for various years. These deficiencies were determined from updated operation studies analyzed in the final report for conditions of the early 1990s.

Response 29

Water is wheeled to San Luis Reservoir for the Central Valley Project. This is for outages, Decision 1485 export makeup, and deliveries to the Cross Valley Canal.

See response 8 to Comment Letter 1 concerning wheeling for the Central Valley Project and the Coordinated Operation Agreement.

Response 30

Contractors' requests do include conservation and reclamation. The Department has closely reviewed its estimates for net water conservation and waste water reclamation from existing laws, current programs and trends, and additional conservation and reclamation from future actions in conjunction with contractor requests for water. No underestimate of demands was found. The review showed that when the Department's recommendations for conservation and reclamation presented in the "Recommended Water Management Plan for Metropolitan Water District of Southern California", December 1982, were used to adjust Metropolitan's total demand, the resulting computed need for State Water Project supplies was equivalent to Metropolitan's request. This shows a consistency between the Department's recommendations and Metropolitan's planning. Details of this review can be found in the "Final Environmental Impact Report, Enlargement of the Governor Edmund G. Brown California Aqueduct", April 1984. The Department recognizes that future planning and implementation for efficient use of urban supplies can best be accomplished at the local level according to the Urban Water Management Planning Act.

In this final environmental impact report for the pumps, the operation studies and corresponding State Water Project demands have been updated to 3.16 million acre-feet, approximately those shown in Bulletin 132-83. In the Bulletin 132 series, the Department has discontinued adjustments of contractors' requests by conservation and reclamation goals, and text in this final report has been made consistent with that change.

Response 31

In the operation studies, target storage levels for San Luis vary with demands assumed in the studies. (See "Efficient Operation of the State Water Project", in Chapter 3 of the final report.)

Southern California reservoirs were not operated to develop yield.

Response 32

This comment has been incorporated into the text of the final report.

Response 33

Figure B-2 in the draft report assumed that all usable intermittent export supply is pumped; on-peak power requirements were not taken into account. However, the power operation studies used for the draft report minimized system on-peak use while delivering substantial amounts of intermittent supplies.

Response 34

Local surface water projects have been proposed as units of the State Water Project. If feasible, each project could develop an additional yield of 2,000 to 10,000 acre-feet per year. The Department evaluates such proposals submitted by State Water Project

contracting agencies. Since the guidelines were issued in February 1979, four proposals have been submitted for surface storage projects, all by Santa Barbara County Flood Control and Water Conservation District.

Response 35

Costs for regulating, storing, and recovering intermittent supplies were specified as "local". Energy costs were included in the estimates. Additional energy costs for deliveries from the Delta were accounted for in the economic analysis. The estimated average annual supplies were shown in Figure B-2. Enough factors needed for a comprehensive economic analysis were available. Further studies would be necessary to provide the other requested information. This information will be important for ground water planning, but is not necessary for an economic analysis of the additional pumps.

Response 36

The paragraph in question has been deleted in the final report, as it is not consistent with the assumptions about priorities in deliveries of State Water Project water described in Bulletin 132-83, pages 6 to 11.

Response 37

The East Branch enlargement was included in operation studies under conditions without the new pumps (no project) and with the new pumps. In both cases, including the full East Branch enlargement would maximize the effects of its use.

Response 38

The format of the report has been changed. Chapter 5 of the final report discusses channel velocities, scour, and siltation.

Response 39

The limit of 7,300 cubic feet per second is an estimated physical constraint with the present intake to Clifton Court Forebay. Because of the complex hydraulic conditions used to estimate the limit of 7,300 cubic feet per second, the final report evaluates an upper limit alternative with no physical hydraulic constraints where winter exports vary according to San Joaquin River inflow relationships established in the Corps constraints. With four additional pumps and San Joaquin River flows above 11,500 cubic feet per second, winter exports were allowed to reach 10,300 cubic feet per second for planning purposes to determine impacts. With two additional pumps, the upper limit is 8,500 cubic feet per second. These high flows occurred less than 1 percent of the time in the operation studies. These alternatives are explained in Chapter 3 of this final report under "Physical and Operational Comparison of Alternative Operational Plans".

See response 8 to Comment Letter 1 concerning wheeling for the Central Valley Project and the Coordinated Operation Agreement.

Response 40

The 8,000 cubic feet per second is a daily diversion into Clifton Court Forebay. This water would be pumped to San Luis Reservoir, then continue down the aqueduct system to satisfy contractor requests or to be stored in ground water basins for later use. In the final report, Chapter 3, "Physical and Operational Comparison of Alternative Operational Plans", clarifies the discussion of diversions into Clifton Court Forebay.

C—105588

C-105588

Response 41

The new pumps would not save energy but would save on-peak energy. Increased yield requires additional off-peak and on-peak energy. This information was presented in Chapter 3 (page 25, Table 2) of the draft report and Table 3-4 in the final report. The additional energy expended to pump firm and intermittent yield supplies was shown under the annual cost items of "State Water Project Energy" and "Local Energy". The sum of these costs represented the largest portion of annual costs for increased yield for each alternative operational plan.

In the final report, the economic analysis in Chapter 3 has been revised for two conditions: median water supply and firm yield.

Response 42

Average annual net energy requirements would increase slightly in wet years, which also happens to be when off-aqueduct hydroelectric supplies are the greatest. There is no relationship. This simply means that when the project's energy requirement increases, there will be ample off-aqueduct hydroelectric supply to meet this demand.

Response 43

The final report reflects this comment.

Response 44

Assumptions in the draft report for hydraulic improvements included dredging West Canal and adding forebay inlet gates. Increasing the size of the forebay would not be needed to sustain a rate of 10,300 cubic feet per second with the above improvements. This assumption focused primarily on short-term operation, would not meet full entitlements, and was basically selected to show impacts of the 10,300 rate, even though on a limited basis.

The report has been updated for a more long-term operation and more southern Delta improvements to be consistent with the report on Delta water transfer alternatives. Southern Delta improvements can be achieved by enlargement of channels or of Clifton Court Forebay. (See Chapter 6, "Alternatives for Delta Water Transfer", for a brief description of these alternatives. For more detail, see Alternatives for Delta Water Transfer, Department of Water Resources, November 1983.)

Response 45

The report has been corrected.

Response 46

Concerns about the demand reduction alternatives are addressed in Chapter 3 (Water Supply and Demand Reduction Alternatives) and the response to General Issue 9 in this chapter. Also, see responses to comments 9 and 12 of this comment letter.

Responses 47 and 48

See Response 3 to Comment Letter 18.

Response 49

Standard procedure in any benefit/cost analysis is to compare the additional (or marginal) benefits with the additional costs. In this evaluation, the marginal costs are the difference between the future costs of operating with and without the proposed project. Thus, the economics of the proposed project are isolated for the benefit/cost analysis. This analysis does not specify repayment charges for the project; it determines only that the

project is economically justified. Costs will be repaid in accordance with existing water supply contracts, which will meld energy costs.

Response 50

The East Branch could be enlarged with or without additional pumps, and the pumps could be installed and operated with or without East Branch enlargement.

The East Branch enlargement and ground water storage will affect the pump economics. With the enlarged East Branch and ground water storage, annual costs and benefits would increase in about the same proportion. The benefit/cost ratio remains about the same.

Response 51

The extraordinary measures in some cases represent high estimates of savings for a conservative economic analysis. The water savings estimates and retention rates for supplemental toilet and showerhead retrofits are probably high. Studies such as that by Brown and Caldwell are being reviewed by the Department of Water Resources and could alter water saving estimates for supplemental toilet or showerhead retrofits.

A decrease in the water saving estimates would not significantly decrease the benefit/cost ratio of the additional pumps, because of the methodology used to compute the value of the pumps in the firm yield analysis (see Appendix C).

The Department has reviewed the assumptions for toilet and showerhead retrofit programs used for the economic analysis. They have been combined into one program that would supplement device distribution methods in the water management plans.

The comment identifies important concerns in connection with many factors and assumptions that affect estimates of water savings and costs for supplemental toilet and showerhead retrofit programs. The assumptions used in this report do not represent a recommendation by the Department for conservation measures to be specifically adopted by water supply contractors. Conservation measures to be adopted by local water users, those to be included for the Urban Water Management Planning Act, will be a local decision that considers many factors and local conditions.

The conservation measures addressed in this comment were used in the economic analysis for the additional pumps. They were assumed to represent extraordinary measures that would provide a small additional offset of large supply shortages without additional State Water Project development. They are possible measures that could further reduce demands while sustaining the existing standard of living. Other conservation measures that are not extraordinary were used to reduce future project demands in the operation studies and were assumed to be implemented with or without the additional pumps. Therefore, they are not alternatives to the pumps. Measures that are not extraordinary would include homeowner placement of plastic bags in toilets; placement of dams by water agency personnel would be extraordinary. The "State Water Project Recommended Water Management Plan for the Metropolitan District of Southern California in Response to Governor's Executive Order B-68-80", presents only measures that are not extraordinary.

The Department recognizes that demographic, social, or economic differences between Oak Park and Metropolitan Water District as a whole might cause installation rates to be lower in the Metropolitan Water District service area. Follow-up surveys in mass mail program areas suggest a positive correlation between income level and installation rate. The proportion of low income and lower-middle income households in Metropolitan Water

District is probably higher than in Oak Park, and this might result in a small difference in overall installation rates. However, before projections of installation rates could be improved, detailed income level information for Oak Park and Metropolitan Water District would be needed. More statistical analysis suggests a correlation between income level and installation rate would also be needed. Finally, a carefully controlled pilot program would be necessary to determine whether low and middle income households respond to free installation programs the same way they respond to mass mailing programs.

In absence of better information on income/installation correlations, the Department has made use of existing studies.

Responses 52 and 53

The Department acknowledges that questions exist over the propriety of who should do landscape designs. However, residential landscape design programs do not necessarily conflict with private enterprise. These alternatives should not be overlooked simply because of matters as yet unresolved. These institutional problems are identified in Chapter 3 (Free Residential Landscape Design) of the final report.

Response 54

This section has been rewritten.

Response 55

The report has been expanded to include the information in this comment.

Response 56

The 2,100 kilowatt-hour per acre-foot figure used as the energy cost of substituting additional Colorado River water for State Water Project supplies was intended to include the cost of energy production foregone at Parker Dam and at generation facilities along the All American Canal. This figure may be about 15 kilowatt-hours per acre-foot too low. Using 2,115 kilowatt-hours could increase the cost of the Imperial Irrigation District alternatives by about $1 per acre-foot.

Response 57

In the final report, the section "Additional Imperial Valley Conservation and Transfer" discusses environmental concerns about the Salton Sea and other considerations. This section of Chapter 3 has been updated.

Response 58

IMS is Irrigation Management System. Table 3 has been deleted in the final report. This table presented information from the Department's 1982 report on use of water by Imperial Irrigation District, which is available to negotiating parties and the public.

Response 59

The report has been revised to clarify the cost figures for Imperial Valley desalting. The $40 per acre-foot was used in the prior economic analyses for energy for local distribution only.

Response 60

The report has been revised.

Response 61

The cost cannot now be quantified. Deleting such costs in the benefit/cost analysis is conservative with respect to benefits of the pumps; including the

costs would raise benefits. Discussion of the San Joaquin Valley desalting alternative has been updated in Chapter 3 of the final report (San Joaquin Valley Drainage Water Desalting).

Response 62

Chapter 3 of the final report contains a summary environmental checklist (Table 3-1). The discussion identifies brine disposal as a potential environmental impact. Also, the cost of brine disposal could affect the feasibility of desalting.

Response 63

The description of Delta outflow provided in the draft report on pages 31, 32, and 33 states that:

- Delta outflows are primarily fresh water.
- The major inflow source to San Francisco Bay is outflow from the Delta.
- The controlled outflows for Delta and Suisun Marsh will provide a major source of inflow to the bay.

The description in the final report is substantially the same.

Response 64

The range of monthly Delta outflows in all year types was shown in Table 11, page 58, of the draft report. Those values represented 1990-level development in the previous operation studies. In the final report, monthly Delta outflows reflect data from updated operation studies. (See Table 5-4.)

Response 65

The final report indicates the stricter standards are for waste discharge.

Response 66

The statement refers to pre-Central Valley Project conditions. The report has been revised.

Response 67

The final report states that the overall facilities for Suisun Marsh cannot be provided by 1984 and updates information on the marsh. See also response to General Issue 7 in this chapter and the discussion on Suisun Marsh impacts in Chapter 5 (Impacts on Suisun Marsh).

Response 68

The 4.23 million acre-foot maximum annual entitlement was mentioned in Chapter 1 of the draft report, under "State Water Supply Contracts".

Responses 69 and 70

The report has been corrected.

Response 71

In the final report the list of factors affecting land use changes in Southern California has been revised. It is true that specific land use is not directly related to water imports.

Response 72

The final report discusses recent successful negotiations for coordinated operations and Suisun Marsh protective facilities and corresponding assumptions for the operation studies. The draft report noted these assumptions for project operation in Appendix B. The final report also lists these and other updated assumptions in Chapter 5 under "Operational Impacts, Conditions During the Early 1990s".

Response 73

In the draft report, the level of development was kept to 1990 because of unresolved water resources planning questions. In Chapter 5 of the final report, the impact assessment for the additional pumps has been extended to the late 1990s, with a more general discussion of post-2000 impacts without any additional facilities in Chapter 6. Full development will require future facilities that will have separate environmental documentation. (See responses to General Issues 1 and 2 in this chapter, "Planning Perspective" in Chapter 1, and Chapter 6.)

Response 74

Adjustments and rounding are responsible for differences in values shown. Changes have been made in the final tables to reflect data from the updated operation studies.

Response 75

See Response 21 to Comment Letter 26.

Response 76

Tables 10 and 11 have been renumbered and revised in the final report. Tables 5-2 (Banks Pumping Plant exports) and 5-4 (Delta outflow) in the final report reflect the updated operation studies and the table headings use the word "average".

Response 77

The draft report (page 64) noted that the table showed effects of high-high tides at Clifton Court Ferry. The same statement is in the final report.

In the final report the data on draw-downs have been revised to be consistent with the updated operation studies.

Response 78

Footnote /5/ "The negative sign indicates reverse flow" has been added to Table 5-7, which reflects data from the updated operation studies.

Response 79

The section has been revised and updated.

Response 80

The final report discusses findings of the Striped Bass Working Group, including the low adult population and inadequate egg production. The findings became available after the draft report was printed.

Response 81

Chapter 5 (General Impacts on Striped Bass) of the final report discusses the lack of correlation between Delta outflow and survival of striped bass since the drought. (See also response to General Issue 3 in this chapter.)

Response 82

The striped bass index has been dropped from the final report; previous use of a striped bass index of 106 was to represent the historical average for 1922 to 1967.

Response 83

Table 19 (Table 5-15 in the final report) has been clarified and now reflects updated impact analysis.

Response 84

The draft report (Chapter 5, "Evaluation of Socioeconomic Impacts" section of the

final report) qualifies this issue by stating, "The other service areas were assumed not to receive significant supplies from the ground water and banking programs." This assumption is appropriate because the intermittent supplies are not necessarily a part of State Water Project yield. Reallocation of intermittent yields among all five service areas would not significantly change the impact analysis.

Response 85

The report has been corrected.

Response 86

Discussion of the Two-Agency Fish Agreement has been revised to reflect the fact it was not signed. See "Mitigation for Impacts on Fish" in Chapter 5 and response to General Issue 4 in this chapter.

Responses 87 and 88

The sections on mitigation have been expanded in the final report. (See General Issue 4 in this chapter and "Mitigation for Impacts on Fish" in Chapter 5.)

Response 89

The discussion of the Cottonwood Creek Project has been updated in the final report.

Response 90

The paragraph has been changed in the final report.

Response 91

Deliveries to ground water storage could take place in months other than winter and spring; however, such deliveries would come from San Luis Reservoir and would affect its operation. The phrase "wet year increases" has been changed to include above normal years.

Cumulative effects on project operations with a ground water storage program are shown in Table 6-1, and wording has been changed to clarify the effects. Yield and environmental benefits from a ground water program are discussed in Response 4 to Comment Letter 18.

Response 92

It is true that desalting, demand reduction, conservation, and recycling south of the Delta would not cause the changes indicated during times of shortage. A footnote has been added to clarify this in the final report.

Response 93

The final report has been expanded to better describe construction related to ground water programs.

Response 94

Table 22 in the draft report includes only projected entitlement water deliveries to the contractors. These figures are those shown in Bulletin 132-81. The table is not included in the final report.

Response 95

Based on the assumptions discussed in Chapter 5 and used to compute these impacts, State Water Project potential shortages could be assumed to correspond to proportional reductions in income and employment.

Response 96

The updated operation studies include a 7,300 cubic foot per second alternative.

C—105594

C-105594

(See Chapter 3 "Physical and Operational Comparison of Alternative Operational Plans", Chapter 5 "Monthly Operational Changes", and Appendix B of the final report for discussions of updated operation studies.) They do not differ significantly from the adjusted studies used in the draft report.

Response 97

Appendix B of the final report shows the years and deficiencies from the updated operation studies.

Response 98

When statewide project operation studies are made to simulate operation with and without a proposed project such as the additional pumps, there are sometimes storage changes at project reservoirs at the beginning and end of the critical water supply period for different operation studies. Estimates of incremental yield account for storage adjustments.

Response 99

The intermittent delivery amounts shown in Table B-2 and Figure B-2 were maximums, assuming full implementation of ground water and surface water programs. Use of these amounts represented maximum Delta and service area impacts and maximum storage capabilities in ground water basins. This was to maximize estimated environmental impacts within the limits of planning uncertainty. Updated operation studies assume less future ground water storage capability (see Appendix B in the final report).

Response 100

In the draft report, the average annual usable intermittent export supply was determined by dividing the total intermittent export supply by the 50-year study period. This has been updated to reflect new operation studies. Ground water yield estimates in the final report are based on the critical water supply period, and annual average ground water yield figures are calculated for the 1928-1934 period. (See Appendix B.)

Response 101

The service area impact analysis in the draft report assumed that average annual intermittent deliveries stored in wet years would be available for extraction during an average dry-period year, and the volumes used were considered to be firm deliveries during a dry period.

The analysis in the final report is made on a dry-period basis.

Response 102

Incremental energy requirements shown in Figure B-2 of the draft report were for pumping 39 percent of the intermittent export supply through Dos Amigos Pumping Plant and 61 percent through Devil's Canyon Powerplant on the East Branch.

Response 103

Since there was no computer operation study for the proposed alternative, there were no comprehensive data for a graph. The figures were plotted by the computer directly from the study data.

In the final report, computer data from the updated operation studies are shown in Appendix B.

Response 104

See Response 21 to Comment Letter 26.

Responses 105 and 106

The report has been corrected.

Response 107

As stated, the power operation studies were made to quantify the on-peak power savings from the additional pumps. The Department uses power optimization studies in conjunction with statistical hydrology and variable demands to determine future power requirements for the State Water Project. These studies are constrained by monthly amounts of water available in the Delta for State Water Project export. These monthly amounts are determined from statistical analysis of historical monthly amounts, as determined in water supply studies. Use of historical amounts in the power studies would introduce an infinite variety of operational variables and is, therefore, not appropriate. Use of these studies is also discussed at the beginning of Chapter 5.

Response 108

Intermittent ground water deliveries were included in the power operation studies.

Response 109

In the draft report, the 3.203 million acre-foot target export demand for the State Water Project in Table B-1 was for the South Bay Aqueduct and the Dos Amigos Pumping Plant, south of San Luis Reservoir. This value did not include North Bay Aqueduct deliveries. Annual exports at Banks Pumping Plant fluctuate widely with water supply conditions and storage regulation at San Luis. Exports are greatest in wet years when San Luis carryover storage is low. Because of these variations, average annual pumping of water supplies was computed to be 3.57 million acre-feet rather than 3.203 million.

Average annual pumping quantities at Banks Pumping Plant (no-project alternative) were about the same in water supply studies as in power studies (3.57 million versus 3.43 million acre-feet). The difference is because studies were done separately with different conditions (discussed in Response 107) and some differences in assumptions. Differences are insignificant for impact analysis. Updated operation studies for the final report represent a similar comparison.

Response 110

Table B-7 in the draft report described four-pump operation. In the final report, the calculations are shown in Tables B-12 and B-13, and include this comment.

Response 111

Off-peak rate periods average half the month.

Response 112

The word "March" has been changed to "month".

Response 113

This is a 13-year average and applies to lines 1, 2, and 3. The report has been corrected.

Response 114

Nomenclature for the bays has been clarified in Appendix B of the final report.

Response 115

The value of the exponent has been corrected.

C—105596

C-105596

Response 116

The values of off-peak proportion have been corrected.

Response 117

The abbreviation "Exp" means exposed to the screen; this has been added in the final report.

Response 118

Firm State Water Project supply at the Delta is water that will be available with or without a ground water program and that can be delivered independently by the additional pumps. Ground water supply is intermittently available water that is pumped by Banks Pumping Plant but, after regulation through ground water storage, becomes a firm supply to service areas.

The service area impact assessment assumed this water as a firm supply. The ground water yield is realized only from ground water storage and the additional pumps. Ground water storage is somewhat uncertain at this time. Table C-1 in the draft report showed the incremental firm and intermittent yields associated with the various pump alternatives.

Response 119

"Average-year conditions" refers to the average annual incremental deliveries of water possible with the additional pumps; i.e., firm or critical period yield plus average annual intermittent deliveries. (See Response 118 for a definition of intermittent deliveries.) The term reflects the average incremental water supply upon which the benefits and costs were calculated. In projecting beyond 1990, it was assumed that the yield from the additional pumps would be constant.

Response 120

Power cost savings are a function of the number of additional pumps (two or four). Savings do not increase with the alternatives that include southern Delta modifications (see Table C-8).

Response 121

In the draft report the intermittent supplies were estimated on an average annual basis for both the economic analysis and the service area impact analysis. In the final report, the intermittent supplies were estimated on a dry-period basis. The term "intermittent yield" has been replaced by the term "ground water yield".

Response 122

Page C-1 of the draft report states: "Benefits and costs were analyzed only for the latter two purposes because it was difficult to quantify the lost pumping capacity and deliveries from future outages of the existing pumps." The final report expands on a discussion of outages and estimates potential standby benefits. See Chapter 3 (Economic Analysis) of the final report and response to General Issue 8 in this chapter, under "General Issues and Responses".

Response 123

The computer model used for the valuation of additional water to State Water Project contractors is an optimization model. It operates to maximize farm profitability based on available resources. Major parameters of the model include:

- Physical relationships between farm outputs (crop yields) and farm inputs (land, seed, fertilizer, water, fuel, etc.).

- The unit market value of the outputs and unit costs of the inputs.
- Quantities of the inputs available.

Changes in these parameters over the study period are incorporated into the model. The model also compensates for the market impacts of various levels of crop output by adjusting the unit value of the output accordingly. Land and climate constraints on crop suitability are also taken into account.

The model assigns a value to additional water (if the amount available is a barrier to increased income) by increasing acreage planted, changing crops grown, or both, whichever generates the greatest excess of income over expenses. At the point where increasing the water supply can no longer result in increased profits (e.g., all available land is used to its best advantage), the value of further increases drops to zero.

Response 124

As discussed on page C-2 of the draft report, State Water Project and local energy costs were determined by a computer program using the parameters discussed on pages C-6 and C-7, the yield allocations in Table C-2, and the local costs for distribution and treatment discussed on page C-17.

Response 125

In the final report, the economic analysis uses updated unit values for energy and capacity. Two sets of unit values are used:

- Low values for purchase. (This is the most likely).
- Higher values for plant construction. (These values were used for a sensitivity analysis).

Response 126

The report has been corrected.

Response 127

In the updated economic analysis, unit costs for energy and capacity with the water supply alternatives are the same as for the additional pumps.

Response 128

As worded in the memorandum cited in the footnote on page C-12 of the draft report, "retail cost" is the cost to the consumer.

Response 129

The report has been corrected.

Response 130

It is possible that the number used for energy generation could be less. These energy generation benefits represented less than 5 percent of total benefits (for all alternatives that develop additional supply); their reduction or elimination would not affect the conclusions drawn from the benefit/cost analysis. In the updated analysis, the value of Metropolitan's energy generation with additional State Water Project deliveries is based on the same unit costs, and was deducted from the local energy costs.

Response 131

Casitas watershed supplies are for Casitas Reservoir, a Federal development. These supplies were integrated into the South Coastal service area supplies, shown in Table C-5 of the draft report.

Response 132

The yields in Tables C-2 and C-5 were inconsistent. The values for State Water Project imports with additional pumps have been deleted in Table C-5 of the final report.

Response 133

In Table C-5 of the final report, imports by local water agencies are from Bulletin 160-83 (Figure 63). The Colorado River portion of these impacts are very close to those shown in Metropolitan's Report 947.

Response 134

The report has been revised.

Response 135

In this final report, changes have been made for mitigation, the fish agreement, and stocking costs. The agreement for the report will provide a method for mitigating for striped bass and chinook salmon based on actual yearly operations. Mitigation costs will be decreased with the additional pumps because of the shifts in monthly export patterns. These are discussed in Chapter 3 (Fish Mitigation Costs) and Chapter 5 (Mitigation for Impacts on Fish).

Response 136

In Appendix C of the final report, Table C-12, "Effect of East Branch Enlargement in the Analysis", has been deleted. The analysis now assumes the East Branch enlargement and ground water storage, with or without the new pumps.

Response 137

The report has been revised.

Response 138

As stated on page D-4 of the draft report, the service area impact analysis assumed implementation of the Department's prior conservation and reclamation goals, which were up to 600,000 acre-feet by 2000. The Department no longer reduces contractor requests to reflect the prior conservation and reclamation goals (see Response 30 to this comment letter).

Response 139

The final report states that the impacts represent average annual impacts resulting from the increased firm yield of the Banks Pumping Plant.

Responses 140, 141, and 142

The report has been corrected.

Response 143

The lack of cost information on the Colorado River banking program has been referenced in the final report.

Response 144

This footnote has been deleted in the final report. Figures used in the draft report were based on data from U. S. Census and the California Department of General Services.

Response 145

Air quality standards are the same throughout the State. This information has been added to the final report.

Response 146

The final report reflects this comment on instream programs.

Response 147

The report has been revised.

Response 148

Information in this comment has been added to the final report. Also, the impact assessment of water supply and demand reduction alternatives has been expanded (see Table 3-1 in the final report).

Response 149

Chapter 5 and Appendix D have been revised for clarification. The text now covers potential mitigation measures for service area impacts and local responsibilities.

Responses 150 and 151

The report has been corrected.

Response 152

The draft report discusses potential significant effects. The wording has been revised for the final report.

Response 153

The operation studies were made prior to the service area impact analysis. At the time, the latest available operation study was based on Bulletin 132-78. Service area impacts were based on the incremental yield of the pumps determined from the operation studies and are, therefore, consistent with the operation studies. The cumulative service area impacts do not depend on the operation studies. The latest available projected deliveries (Bulletin 132-81) were used to develop the cumulative values for comparing the relative magnitude of impact increases. Use of the latter projections did not affect evaluation of actual incremental service area impacts for each alternative operational plan. Updated operation studies reflect recent planning assumptions. (See Appendix B of the final report.)

Response 154

The report has been corrected.

Response 155

The 3.112 million acre-foot figure has been replaced with "projected amounts".

Response 156

The report has been corrected.

Letter 19
Commenting Entity:
Palmdale Water District
February 10, 1983

Comment noted. See responses to Comment Letters 26 and 27.

Letter 20
Commenting Entity:
San Francisco Bay Conservation and Development Commission
February 10, 1983

Response 1

The analysis in this final report demonstrates that four additional pumps operated under the preferred alternative achieve the highest net benefits. It also shows that all economic and other benefits described will occur without construction of additional State Water Project facilities. Other conditions can exist later depending on project development; this is discussed in Chapter 6 under "General Impacts of Additional Pumps With Potential Related Projects" and "Post-2000 Operation of Banks Pumping Plant Without Added Storage or Improved Delta Water Transfer".

See responses to General Issues 1, 2, 8, and 11 in this chapter, under "General Issues and Responses".

Response 2

The final report has been updated to reflect the fact that the Two-Agency Fish Agreement was not executed and to discuss other options including new negotiations being conducted to finalize a new agreement for preservation of fish at Banks Pumping Plant. The proposed agreement may place the operational constraints from the Corps criteria into a contract, with corresponding protection against change without appropriate agreement between both parties.

In any event, operations of the project much beyond the Corps constraints would require additional environmental review and involve the Corps process. The agreement will include other fish protective provisions that extend beyond operations with the additional pumps to compensate for fish that would have been in the estuary if Banks Pumping Plant had not been constructed. Operational restrictions included in the preferred alternative allow operations with justified benefits of highest net benefits, increased reliability, more efficient use of the project energy supplies, and operational flexibility that reduces direct impacts to many fish species.

See responses to General Issues 4 and 6.

Response 3

The economic analysis of the additional pumps has been updated to reflect the Department's operating experience as a utility. This has identified higher values for decreasing on-peak power use. The extraordinary conservation measures that were alternatives were determined to be implemented before the additional pumps could become operational under study assumptions. Therefore, those measures would be needed with the pumps to offset future shortages that would occur with no other development.

See responses to General Issues 8 and 9.

Letter 21
Commenting Entity:
San Gabriel Valley Municipal Water District
February 10, 1983

See responses to Comment Letters 26 and 27.

Letter 22
Commenting Entity:
Santa Barbara County Flood Control and Water Conservation District
February 15, 1983

See responses to Comment Letters 26 and 27.

Letter 23
Commenting Agency: Santa Clara Valley Water District
February 15, 1983

Response 1

See responses to Comment Letters 26 and 27.

Response 2

General Issue 9, in this chapter under "General Issues and Responses", discusses the use of water conservation in the environmental documentation process.

Response 3

The San Felipe Division will not increase Delta exports. The reference has been deleted from Chapter 6 in the final report.

Letter 24
Commenting Entity:
Solano County Flood Control and Water Conservation District
February 14, 1983

See responses to Comment Letters 26 and 27.

Letter 25
Commenting Entity:
Tulare Lake Basin Water Storage District
February 11, 1983

See responses to Comment Letters 26 and 27.

Letter 26
Commenting Entity:
State Water Contractors
February 15, 1983

Response 1

The final report reflects this information.

Response 2

The section on the proposed agreement of December 1982 has been deleted. The final report describes a new agreement that is the preferred mitigation option. Some provisions are similar, but the scope is different from the 1982 proposed agreement. See response to General Issue 4 in this chapter under "General Issues and Responses" and Chapter 5 under "Mitigation for Impacts on Fish".

Response 3

The response to General Issue 8 in this chapter addresses the 5 mills per kilowatt-hour differential as shown in the draft report. The value of the on-peak power savings in the final report has been updated to reflect the Department's operating experience as a utility. The differential value is now 10 mills per kilowatt-hour; added capacity values have also been identified.

Response 4

The discussion of State Water Project shortages in Chapter 2 of the draft report has been expanded and shifted to "Available Water Supply, State Water Project Demands, and Delivery Capabilities", in Chapter 1 of the final report. Also, in Appendix B, State Water Project deficiencies for agricultural and municipal and industrial purposes are shown for various years. These deficiencies were determined from updated operation studies analyzed in the final report for conditions of the early 1990s.

Response 5

The mention of "permanent shortage" in the draft report was not intended to indicate a permanent reduction in the contractors' entitlements. The report has been revised. Simulation studies of the State Water Project and Central Valley Project system for conditions during the early 1990s show State Water Project deficiencies in various years under water supply contract provisions and critical water supply conditions. These deficiencies are tabulated in Appendix B of the final report.

Response 6

The Departments figures on reductions in contractors' requests for entitlement water due to water conservation and reclamation are consistent with the contractors' demands. See responses 30 and 138 to comment letter 18B.

Response 7

See response to General Issue 9 in this chapter under "General Issues and Responses".

Response 8

Constraints in the proposed agreement have been deleted in the listing of operational considerations for the pumping plant and forebay in the final report. Updated information on an agreement is discussed in Chapter 5 and in response to General Issue 4 in this chapter.

Response 9

Impact assessments in the draft report for the eight alternatives evaluated are worse than will actually occur. Updated operation studies generally show less impacts than the previous studies. The environmental impact assessment in Chapter 5 of the final report is based on the updated operation studies, which reflect more effective operation of the State Water Project. The final report discusses these operations in more detail in Chapter 3 under "Efficient Operation of the State Water Project".

Response 10

See response to General Issue 10 in this chapter. The final report has been expanded for clarification. See "Hydraulic Constraints and Banks Pumping Plant Capacity" in Chapter 3.

Response 11

See response to General Issue 2 in this chapter. The final report discusses that the decision on the additional pumps at this time is for restricted operations with no additional permit; this should not be interpreted as limiting the Department from applying for a permit in the future and preparing additional environmental documentation. The benefits of the additional pumps were reviewed and were supportable without any other project facility; therefore, the added pumps can be operated with net benefits until the uncertainty surrounding future water resources planning is resolved.

Response 12

Assumptions in the draft report for increasing the monthly diversion rate were for operational impact assessment; they represented minimum improvements for short-term operations at a 10,300 cubic foot per second rate and were not meant to represent State Water Project development plans for full pumping. Assumptions of improvements for use of full capacity of the additional pumps (regardless of San Joaquin River inflows) have been changed in the final report to include improvements in some southern Delta channels to represent alternative types discussed in the Department report Alternatives for Delta Water Transfer (November 1983).

Response 13

The benefit/cost analysis contains operational advantages for the alternatives, which include power and yield benefits. The analysis for the draft report did not include standby savings; actual savings are difficult to predict. Chapters 2 and 3 of the final report discuss standby capacity and potential economic savings. See response to General Issue 8 in this chapter.

Response 14

The alternatives must be ones that develop benefits independent of the additional pumps. Storage facilities depend on the pumps and, therefore, they would be potential future projects in addition to, but not alternatives to,

the additional pumps. See response 12 to comment letter 18B and the introductory section to "Water Supply and Demand Reduction Alternatives" in Chapter 3 of this final report. See also responses to General Issues 2 and 9 in this chapter.

Response 15

See response to General Issue 9 in this chapter.

Response 16

Under the study assumptions, the more costly alternatives were used only for the Metropolitan Water District service area, and they would be implemented only after 2010, when large deficiencies are projected. Under such extreme conditions, given continued use of average cost pricing, such alternatives would probably be financially feasible. The economic analysis showed favorable cost advantages of the additional pumps over Imperial Valley conservation and transfer; drainage water desalting in San Joaquin Valley, Riverside County, and Imperial Valley; and ground water desalting. The draft report also noted that the water supply and demand reduction alternatives could not duplicate the operational advantages of the additional pumps.

Response 17

Concerns relating to the Suisun Marsh facilities are addressed in the final environmental impact report for the Suisun Marsh Plan of Protection (February 1984) and the agreement recently negotiated regarding the marsh.

The sections on Suisun Marsh in Chapters 4 and 5 of the final report on the additional pumping units have been updated, and the response to General Issue 7 in this chapter describes the relationship between the additional pumps and the marsh plan of protection. The additional pumps will have no significant impacts on the marsh, since it is protected by Delta outflows, physical facilities, and a monitoring program.

Response 18

See Response 12 to this comment letter and the response to General Issue 10 in this chapter under "General Issues and Responses". Velocities described in the draft report were based on a reconnaissance level hydrodynamic study. Assumptions on improvements in the southern Delta have been updated in the final report.

Response 19

The final report has been revised for clarity. Also, see "Comparison of Previous and Updated Operation Studies" in Appendix B, which addresses the Coordinated Operation Agreement, the Auburn-Folsom South Unit, and the Suisun Marsh facilities.

Response 20

Operation studies are set up to make best use of available water supplies. Best use includes filling of San Luis Reservoir, located south of the Delta, early in the water year. The rule curve for filling San Luis Reservoir in the operation studies for the draft report did fill the State Water Project's share of the reservoir in the beginning of many water years and, therefore, exports in later summer months were reduced below Decision 1485 permissible standards in May and June since supplies were not needed. Actual yearly operations may vary according to hydrology and contractors' requests that result in using permissible Decision 1485 exports. Updated operation studies used in this final report use an updated rule curve and show slightly different May and June exports.

C—105604

C-105604

In the final report, Table 5-2 shows monthly exports at Banks Pumping Plant only. Tracy Pumping Plant exports are shown in Appendix B.

Response 21

Delta outflows shown in Table 11 of the draft report were averaged according to five year types in Decision 1485 (wet, above normal, below normal, dry, and critical). Average outflows in May and June in all nine below normal years did meet Decision 1485 requirements for striped bass survival. Three of the years were actually designated "subnormal snowmelt" in the operation studies, as provided by Decision 1485 when the April through July unimpaired runoff is less than 5.9 million acre-feet. Outflow requirements for striped bass survival in subnormal snowmelt years are about 57 percent of those in years otherwise designated "below normal".

In the final report, Delta outflows from the updated operation studies, also averaged according to the five year types, are shown in Table 5-4 and Figure B-2. Four of the ten otherwise below normal years were designated subnormal snowmelt for determination of minimum outflow requirements in accordance with the Decision 1485 year classification.

Response 22

The changes do not occur as a result of export changes only. Export rates can indirectly affect flows in the Delta Cross Channel and Georgiana Slough by requiring a change in upstream reservoir releases for carriage water under regulated Delta flow conditions. This causes some changes in flows and water levels in the Sacramento River. Water levels in the Sacramento River affect Delta Cross Channel and Georgiana Slough flows. Southern Delta water levels are related to export rates, but do not significantly affect cross-Delta flow rates.

Response 23

This section in the final report now summarizes the report of the Striped Bass Working Group, including the factor of toxic substances. That report was not available when the draft environmental impact report was printed. The section also now discusses failure of the export/outflow relationship to predict striped bass populations since 1976. See discussion of "General Impacts on Striped Bass" in Chapter 5 and response to General Issue 3 in this chapter under "General Issues and Responses" section.

Response 24

The preferred mitigation option is a new agreement between the Department of Water Resources and the Department of Fish and Game. The new agreement would include fish improvement programs with priority on nonstocking provisions. See "Mitigation for Impacts on Fish" in Chapter 5 and the response to General Issue 4 in this chapter.

Response 25

Water conservation is discussed in the response to General Issue 9.

Response 26

The Department's plans are discussed in Chapter 6 and in the response to General Issue 2.

Response 27

Discussion of San Felipe has been revised and shifted to Chapter 1 of the final report, since it would not increase Delta exports.

Response 28

The cumulative impact chapter was intended to deal with reasonably foreseeable projects and programs affecting the Delta and the State Water Project service areas. Therefore, both desalting and water conservation are appropriate for this chapter.

Response 29

The 3.25 million acre-feet for the State Water Project shown in Table B-1 of the draft report was the assumed 1990-level contractors' export requirement in a normal year. Annual firm yield is considerably less. These demands were from Bulletin 132-78, with an adjustment due to conservation and waste water reclamation. With further reductions for conservation and reclamation, demands after 1990 are projected to increase slowly. In the updated operation studies, the demand has been decreased to 3.16 million acre-feet per year and includes similar reductions for conservation, reclamation, and other water management measures.

Many assumptions in these operation studies have been updated, particularly: (1) fully coordinated operation of the Central Valley Project and State Water Project, and (2) completion of the Auburn-Folsom South Unit by 1990. It is assumed that the most critical Suisun Marsh facilities will be operational by 1990. (See response to General Issue 7 in this chapter.)

Neither previous nor updated operation studies assumed a Delta water transfer facility. Carriage water requirements were incorporated into the operation studies. The 3.25 million acre-feet was the assumed normal year demand, not the yield. The studies assumed various deficiencies, which were further reduced by carriage water requirements.

Economic, environmental, and service area assessments have been revised to incorporate the results of updated operation studies. Revised firm yield estimates generally approximate those in the draft report. However, ground water yield estimates (intermittent yield in the draft report) are consistently less. Direct fish impacts are also generally less.

Updated operation studies, using the draft Coordinated Operation Agreement of December 1982, were developed too late to be included in the draft report. See Appendix B of the final report for a comparison of previous and updated operation studies.

Response 30

The Department agrees that assumptions for intermittent exports in the draft report probably overestimate Delta impacts. The more effective operation studies used for the final report generally show less impacts.

Letter 27
Commenting Entity: State Water Contractors Audit Committee
February 15, 1983

Response 1

Comment noted.

Response 2

The Draft Environmental Impact Report on the Proposed Additional Pumping Units identified the greater benefits of Alternative 4-10.3 over those of the preferred alternative. Table S-1 in the draft report showed substantial increases in firm and intermittent yield for Alternative 4-10.3. Table S-4 showed that Alternative 4-10.3 would have the highest net benefits. Table S-5 showed that young striped bass losses would be less than for all other alternative operational plans for the

C—105606

C-105606

additional pumps. This information in the summary tables was discussed in Chapters 3, 5, and 6 and Appendices B, C, and D of the draft report and is included in the final report.

The 10,300 cubic foot per second rate was used to evaluate operational impacts of the 4-10.3 alternative to emphasize impacts of maximum pumping constrained only by water supply. The 4-10.3 alternative would require, at a minimum, increased southern Delta channel capacity, which would cause some impacts. The total yearly volume of export under the 4-10.3 alternative would be the highest, and this would also have associated impacts.

Response 3

The basis for the limitation of 7,300 cubic feet per second was discussed in Chapter 5 of the draft report, under "Clifton Court Forebay Constraints". This estimate is for State Water Project exports and does not relate to sharing total diversion capacity with the Federal Tracy Pumping Plant. More information is presented on the 7,300 cubic foot per second limit in Chapter 3 (Alternative Operational Plans 2-7.3(Corps), 2-8.5(Corps), 4-7.3(Corps) and 4-10.3(Corps), Including the Preferred Alternative) and Chapter 5 (Operational Impacts, Conditions During the Early 1990s) of the final report. (See response 4 to this comment letter and response to General Issue 2 in this chapter under "General Issues and Responses" for Department's intentions on future operations of the pumps.)

Response 4

The Department recognizes its responsibilities under the Burns-Porter Act and the water supply contracts to supply contractual needs. Department planning for future facilities is geared toward meeting this obligation.

Department studies in connection with a Delta water transfer facility are discussed in Chapter 6 (Alternatives for Delta Water Transfer) of the final report and in response to General Issue 2 in this chapter. The report recognizes that a higher pumping rate would be necessary to maximize diversions from the Delta during periods of high flow to meet contract demands. If a facility were constructed, any necessary Corps of Engineers permit would be obtained at that time. In addition to the Burns-Porter Act, water resources planning must recognize other State and Federal laws such as water right laws, California Environmental Quality Act, National Environmental Policy Act, Davis-Dolwig Act, and Fish and Game Code.

Operation of the additional pumps under Corps constraints is, however, an economically viable project regardless of whether future facilities are built.

Response 5

Historical flows are not the only consideration in determining additional divertable flow. Estimates of divertable flows under Corps of Engineers criteria used in the environmental impact report are obtained from project operation studies that consider the many institutional, hydraulic, and water supply constraints that affect divertable flows. (See response to General Issue 10.)

Response 6

The final report recognizes the U. S. District Court Decision of December 30, 1982.

Response 7

The Burns-Porter Act did authorize a capacity of 10,000 cubic feet per second

for the California Aqueduct, and it has been built with that capacity. (See Response 4 to this comment letter and responses to General Issues 1 and 2.)

Response 8

On page S-1 and in Chapter 2, page 13, of the draft report, one reason given for installing and operating additional pumps is to provide standby capacity to compensate for scheduled and unscheduled outages of existing units. The final report discusses this in more detail. The updated text notes that the additional pumps could provide flexibility for canal lining failures, depending on where and when failures occur, and could possibly provide flexibility for outages of units at the Federal Tracy Pumping Plant. Inlet work at Clifton Court Forebay is not necessary to provide these benefits.

Response 9

The draft report described factors that have affected the complex environment of the Bay-Delta estuary (Chapter 6, page 91). Determinations of the Striped Bass Working Group have been included in the final report. (See Chapter 5 "General Impacts on Striped Bass" and response to General Issue 3.)

The fishery in the aqueduct system was discussed in Chapter 5, page 78, of the draft report.

Response 10

The preferred mitigation option is a new agreement between the Department of Water Resources and the Department of Fish and Game. The agreement would include fish improvement programs with priority on nonstocking measures. (See Chapter 5, "Mitigation for Impacts on Fish", and the response to General Issue 4 in this chapter under "General Issues and Responses.)

Response 11

The final report includes contractual commitment to conservation goals as one of several mitigation options, but it is not the preferred mitigation option. (See response to General Issue 9 in this chapter.)

Response 12

Structural works such as reservoirs or transfer facilities are not considered an alternative to the pumps, because they depend on the pumps to meet entitlement deliveries. Structural works are addressed with cumulative impacts in Chapter 6 under "General Impacts of Additional Pumps With Potential Related Projects". See Response 9 to Comment Letter 18B.

Response 13

The Department is aware of its obligations under the Burns-Porter Act and the water contracts. (See response 4 to this comment letter and response to General Issue 2 in this chapter.)

Response 14

Economic analysis was considered important to justify proceeding with the new pumps independent of any other addition to the State Water Project. (See response to General Issue 2 regarding the intent of the additional pumps.) In addition, an economic analysis is needed to fulfill basic purposes of the California Environmental Quality Act regarding public disclosures and reasons for approving a project that may have significant environmental effects. See Response 2 to this comment letter.

Response 15

The Department is aware of the financial obligations and realizes the economic

importance to the water supply contractors of receiving their full supply. Without other facilities, the additional pumps can reduce water shortages that could occur. Transfer and storage facilities are necessary for future State Water Project operations to meet the maximum annual contracted entitlement. See response to General Issue 2 in this chapter.

Response 16

The Urban Water Management Planning Act has set new requirements regarding conservation. The Department is reviewing this new direction and is investigating water conservation measures. Preliminary water management plans completed by the Department will assist State Water Project users to comply with the Urban Water Management Planning Act. These preliminary water management plans were prepared after the draft report was printed; therefore, specific information on the plans was not included. The final report provides information on these plans and on recommended water conservation measures (Chapter 5 and Appendix F).

Response 17

The Department believes that the draft report demonstrates a need and justification for proceeding with additional pumps at this time. This need is outlined in the Summary and in Chapter 2 of the report. (Also see Response 29 to Comment Letter 26.)

State Water Project water demands for the 1990 level used in the draft report were those shown in Bulletin 132-78 (Table B-5), which included a reduction for conservation and waste water reclamation. Compared to 1990-level demands shown in Bulletin 132-81 (Tables B-5A and B-5B), demands in the draft report were not underestimated. Contractor requests in Bulletin 132-81 (Table B-5C) include similar reductions for conservation and waste water reclamation. These reductions have been compared to the Department's recommended water management plans developed for State Water Project contractors, and they are consistent. Carriage water requirements have not been overlooked and have been included in the operation studies to represent actual operations.

For the final report, the Department has revised the economic, environmental, and service area assessments to reflect results of updated operation studies that use current state water contractors' requests (Bulletin 132-81, Table B-5C). See response 29 to Comment Letter 26.

Letter 28
Commenting Agency: The California Fisheries Restoration Foundation
January 29, 1983

Response 1

Actual operation of the State Water Project will not increase water export by 61 percent, or more than 2.8 million acre-feet per year. Although the physical capability of Banks Pumping Plant would be increased from 6,400 to 10,300 cubic feet per second (61 percent), the estimated yield increase for the preferred alternative operational plan is about 60,000 acre-feet per year, as shown in Table S-1 of the draft report. Physical and institutional factors, such as hydraulic constraints and legal standards for water quality, will determine the actual increase in export water volume. (See response to General Issue 10 in this chapter, under "General Issues and Responses".)

Impacts associated with increased off-peak pumping, at night and on weekends, were included in the fish screen loss analysis (Appendix B of the draft and final reports).

Field testing at the Skinner Fish Protective Facility has demonstrated

that primary louver efficiency for striped bass is slightly better at night than in daylight at velocities below 2.5 feet per second and better during daylight hours at higher velocities. During daylight, efficiency of the secondary louvers for striped bass is generally better at lower velocities and inconsistent at higher velocities. Differences in combined efficiency of the primary and secondary systems are slight between daylight and dark. No similar data exist for chinook salmon. The fish impact assessment in the final report incorporates historical fish salvage data representative of pumping operations during both daylight and dark. See Response 18 to Comment Letter 30.

The fishery analysis in the final report is based on updated operation studies that reflect more effective operation of the State Water Project. The revised analysis shows less impacts on most fish species with additional pumps because exports can be reduced during peak abundance periods. Salmon is the major fish species that is adversely impacted; however, such impacts can be mitigated.

Other effects associated with additional pumps, as well as mitigation for significant impacts, are discussed in Chapter 5 in their respective sections. Updated information on fish impacts is also discussed in response to General Issue 3 in this chapter.

Discharge to the Bay-Delta estuary is no longer probable as a long-range solution to drainage problems in the San Joaquin Valley. A discussion of drainage problems and studies in the San Joaquin Valley has been added to Chapter 4 of the final report.

Response 2

When flows in the San Joaquin River are greater than 1,000 cubic feet per second from December 15 through March 15, diversions could be increased up to one-third of the flows in the San Joaquin River at Vernalis. San Joaquin River flows are an indicator of the times and to what extent the diversion could be increased; however, most of the increased diversions would still come from the Sacramento River and not the San Joaquin River. During this period, Delta outflow is high. This was discussed on pages 23 and 24 of the draft report. The report analyzed fish impacts associated with such increase in winter diversions, and impacts to salmon were identified as significant. Mitigation will be provided as discussed in the following response.

Impacts on fish, Delta outflows, and Delta outflow surges, which include the higher exports in winter, were discussed in Chapter 5 of the draft report. In the final report, the discussion has been revised to reflect results of the updated operation studies. See also response to General Issue 11 in this chapter for discussion of concerns that exports should not be increased until impacts of Delta outflow on fish are understood.

Response 3

See responses to General Issues 4, 5, and 11 in this chapter under "General Issues and Responses".

The level of protection provided under Decision 1485 was adopted by the State Water Resources Control Board to be a reasonable level until final determinations are made concerning a Delta water transfer facility or other means that can provide additional benefits for fish. The preferred mitigation for the proposed additional pumps is in addition to Decision 1485 protection; it focuses on impacts of Banks Pumping Plant and accounts for significant direct fish impacts, as presented in Chapter 5 (Mitigation for Impacts on Fish) of the final report.

The preferred mitigation option discussed in the final report and in response to General Issue 4 compensates

for not only the incremental fish impacts of the additional pumps, but for the direct loss impacts associated with the existing pumps, including impacts to fish that would have been in the estuary if Banks Pumping Plant had not been constructed. This option includes a variety of fish improvement programs with priority on nonstocking measures. State Water Project full and incremental impacts are discussed in Chapter 5 of the final report and also in the December 1982 Final Environmental Impact Report on the Agreement to Manage Fish and Wildlife Resources in the Sacramento-San Joaquin Estuary.

Historical data from Skinner Fish Facility were applied in the impact analysis. Information such as provided by the graphs on fish passage at Red Bluff are being carefully reviewed to assure necessary fish protective measures in the Sacramento River.

Response 4

Section VIII of the proposed Two-Agency Fish Agreement (December 1982) specified that if Banks Pumping Plant capacity is increased, the Department will not propose increasing exports above those specified in the Corps of Engineers criteria, unless the Department of Water Resources and the Department of Fish and Game agree on additional operational constraints and upgraded fish screens to comply with the goals of the agreement. If agreement on screens cannot be reached, the section does not specify that the pumps are to be shut down, but the Department of Water Resources cannot propose to exceed Corps criteria that limit project export. (See response to General Issue 4 regarding the modified Two-Agency Fish Agreement.)

Pumping levels to protect striped bass were specified by the State Water Resources Control Board in Decision 1485. The Board will continually assess data collection and evidence that concern fish and export rates. For instance, the Board will consider results from studies recommended by the Striped Bass Working Group. The Board has authority to modify Decision 1485, and the State Water Project will be operated to satisfy any valid standards.

Response 5

The Department of Fish and Game recognizes four strains of chinook salmon that migrate into the Sacramento River: fall run, late fall run, winter run, and spring run. They migrate as depicted in Figure 8 in the final report (the late fall run is incorporated into the fall run). Runs are so classified because of the similar behavior exhibited by individual fish in the run. The fall run is largest, averaging about 200,000 adults in recent years; the winter run averages 30,000 adults, the late fall run averages 17,000, and the spring run averages 11,000.

It is not possible to differentiate between runs of juveniles migrating to the ocean, although winter run juveniles start to migrate first, followed by spring run, fall run, and late fall run fish. Most juvenile migration is in spring and early summer for all runs; therefore, fish would be affected by any of the factors influencing survival in proportion to their abundance.

General impacts on all Bay-Delta game, nongame, resident, and anadromous fish are discussed in Chapter 5 of the final report. In addition, information has been added that quantifies the salvage impacts of these fish at the Skinner Fish Facility.

Response 6

The section "Impacts Evaluated with Insufficient Information to Determine Significance" in Chapter 5 relating to fish in San Francisco Bay has been expanded. See Response 23 to Comment

Letter 1. See also response to General Issue 11 in this chapter.

Response 7

The magnitude of American shad losses caused by the project is unknown. Information on salvage is shown in Tables S-7 and 5-17 of the final report. Shad are difficult to handle, and any salvage system that requires trucking shad causes damage. No information is available that would allow an analysis of juvenile American shad losses and their relationship to the size of the adult population. Department of Fish and Game unpublished data show that abundance of juvenile American shad is directly correlated with riverflow rates during spawning and nursery periods. The updated impact analysis shows that additional pump alternatives will shift exports away from high abundance periods to decrease exposure of shad to the fish screens, resulting in reduced losses. For the preferred alternative, the decrease is about 7.5 percent for American shad. The population is expected to remain high. There is now no effective means of mitigation, but this does not preclude mitigation if appropriate methods are learned. (See Chapter 5 "General Impacts on American Shad" of the final report).

Response 8

See Response 1 to this comment letter.

Factors known about the determination of sturgeon year class size were discussed under "Impacts on Sturgeon", page 76 of the draft report. Knowledge is limited, but exports in May may influence sturgeon. Factors affecting sturgeon life cycles in other months are not known.

Computed salvage for sturgeon at the Skinner Fish Facility was reduced slightly for project operation with additional pumps. The final report found no significant impacts on sturgeon from operating the additional pumps.

Response 9

The high capital expense of moving the screens to a location near the intake gates (assuming it is possible from an engineering standpoint) makes a predator control program in the forebay the most appropriate action. A new location for the fish screens would cost about $100 million. There would still be handling and hauling losses and losses due to the dead-end flow situation at the screens. Without Federal participation in a common fish screen and export location, relocation would not be effective. It has not been determined that relocation would be an improvement.

The Department of Fish and Game believes that rescue programs show little promise of success and would be expensive, if measured by the number of fish returned to the Delta. Further, any rescue program would counter the recognized fishery benefits in the aqueduct system. Rescue programs and relocating the screens are discussed in Chapter 5 (Other Mitigation Possibilities) of the final report.

Response 10

As explained in Response 1 to this comment letter, the 2.8 million acre-feet is not a valid number. The increased yield of about 60,000 acre-feet per year for the preferred alternative is available for export because additional pumps would allow increased use of unregulated water. This firm yield amount would remain constant in the future, since it is controlled by available water supplies. Nonfirm average exports for non-critical water supply can be as high as 90,000 acre-feet per year in the future as demands build. Exports with future facilities and an approved permit and environmental impact report can be higher. North Coast

C—105612

C-105612

rivers, including those protected by Senate Bill 107, are not included in present planning of facilities to provide yield for the State Water Project. This is discussed in Chapter 6, "Onstream Storage North of the Delta".

Letter 29
Commenting Entity: California Waterfowl Association
January 5, 1983

Response 1

Changes in pumping schedules with additional pumps are not expected to affect waterfowl use of Clifton Court Forebay. Forebay simulation studies show increased fluctuation on weekends, due to increased off-peak pumping, and decreased fluctuation during the week. Such changes are not expected to disturb waterfowl using the area.

Response 2

Recreational opportunities at Clifton Court Forebay should not be affected by changes in pumping schedules. The body of water remains essentially the same at all times, although access to the shoreline is restricted by muddy banks when the forebay level is low. The limits of fluctuation are not expected to differ among the alternatives.

Response 3

Concerns relating to the Suisun Marsh facilities are addressed in the final environmental impact report for the Suisun Marsh Plan of Protection (February 1984) and the agreement recently negotiated regarding the marsh.

The sections on Suisun Marsh in Chapters 4 and 5 of the final report on the additional pumping units have been updated, and the response to General Issue 7 in this chapter describes the relationship between the additional pumps and the marsh plan of protection. The additional pumps will have no significant impacts on the marsh, since it is protected by Delta outflows, physical facilities, and a monitoring program.

Letter 30
Commenting Entity: Delta Environmental Advisory Committee
February 3, 1983

Response 1

The Department has updated this final report to improve the impact analysis. The insight and technical matters provided by this letter were a major source for the updating.

Institutional, physical, and water supply constraints that limit divertable State Water Project supplies are discussed in Chapter 1 "State Water Project Operation" and in the response to General Issue 10 in this chapter under "General Issues and Responses". The environmental analysis of the additional pumps in the final report encompasses ten alternative operational plans. The analysis shows specific details about changes in State Water Project operations, including more use of lower off-peak power rates. Chapter 5 (Mitigation for Impacts on Fish) of the final report includes a mitigation option that investigates changes in off-peak pumping to benefit fish.

Responses 2, 3, and 4

In Chapter 5 of the final report, "General Impacts on Striped Bass" has been modified based on comments and determinations by the Department of Fish and Game in connection with mathematical correlations for the striped bass index. The final report still considers exports and outflows in May, June, and July as an important factor in the qualitative evaluation of general striped bass impacts. The section "Impacts on Fish

Salvage Operations" has been replaced by the section "Direct Impacts of the Delta Complex on Striped Bass, Including Eggs and Larvae", which now includes entrainment estimates for striped bass eggs and larvae. See responses to General Issues 3, 4, and 5 in this chapter, and Response 6 to Comment Letter 31.

See also General Issues 1 and 11 for a discussion of proceeding with the additional pump installation prior to resolving fishery problems. Operation of the pumps under the preferred alternative has some environmental and water supply benefits and does not preclude further efforts to benefit fish.

Response 5

The draft report summarized available information on the effects of the present project and additional pumps on striped bass. The final report expands and updates this information (see response to General Issue 3 in this chapter). The Department will continue to participate in studies and experimental operations to provide more information on factors affecting striped bass.

Response 6

The impact analysis in Chapter 5 has been expanded to include more analysis of impacts on other fish. See response to General Issue 3 in this chapter.

Response 7

The proposed Two-Agency Agreement has not been signed. The mitigation in Chapter 5 has been expanded to consider other measures. See also General Issue 4.

Response 8

The Department has authority to increase export pumping within appropriate water right and other constraints, including Decision 1485, established by the State Water Resources Control Board. Decision 1485, the subject of a final environmental impact report dated 1978, established outflow requirements and export constraints for the State Water Project. Testimony during Decision 1485 hearings documented buildup in demands for State Water Project deliveries.

Historical and future export rates and amounts are shown in Chapter 5 (Monthly Operational Changes). As demands increase, existing pumps will be used at or near capacity more often, subject to water right constraints. During critical periods, however, firm yield and exports will decrease without further development. With additional pumps under the preferred alternative, exports would increase by about 60,000 acre-feet per year during a critical period.

The State Water Resources Control Board has authority to modify Decision 1485, and the State Water Project will be operated in accordance with any new valid standards.

Response 9

Estimates of entrainment cited in this comment were based on densities of eggs and larvae in 1978 and 1979, two years of relatively low abundance. Impacts on striped bass eggs and larvae contained in the final report are based on Department of Fish and Game data that cover a longer base period and incorporate years of higher abundance. The draft report discussed eggs and larvae qualitatively; the final report provides quantitative information.

As pointed out in the Striped Bass Working Group report, aside from knowing that the numbers entrained are high, the resultant impact of such losses on the adult striped bass population is not understood. Computed historical (1968-1977 excluding 1974) yearling equivalent losses of striped bass corresponding to losses of eggs and larvae are about

C—105614

C-105614

70,000 per year. This loss of eggs and larvae is not large when compared to the total estimated yearling population. See Table 5-15 in Chapter 5 for estimates of impacts on eggs and larvae for the alternative operational plans during the early 1990s. The preferred alternative would reduce effects on striped bass as compared to the no-project alternative.

Response 10

It is true that stocking hatchery-reared striped bass in the estuary is experimental; however, experimental stocking was one of the recommendations of the Striped Bass Working Group. Because the evidence points to a problem in striped bass early life history, the Department of Fish and Game believes that bypassing that portion of the striped bass life cycle with hatchery production is likely to be successful. This would augment, rather than negate, the need for other forms of protection, such as adequate outflows. Evidence that stocking will succeed can be garnered only by carrying out such a program and evaluating its effects. See response to General Issue 5 in this chapter.

Response 11

The draft report addressed impacts of increased off-peak pumping and increased winter diversions. Operational alternatives that use the pumps at full capacity were also evaluated in Chapter 3 under "Alternatives 2-8.5 and 4-8.5" and "Alternatives 4-10.3" in the draft, and same chapter under "Alternative Operational Plans 2-8.5 and 4-8.5" and "Alternative Operational Plan 4-10.3" in the final report. With respect to full-time pumping operations, see response to General Issue 10 in this chapter. The discussion of cumulative impacts in Chapter 6 has been expanded for clarification. See response to General Issue 2.

Response 12

The State Water Resources Control Board considered Decision 1485 standards reasonable when enacted. The underlying principle of these standards is that water quality in the Delta should be at least as good as would have been available had the State and Federal projects not been constructed, as limited by the constitutional mandate of reasonable use. The standards include adjustments in levels of protection to reflect changes in hydrologic conditions under different water year types. The Board recognized that the standards for fish would not provide without-project conditions, but deemed it unreasonable to require total mitigation.

Uncertainty in connection with the striped bass decline makes it difficult to ascertain what, if any, changes are required in Decision 1485. The Department will participate in experiments to provide more information on factors affecting striped bass. All findings to date concerning the striped bass decline are inconclusive with respect to the cause or causes. If the decline is due to toxic pollution in the estuary, the projects would not necessarily be responsible, and Decision 1485 standards or even greater restraints might not help.

The State Water Resources Control Board will examine evidence from the experiments and may adopt new standards. State Water Project operation will be in compliance with any valid new standards.

Responses 13 and 14

The statements regarding the December 1982 agreement are not inconsistent with knowledge that stocking programs are still in an experimental stage. However, the 1982 agreement has not been included as a mitigation option in this final report; a modified agreement has

been proposed that would give priority to nonhatchery-related mitigation measures. See response to General Issues 4 and 5 in this chapter under "General Issues and Responses" and Response 10 to this comment letter.

Response 15

The California Environmental Quality Act requires identification of unavoidable impacts associated with the proposed project. The losses identified are those that would occur under the preferred alternative. As discussed in the section on unavoidable impacts, the mitigation proposed for the preferred alternative would not only mitigate for incremental impacts of the preferred alternative, but would compensate for fish that would have been in the estuary if the Banks Pumping Plant had not been constructed. See Response 10 to this comment letter on stocking.

Response 16

The striped bass index is no longer used to predict abundance levels.

Response 17

See Response 12 to this comment letter. This is discussed in the text of the Introduction and the section on striped bass in Chapter 5.

Response 18

Daily pumping changes with the preferred alternative would not significantly affect juvenile migrants over a 7-day average. Such changes would consist of increasing the average rate on weekends and at night and decreasing the average rate during weekdays. These changes represent exports from the forebay and not Delta channels. Diversions into the forebay cannot exceed historical levels for non-winter months. These changes will not significantly alter the average 7-day volume diverted into or pumped from Clifton Court Forebay. Half the hours in a week are off-peak and half are on-peak.

Net flows in Delta channels are not expected to be significantly different, based on daily pumping schedule changes with the additional pumps. (See "Daily Operational Changes at Clifton Court Forebay" in Chapter 5 of the final report.) This is because the reaction time between net flow changes and exports is buffered by Clifton Court Forebay and the cancelling effect of lower weekday pumping with higher weekend pumping.

The paragraph in question has been revised to state that entrainment of juvenile salmon into Clifton Court Forebay is a function of their average monthly density in the water, an assumption supported by salvage records. Fish densities have been calculated on a monthly basis from salvage records at Skinner Fish Facility. Entrainment numbers for any given day, week, or month are considered to be the product of density and diversion amounts. This, together with the unchanged 7-day volume, is the basis for the statement concerning entrainment of juvenile migrants during the spring under the preferred alternative.

The increased proportion of pumping at night may aid in reducing losses of entrained salmon. Some studies show more movement of salmon during dark hours than daylight. Pumping during this active period would increase the rate at which the salmon are moved from the forebay to be salvaged at Skinner Fish Facility. Since predation losses for salmon are higher than salvage losses, removing fish as quickly as possible could reduce predation losses. However, this factor could not be estimated in the direct loss calculations for chinook salmon.

C—105616

C-105616

Responses 19, 20, and 21

A Department of Fish and Game memorandum, attached to Appendix B, presents data on density of eggs and larvae in the central Delta for 1968 through 1977, excluding 1974, then uses these densities to estimate entrainment for each of the years. Historical and projected 1990 entrainment are discussed in "Direct Impacts of the Delta Complex on Striped Bass, Including Eggs and Larvae" in Chapter 5.

Discussion of the striped bass life history has been expanded in the final report. Further details are in the Final Environmental Impact Report on the Agreement to Manage Fish and Wildlife Resources in the Sacramento-San Joaquin Estuary, December 1982, incorporated by reference.

The section "General Impacts on Striped Bass", expanded in line with these comments, indicates that scientists are not clear as to the cause of the decline of striped bass in the Delta. Various factors, including project operations and pollution, have been identified.

Response 22

The final report lists these factors that affect the number of bass that survive to become adults:

- Egg viability and number.
- Losses at diversions.
- Habitat size and suitability.
- Food supply.
- Predation.
- Competition.
- Pollution.
- Disease.

High critical year salinities in the lower San Joaquin River during spawning can affect egg survival. The discussion of these effects and egg survival in the laboratory has been retained in the final report. Reduced egg survival or viability due to high critical year salinities was one factor considered in evaluating the alternative plans.

Salinity standards to protect striped bass spawning in the lower San Joaquin River were a major component of Decision 1485. There is no question that fish produced there contribute to the number of adult bass in the estuary. The issue was not addressed by the Striped Bass Working Group in 1982 because the standards have been met and the group's charge was to investigate the causes of the decline. The fact that the condition has not been limiting in recent years does not negate its value in maintaining suitable conditions for striped bass spawning in the lower San Joaquin River.

Response 23

The striped bass index has been eliminated in the final report. See response to General Issue 3 in this chapter under "General Issues and Responses".

Response 24

Current impacts of pumping on striped bass were discussed on page 78 of the draft report and under "Direct Impacts of the Delta Complex on Striped Bass, Including Eggs and Larvae" in Chapter 5 of the final report.

In the final report, projected 1990-level monthly exports at Banks Pumping Plant for all the alternatives, including no project, are compared with actual exports in 1982. Estimated average annual losses of striped bass yearling equivalents of screenable size fish with the existing pumps (the no-project alternative) are 950,000 in 1982 and 1,425,000 in 1990. Both levels of development are based on Decision 1485.

The text on page 56 of the draft report has been clarified in the final report

("Monthly Operational Changes" in Chapter 5) to indicate that average monthly exports would be higher for most months in 1990 under the no-project alternative.

Response 25

Many factors in connection with young striped bass abundance and corresponding impacts have been updated in Chapter 5 and discussed in response to General Issue 3. One factor considered in comparing general fish impacts of the preferred alternative is a qualitative assessment of exports and outflows during May, June, and July. Export and outflow during this period are considered important for young-of-year striped bass. Losses in yearling equivalents at the Delta Complex are shown for the preferred alternative in Table 5-15. The updated studies used in this final report show reduced direct losses under the preferred alternative. These are due mainly to decreased diversions during June, July, and August. This more than offsets increased diversions during winter.

Figure 8 in the draft report was intended to indicate trends in daily operational changes with additional pumps to maximize off-peak power, without changing 7-day average or monthly export volumes. The plots in that figure were made from previous hourly forebay simulation studies that are not comparable with the updated 1990 level monthly operation studies of the State Water Project.

To eliminate confusion in the final report about improper study comparisons, Figure 8 has been replaced with Table 5-3. This new table shows typical daily variations in diversions into Clifton Court Forebay, based on the average monthly exports determined in the updated studies. From May to September, monthly exports under all alternative operational plans are less than 3,200 cubic feet per second. This means that all pumping could be off-peak during those months, with or without the additional pumps.

The effects of daily operational changes on fish entrainment are discussed in Response 18 to this comment letter. The discussion of all fish impacts has been expanded in Chapter 5.

Response 26

See Responses 3 and 12 to this comment letter and responses to General Issues 3 and 11 in this chapter under "General Issues and Responses". Table 18 (Striped Bass Indices) has been deleted.

Response 27

The movement of water (and fish) through the Delta is not instantaneous; it takes several days to enter and leave the area as outflow or export. Therefore, fish drawn across the Delta with export water are influenced to a much greater degree by the general flow pattern than by the stopping or starting of the State Water Project pumps during off-peak and on-peak periods.

Clifton Court Forebay is filled on a daily cycle, providing a buffer between the estuary and the State Water Project export pumps. Migratory fish such as salmon and shad are entrained based on the general export pattern (of several days to weeks duration) rather than on hourly pumping schedules. Response 18 to this comment letter discusses entrainment of fish on a daily, weekly, or monthly basis. Entrainment estimates based on mean monthly flows, such as in the operation studies, are used for impact analyses. Figure 8 has been replaced by Table 5-3. The final report presents annual salvage estimates for American shad and other fish (see Table 5-17), based on monthly exports under the various alternatives and on historical monthly salvage densities.

C—105618

C-105618

Response 28

The quantitative impact assessment has been expanded and now presents annual salvage estimates for American shad and other fish (see Table 5-17). In addition, Table 5-12 of the final report shows cross-Delta flow ratios for months of high American shad abundance. These flow ratios are an indicator of displacement from normal migration routes. They change very little with the additional pumps. Thus, there do not appear to be significant impacts.

Response 29

The preliminary analysis referred to was made by the Department of Fish and Game (unpublished). This is indicated in the final report. Information concerning the analysis is on file with that department. Variations due to May runoff conditions have been clarified in the final report.

Response 30

The quantitative impact assessment has been expanded and now presents annual salvage estimates for sturgeon and other fish (see Table 5-17), based on monthly exports under the various alternatives and historical monthly salvage densities.

Responses 31 and 32

The section in Chapter 5, "Impacts on Resident Fish", has been modified in response to this comment. While it is true that the Department of Fish and Game has studied a limited number of resident fish species, no comprehensive information on many of these species is available. Tables 5-7 through 5-20 show important information on over 30 resident and anadromous fish in the Delta that have been salvaged at the Skinner Fish Protective Facility.

In the final report, the sections on phytoplankton and aquatic invertebrates discuss food supply for fish. Although considerable information is available, the interrelationships between the many stages of the food chain are complex and not well understood. For this reason the overall impact of the project on food supply is classified as unknown.

Response 33

See Response 8 to this comment letter on how exports will increase with existing pumps. Export increases are based on continuation of Decision 1485 standards and constraints adopted in 1978. Decision 1485 allows for increased exports within the constraints of established outflow requirements and export limitations. If the State Water Resources Control Board adopts valid new standards, the State Water Project will be operated in compliance.

Response 34

See Responses 18, 25, and 27 to this comment letter.

Response 35

Pages 77 and 78 of the draft report discussed Neomysis mercedis. Chapter 5 has been expanded to include a section on food supply as a possible cause of the decline of striped bass (Overview of Fish Food Supply Impacts). No conclusions have yet been reached by the Striped Bass Working Group or any other group on export pumping and a lower food supply for fish in the Delta. Export pumping could be one of several causes.

Distribution of Neomysis is affected by the movement of water, since this species of invertebrate has limited swimming ability. Most of the mid-summer Neomysis population is found in the Suisun Bay area, which is related

to the position of the entrapment zone in that area (J. J. Orsi and A. C. Knutson, Jr., 1979, "The Role of Mysid Shrimp in the Sacramento-San Joaquin Estuary and Factors Affecting Their Abundance and Distribution", in San Francisco Bay: The Urbanized Estuary (Pacific Div. AAAS)). It is beneficial to have the entrapment zone in the Suisun Bay area, since its movement into the western Delta (at low Delta outflows) is always associated with decreased Neomysis abundance.

The effects of export operations on Delta flows are discussed on page 73 of the final environmental statement, Operation of the Delta Pumping Plant (U. S. Army Engineer District). The general effects are:

- Channels north of San Joaquin River (minor flow increases).
- San Joaquin River (reduced flows and frequent flow reversals).
- Channels north of Clifton Court (increased reverse flows).
- Southern Delta channels (increased net downstream flows).

The extent to which these flow changes have affected Neomysis populations is unknown. It is true that more Neomysis were found in the Delta before State and Federal water project operation; however, there is no correlation between Neomysis populations and internal Delta flow changes caused by export operations. The analysis in the final report found no significant impacts on Neomysis for the preferred alternative. Because of reduced entrainment during critical months, the preferred alternative may actually have various beneficial effects. This finding is based on Department of Fish and Game's current analysis of factors affecting Neomysis abundance and evaluation of direct entrainment of Neomysis. As discussed in Chapter 5, assessment of effects of the alternative operational plans on aquatic invertebrates, including Neomysis, is based on present knowledge of their abundance and distribution and on the effects of water project operation.

Response 36

The export increases are based on continuation of Decision 1485 standards and constraints, as discussed in Response 8 to this comment letter.

Response 37

See Responses 25, 27, and 35 to this comment letter.

Response 38

Direct entrainment losses have been updated in this report and now include unscreenable eggs and larvae. The estimate of 100 million striped bass losses does not account for yearly equivalent adjustments that account for natural mortality. Updated operation studies were used. See Responses 3 and 9 to this comment letter. See also response to General Issue 3 in this chapter under "General Issues and Responses" and "Direct Impacts of the Delta Complex" in Chapter 5.

Response 39

Concerns relating to the Suisun Marsh facilities are addressed in the final environmental impact report for the Suisun Marsh Plan of Protection (February 1984) and the agreement recently negotiated regarding the marsh.

The sections on Suisun Marsh in Chapters 4 and 5 of the final report on the additional pumping units have been updated, and the response to General Issue 7 in this chapter describes the relationship between the additional

C—105620

C-105620

pumps and the marsh plan of protection. The additional pumps will have no significant impacts on the marsh, since it is protected by Delta outflows, physical facilities, and a monitoring program.

Response 40

Expected changes in velocities in West Canal (from a maximum of 2.2 to 2.3 feet per second) were discussed on page 67 of the draft report. These velocities are below scouring levels. Velocity changes in other channels would be less. Information on velocities has been updated in the final. The Corps of Engineers will monitor operations when the additional pumps are installed, as required by a Federal District Court decision filed on December 30, 1982. This monitoring will pertain to effects on the course, location, and condition of Delta water. Velocity changes will also be considered for monitoring. Incremental velocity changes that could occur from the added pumps were evaluated under "Impacts on Channel Velocities, Scour, and Siltation" in Chapter 5, and were judged not to be a significant impact to fish. The small increases in velocity will be during winter periods, which are less critical to fish.

Changes in cross-Delta flows in connection with salmon and steelhead impacts were discussed on page 68 of the draft report and in "General Impacts on Salmon and Steelhead" in Chapter 5 of the final report, and found to be not significant because the additional exports would be during times of unregulated Sacramento River flows, when Delta Cross Channel gates are normally closed for flood control.

As discussed in Response 18 to this comment letter, entrainment of fish on any given day, week, or month is estimated as a function of average monthly fish density and diversion amounts. Discussion of effects caused by factors other than entrainment on the species mentioned has been expanded in the sections on general impacts in the final report. Entrainment is further discussed under direct impacts.

The list of incremental impacts found not significant has been updated to represent the expanded impact analysis in the final report. No new significant impacts have been identified.

Responses 41 and 42

Table 5-15 in the final report shows estimated entrainment losses and yearling equivalents for striped bass eggs and larvae under the alternative operational plans. These estimates are based on the updated operation studies, which reflect more effective operation of the State Water Project and show reduced direct losses for striped bass with additional pumps.

See Responses 3, 9, and 19 to this comment letter. See also response to General Issue 3 in this chapter under "General Issues and Responses".

Response 43

As discussed in Response 25 to this comment letter, Figure 8 was intended only to show trends in daily operational changes for various alternatives. In the final report, Table 5-3 replaces Figure 8. Over a 7-day period, no significant changes in diversions during April are expected with the additional pumps. The 7-day period is significant because of the relationship found by the Striped Bass Working Group between peak phytoplankton levels during the spring bloom and exports by the State Water Project and Central Valley Project 7 days before the start of the bloom (see Figure 17 in the Striped Bass report).

It is true that April may be a particularly important month for phytoplankton

development, and May and June may be important for generation of zooplankton food supply. The preferred alternative operational plan will not significantly change the 7-day average or monthly average exports for April, May, and June. The updated operation studies show reduced monthly exports in April, June, July, August, and September. The discussion on food supply has been updated and clarified. The interagency Phytoplankton Work Group conducted export management experiments in April of 1984 and 1985, but the results were inconclusive. Further experiments are scheduled for 1986 and 1987. Impacts are not now quantifiable because of a lack of information. The State Water Resources Control Board will examine evidence from these experiments and may adopt new standards. The project will be operated in compliance with valid standards, with or without the additional pumps. See responses to General Issues 1 and 3 in this chapter.

Overall interrelationships between factors affecting fish food supply continue to be studied, but are not well understood. A particularly important unknown aspect pertains to the food supply for young striped bass, which was discussed in Chapter 5 under "General Impacts on Striped Bass" and "Overview of Fish Food Supply Impacts".

Response 44

See responses to General Issues 3 and 10 in this chapter.

Response 45

See Response 10 to this comment letter and responses to General Issues 4 and 5 in this chapter.

Response 46

Chapter 5 in the final report (General Impacts on Salmon and Steelhead) includes a discussion on the effects of flow maintenance and hatcheries in the American, Feather, and upper Sacramento rivers during fall, winter, and spring salmon runs. The decline of salmon runs in the San Joaquin River system is also discussed.

Given the many environmental problems that have impacted salmon in the past century and a half, artificial stocking of juvenile salmon throughout the Pacific Northwest in general, and the Sacramento-San Joaquin system in particular, has supported and continues to support a considerable part of the overall resource. For example, the chinook salmon population in the American River is larger than it was before construction of Folsom Dam, due largely to hatchery production.

Response 47

The section referred to in the comment has been dropped from the final report for reasons discussed in Chapter 8. As discussed in Response 10 to this comment letter and in response to General Issue 5, stocking is judged to be an effective mitigation measure, but not the only measure.

Letter 31
Commenting Entity:
Environmental Defense Fund
February 10, 1983

Response 1

The draft report did explain the Department's intent regarding future pumping plant operations. It stated that the preferred alternative was to install four additional pumping units and to operate the pumping plant in a limited manner, which would for the most part not exceed historical maximums of pumping with existing pumping units. It stated that there were economic benefits that justified operation in this manner

C—105622

C-105622

regardless of the potential for expanding operation to the pumping plant's full capacity. It also stated the Department's intention to eventually operate the pumping plant at full capacity -- a development that would require additional facilities or dredging in the Delta. It noted that planning and political uncertainties made it impossible to determine at this time what such development would consist of and when it would occur.

The final report expands on some of these points. See "Planning Perspective" in Chapter 1 of the final report. The Federal permit process is discussed in response to General Issue 6 in this chapter, under "General Issues and Responses" and General Issue 2 addresses future operation with additional pumps.

Response 2

Input from the National Marine Fisheries Service and other organizations has been important to State water resources planning and has not been minimized in connection with planning for additional pumps. Public input associated with planning for the additional pumps is discussed in Chapter 1 of the final report. Recommendations of the National Marine Fisheries Service are discussed in Chapter 1, under "Regulatory Permits for Banks Pumping Plant, and Related Environmental Documentation", and in Response 2 to Comment Letter 1. The National Marine Fisheries Service provided information on the additional pumping units through testimony at a public hearing and by written comments on the draft report. (See Comment Letter 1.)

The Department of Water Resources shares with the National Marine Fisheries Service the objective of fishery protection for the estuary. The preferred option could provide a shift in exports away from periods of high fish abundance to periods of low abundance. This concept of timing was a National Marine Fisheries Service concern. One mitigation option uses the capacity of the additional pumps to modify export timing in a manner that further reduces fish impacts.

Fish screens were also an important concern of the National Marine Fisheries Service. The Department has invested millions of dollars and years of study to improve fish screens. This work has been fully coordinated with the Department of Fish and Game and Federal agencies such as the Fish and Wildlife Service. This work has advanced design and operational knowledge about screens. A direct result is the $4.5 million expenditure for upgraded screens at the Skinner Fish Protective Facility to reduce impacts of Banks Pumping Plant. Additional screens for fish protection are also being studied and will be a consideration in planning hydraulic changes in the Delta. The preferred mitigation measure -- a fish protective agreement with Department of Fish and Game -- includes screening large agricultural diversions as a potential mitigation measure.

Another request by National Marine Fisheries Service was to monitor impacts of Banks Pumping Plant operations on fish and provide measures such as hatchery production to replace losses. These points will be specifically covered in the agreement between the Department of Water Resources and the Department of Fish and Game for mitigation of Banks Pumping Plant, including the additional pumps.

A request by the National Marine Fisheries Service to limit annual exports would focus on fishery benefits by reducing project benefits to below no-project alternative levels. If this were done, there would be a negative economic benefit of the additional pumps to the State Water Project. However, two important steps have been taken in this area. The first, established by the State Water Resources Control Board, is to limit exports in May, June, and

July during peak fish abundance periods. The Department works with the Bureau of Reclamation to coordinate operation of both the Federal and State projects to maintain these limits. The second is extensive water conservation planning by the Department and actions taken by the Legislature to improve use of all project supplies. These actions reduce annual export buildup rates and the risks of dry year shortages.

Response 3

Cumulative impacts for additional potential storage and transfer facilities, which would make use of the additional pumps, were discussed in Chapter 6 of the draft report. This discussion has been updated and expanded to include water planning presented in the Department's report, Alternatives for Delta Water Transfer. The final report discusses impacts for operation of the additional pumps at full capacity with no increase in project storage facilities, as well as the preferred alternative, and that the preferred mitigation package builds in increased mitigation for increased diversions to cover full operation. Potential mitigation measures for cumulative impacts are also described in the final report. Anything more specific is not now possible, given uncertainty over possible future actions and their effects. See response to General Issue 2 in this chapter under "General Issues and Responses".

Response 4

The existing Banks Pumping Plant, including its maximum operation, is authorized by the nationwide permit for work completed before December 1968 (see copy of Public Notice 5820A, Amended, page 7 of the draft report).

The Department has reviewed the study results of the Striped Bass Working Group, as well as input from the State Water Resources Control Board and the Department of Fish and Game, and has found this information important in developing a planning approach for the additional pumps. However, no conclusion has been reached as to the cause of the decline in anadromous fish in the Sacramento-San Joaquin Delta, San Francisco Bay, and the continental shelf. The Department recognizes that Banks Pumping Plant is an important potential factor to study in connection with the decline.

The final report discusses the striped bass decline and related studies (see "General Impacts on Striped Bass" in Chapter 5) and factors affecting fish food supplies (see "Overview of Fish Food Supply Impacts" in Chapter 5). It also contains an expanded discussion of fish mitigation for the existing plant and for additional pumps (see response to General Issue 4 in this chapter).

Response 5

Correlations and assumptions used by the State Water Resources Control Board to develop Water Rights Decision 1485 have been reviewed by the Department of Fish and Game. It has been determined that the striped bass index values computed by June-July Delta outflows and exports are no longer valid. The discussion on this index correlation in Chapter 5, page 73, of the draft report has been updated to reflect these changes. In the final report, changes in summer outflows and exports are evaluated from a qualitative rating approach rather than a quantitative statistical approach.

The reason the index correlations have failed to predict recent conditions is not known. The reason may or may not be related to operation of Banks Pumping Plant. The abundance of young striped bass in Suisun Bay was highly correlated with the logarithm of June-July Delta outflow during the period from 1959 to 1976. The abundance of young striped bass in the Delta during that period was

C—105624

C-105624

correlated with exports (State, Federal, and local) and Delta outflow during June and July. Since 1976, the outflow/export relationships have failed to accurately predict the abundance of young striped bass in the estuary.

Several possible causes have been identified. They include possible project-related impacts and additional stress placed on striped bass by toxic substances such as petrochemicals and pesticides. If such pollution were the cause of the problems with the index correlations, then the assumptions used by the State Water Resources Control Board to develop Decision 1485 could still be valid. This topic and others related to water right standards are important, and the Department will participate with others in studies of the problem and during the upcoming public rehearing process to obtain improvements to existing standards, where the problems are project-related.

Response 6

Salvage and loss values for striped bass and chinook salmon in the draft report were computed for the purpose of comparing alternative methods of operation, and were not an estimate of absolute entrainment losses for the Delta Complex. Estimates in the draft report were based on data representing screenable fish only. This was explained in Chapter 5, page 80, and in Appendix B, page B-9 of the draft report.

To represent total fish entrainment impacts, three other factors must be considered: losses to predation in Clifton Court Forebay; losses due to handling or trucking; and losses of striped bass eggs and larvae. These factors were discussed in Chapter 5, pages 74 and 80, of the draft report. In the final report these factors are presented in Tables S-6 and 5-15. These results are based on updated operation studies that represent more efficient operation of the State Water Project. Calculations show about a 9 percent reduction of striped bass losses under the preferred alternative; however, chinook salmon losses would be increased by about 5 percent.

Total direct entrainment losses are not necessarily comparable to total fish losses in the estuary, because some of the entrainment losses may not have occurred during the normal life cycles of the fish. In addition, the Striped Bass Working Group report pointed out that even though losses of eggs and larvae at the pumps are high, the resultant impact on adult striped bass is unknown.

The estimates relating to 100 million striped bass lost are for eggs and larvae less than 38 millimetres long, and were based on density of striped bass eggs and larvae in 1978 and 1979, two years of relatively low abundance.

Entrainment estimates for eggs and larvae in the final report are based on Department of Fish and Game data that cover a longer base period and include years of high abundance. This more accurate value was computed for this report using historical data (1968 through 1977, excluding 1974). The historical yearling equivalent striped bass loss corresponding to entrainment of 100 million eggs and larvae for this period is about 70,000 annually. This loss is not large compared to the total estimated yearling population, which adjusts for natural mortality (see Table 5-15 for 1990 level estimates.)

Impacts on the food supply for larval striped bass cannot be analyzed with present knowledge. The Department is funding and participating in studies and experiments to provide more information on factors affecting the larval striped bass food chain.

Indirect fish losses through potential impacts on food supply or nursery areas were considered in calculations used to

evaluate total estuary fish impacts and were found to be small or unknown. In addition, indirect impacts were considered in developing the mitigation suggested in the draft report by requiring further studies and providing a method to extend negotiations. Also, mitigation goes beyond incremental impacts of the proposed agreement to mitigate for other impacts. Evaluation of total estuary impacts and mitigation for the additional pumps has been updated for the final report; indirect impacts are still included and discussed under the topics of general impacts. The section "Overview of Fish Food Supply Impacts" in Chapter 5 discusses the food chain.

In the draft report, total estuary fish impacts were evaluated by use of the striped bass index correlations described in Response 5 to this letter. This correlation was based on 15 years of data collected during periods of State and Federal project operations. The striped bass index has been considerably lower than predicted in recent years. This was explained in the draft report and (along with assumptions for application of the index) in the draft and final environmental impact reports for the agreement between the Department of Water Resources and Department of Fish and Game to manage fish and wildlife resources, cited in the draft environmental impact report.

The striped bass index was used for comparative purposes, and correlations provided by the index provide information about relative impacts due to changes in Delta exports and outflows from State Water Project operations. The index was dropped from the final report because the comparative basis caused confusion. Export and outflow changes in May, June, and July are, however, still one factor considered in the qualitative environmental impact analysis for striped bass (see Table 5-19 in the final report).

The total estuary fish impacts for the final report are evaluated differently; however, historical data are still used. Inherent in these data are indirect fish losses. The evaluation of total estuary losses for the final report does not use specific mathematic relationships between Delta exports/outflows and the striped bass index; the evaluation does use demonstrated trends between Delta exports/outflows and striped bass abundance to rank the impacts of the alternatives presented in the final report. This allows for a valid relative comparison, while recognizing inaccuracies of the existing specific mathematical equation.

The discussion on mitigation for the additional pumps has been expanded; the indirect losses have received consideration as discussed. (See General Issues 4 and 5 in this chapter, under "General Issues and Responses".)

Response 7

The fish impact analysis in the final report is based on updated operation studies that do maximize pumping when flows are high and exposure of most fish is low and minimize pumping during regulated flow periods of high abundance for most fish. Such operation is consistent with efficient operation of the overall State Water Project, including Lake Oroville and San Luis Reservoir; i.e., such operation does not adversely affect State Water Project deliveries or costs. The analysis shows a reduction in direct losses for most fish species, including striped bass, with additional pumps. Exceptions are chinook salmon and certain other species that are more abundant during winter.

In addition, the final report evaluates two restrictive mitigation alternative modes of operation that would further reduce impacts on fish, mainly striped bass. The associated loss of State Water Project benefits was also evaluated. The restrictions investigated consist of off-peak pumping curtailments and reduced export limits in May, June, and July in proportion to increased

C—105626

C-105626

winter exports. These two restrictive operations are discussed under mitigation alternatives, in Chapter 5. Also see the response to General Issue 4 in this chapter under "General Issues and Responses".

Additional facilities such as Los Banos Grande, which could, in conjunction with the additional pumps, make even more use of high flows when fish exposure is low, are discussed in Chapter 6. Such action would require further environmental documentation and Federal regulatory permits. See Response 7 to Comment Letter 1.

Response 8

In the final report, ten alternative operational plans are analyzed. Two plans were added because of the uncertainties about hydraulic constraints under the Corps criteria.

Response 9

Storage south of the Delta does appear to have economic and environmental benefits and is a planning priority. Preliminary studies show such storage facilities would require additional pumps to operate feasibly. Expansion of the pumping facility without such storage does provide a smaller level of economic and environmental benefits and does not preclude use of storage south of the Delta.

See Response 7 to this comment letter on annual export operations that minimize fishery impacts and Response 7 to Comment Letter 1 concerning additional surface storage south of the Delta.

Response 10

The National Marine Fisheries Service recommendations for operation of the present pumping plant maximizes fishery benefits by reducing project benefits to below no-project levels. If this operation were chosen, there would be a negative economic benefit of the additional pumps to the State Water Project. See Response 2 to Comment Letter 1. A similar reduced pumping alternative was analyzed in the Corps of Engineers' environmental statement on the Delta (now Banks) Pumping Plant (September 1980). This alternative, labeled "moderate reduction of pumping (70 percent of capacity)", essentially represented 1980-level entitlement deliveries by the State Water Project. It is summarized in the introductory section of Chapter 3, and the "Summary from the final environmental Statement for the Operation of the Delta Pumping Plant" is in Appendix A.

Response 11

Water supply and demand reduction alternatives are considered and analyzed as project alternatives, by themselves and in combination with the preferred alternative. These alternatives are discussed and analyzed on pages S-5 through S-7, 26 through 30, and in Appendix C of the draft report, and in the final report in Chapter 3 (Water Supply and Demand Reduction Alternatives) and Appendix C. The water supply and demand reduction alternatives are evaluated separately for cost and yield and for institutional and environmental problems. In addition, water supply and demand reduction alternatives were used to evaluate the economic benefits of the pumps by comparing yields and associated costs per acre-foot. This was shown in Appendix C, page C-9, of the draft report. Discussion of these alternatives has been expanded and updated in Chapter 3 in the final report.

Water conservation measures included in the water supply and demand reduction alternatives are extraordinary and are in addition to the ongoing conservation measures, which were included in the

operation studies and in the Department's recommended water management plans. These extraordinary measures are alternatives to water supply benefits of the additional pumps; however, they do not duplicate the operational advantages of the additional pumps for standby capacity and increased off-peak energy use.

See also response to General Issue 9 in this chapter.

Response 12

The draft report considered pricing reform and the impact of other alternative pricing mechanisms. Pricing was a part of the recommended water management plans initiated by executive order; these plans were discussed in Chapter 6, page 91, of the draft report and under "Water Conservation and Water Management Plans" in Chapter 1 of the final report. Specific conservation measures were not addressed in the draft report, because the recommended water management plans were not yet published. Specific conservation measures from the published plans are discussed in the final report.

The plans for Metropolitan Water District suggest that Metropolitan review the pricing mechanisms identified in this comment and implement them if such pricing rate structures can be used to encourage conservation without adversely affecting revenue.

Pricing measures and other urban conservation measures in the recommended water management plans were assumed to reduce contractors' requests by about 250,000 acre-feet per year in 1990, and represent water management efforts in addition to the pumps.

The recommended water management plans for Kern and Tulare water districts did not include agricultural pricing measures because these districts are already efficient in conserving water, and pricing mechanisms would result in no further water savings. The plans did identify other potential conservation measures for the districts.

Specific demand reductions from these types of measures are difficult to estimate because of many related variable factors. However, the demand reduction associated with the type of water conservation measures presented in the plans was included in the draft report alternative evaluations. This reduction was described on page 20 of the draft report ("Water Supply and Demand Reduction Alternatives" in Chapter 3 of the final) and was included in the project operation study results in Appendix B.

These updated 57-year, early-1990-level project operation studies incorporate reductions for ongoing water management efforts. Urban water conservation, the largest component, is estimated to be 250,000 acre-feet per year. The exact measures chosen are up to the individual districts and may include such measures as Metropolitan Water District pricing measures. Urban districts subject to the recently enacted Urban Water Management Planning Act will consider similar actions. More information on water management plans is contained in Chapter 1 and Appendix F.

Response 13

A water transfer between Imperial Irrigation District and Metropolitan Water District was investigated for the draft report (see pages S-6, 27, 28, 29, and C-13) and for the final report in Chapter 3 (Additional Imperial Valley Conservation and Transfer) and in Appendix C. This alternative was also discussed in a Department of Water Resources Southern District report, Investigation Under California Water Code Section 275 of Use of Water by Imperial Irrigation District, December 1981. This was cited in the draft report (Chapter 3, page 28). This conservation-transfer alternative was presented as a water supply alternative for a comparison of cost and yield

C—105628

C-105628

potential with the proposed additional pumps. Unit costs for this alternative were determined to be higher than those for the additional pumps.

The Department's preliminary water management plan for Metropolitan Water District discusses this transfer, the legal and institutional barriers, and limiting factors on availability of conserved water. The recommendation is:

> "Metropolitan, the State Water Resources Control Board, and the Department of Water Resources should pursue the possibility of obtaining part of the water conservation potential in the Imperial Irrigation District to reduce the need for State Water Project Delta water supplies in the Metropolitan service area."

Based on these reports and recent developments, the final report assumes about 330,000 acre-feet of water that potentially could be obtained from Imperial Valley water savings. It considers supplies from Imperial Valley in two parts: (1) up to 250,000 acre-feet as a projected supply in Metropolitan's service area, and (2) an additional 180,000 acre-feet as an alternative to the additional pumps. The updated cost estimates show that the measures needed to get the additional 180,000 acre-feet would be more expensive to the consumer than would the additional pumps when water quality and energy are taken into account.

The Department supports the cooperative water salvage studies and negotiations. The greatest value of the salvage program would be to offset some of Metropolitan's Colorado River entitlement losses.

Response 14

The intermittent yield amounts in the draft report represented estimates of the abilities of local agencies to regulate the intermittent supplies to a usable schedule within a given year. The intermittent yield figures did not necessarily reflect yield that would be available to the State Water Project or to local agencies through long-term storage programs. The final report shows intermittent yield calculations in Appendix B.

Alternative operational plans presented in the draft and final reports analyze storage south of the Delta, including ground water storage. The alternatives show a positive benefit/cost ratio and independent utility for installation and operation of the additional pumps with present State Water Project storage south of the Delta. In addition, evaluation of these alternatives demonstrates that operation of the additional pumps would shift exports away from summer months of high fish abundance toward winter months of low fish abundance, thereby reducing direct impacts on striped bass and many other fish species. This would occur with or without additional ground water storage and within the diversion limits established in Corps of Engineers Public Notice 5820A, Amended.

In the final and draft reports, ground water considerations were included in economic and environmental analyses assuming that ground water development would occur in addition to the additional pumps rather than as an alternative to the additional pumps. This is because feasibility of ground water and conjunctive use is aided by the additional pumps.

Long-term Department planning includes ground and surface water storage south of the Delta. This planning assumes installation and operation of additional pumps and a Delta water transfer facility. Impacts of "Offstream Storage South of the Delta" are discussed in Chapter 6.

Additional offstream storage south of the Delta would provide operational flexibility in timing Delta diversions to meet seasonal needs of various fish, as well as increasing project yield. In

May 1984, the Department prepared a progress report, Alternative Plans for Offstream Storage South of Delta, which recommends that future studies focus on feasibility of Los Banos Grandes Reservoir, just south of San Luis Reservoir. The Los Banos Grandes Reservoir has been authorized, and intensive feasibility studies are underway.

Response 15

The report mentioned in the comment was a preliminary version. In August 1984, the Department issued Bulletin 160-83, The California Water Plan-Projected Use and Available Water Supplies to 2010, and Bulletin 198-84, Water Conservation in California, both of which also discuss ground water storage.

Ground water storage programs will be vital in future management of the State Water Project. Traditionally, ground water in California has been managed by local agencies. Department planning for ground water is based on that concept. This planning is to help local managers better operate the ground water basins in conjunction with State Water Project supplies. Bulletin 132-83 (pages 25-26) describes the status of studies for ground water storage programs. Planning for ground water storage programs will need the operational flexibility of the additional pumps to divert winter flows to permit such programs to be significant and feasible on a long-term basis. The Department and legislature are moving forward to make such programs work, and believe such programs will be needed in addition to, rather than as an alternative to, the additional pumps. Contractual agreements for operation and use of supplies will be negotiated as needed for feasible programs.

Response 16

The discussion on mitigation for the additional pumps has been expanded to account for:

- The fact that the 1982 proposed agreement between the Department of Water Resources and the Department of Fish and Game to manage fish and wildlife resources in the Bay-Delta estuary was not executed.
- The recent publication of water management plans for various State Water Project contractors.
- Comments received on the draft report.
- Changes by the Department of Fish and Game to update computations of fish impacts associated with additional pumps.
- Analysis of the updated operation studies.

The updated discussion on mitigation for additional pumps includes the following mitigation alternatives, all of which include Decision 1485 as a base condition:

- State Water Project operational changes to reduce direct fish losses at the Skinner Fish Protective Facility by making more efficient use of winter flows.
- An agreement between the Department of Water Resources and Department of Fish and Game for the preservation of fish in relation to Banks Pumping Plant. This includes: mitigation for fish that would have been in the estuary if Banks Pumping Plant had not been constructed; mitigation for ongoing operation of the existing pumping units; and mitigation for the additional pumping units.
- Stocking program by the Department of Water Resources without a specific agreement.
- A contractual commitment to meet conservation goals by State Water Project contractors based on the water management plans and other things.

Mitigation options are explained further in Chapter 5 (Mitigation for Impacts on Fish) of the final report and discussed in General Issue 4 in this chapter.

The preferred alternative identified in the draft and final reports does include the pumps in combination with a number of items discussed in the Environmental Defense Fund letter, including:

- Operation of the pumps to reduce direct impacts to striped bass and many other fish species through more efficient use of winter flows.
- Conservation, including pricing measures, built into determinations of need for water.
- Water transfers, built into determinations of supply of water available.
- A fish mitigation agreement that will compensate for the direct incremental effects of additional pumping units, for most effects of the existing pumping units, and for fish that would have been in the estuary if Banks Pumping Plant had not been built.
- The potential for additional improvements if additional surface and ground water storage south of the Delta is implemented.

Response 17

Decision 1485 protective standards were used as a base condition to compare impacts of operational alternatives because they represent no-project conditions. All alternatives and mitigation measures include Decision 1485 as a base condition. The Department would continue to comply with Decision 1485 regardless of what mitigation option would be chosen.

The State Water Resources Control Board has continued reservation of jurisdiction in connection with Decision 1485. If new protective standards are established for the Delta, then the State Water Project will be operated to meet valid new criteria. There is not now enough information to assume how Decision 1485 standards will be changed or if changes will be made.

Response 18

General Issue 4 in this chapter addresses a proposed agreement to protect fish. While different from the previously proposed Two-Agency Agreement, it would mitigate for direct impacts, not only of the additional pumping units, but for all or most of the existing pumping units as well.

Response 19

Contractual commitment to conservation goals similar to those proposed in the Department's recommended water management plans is included as a mitigation option. The Department is not proposing it, however, for several reasons. First, urban districts are now required to prepare water management plans. The law requiring these plans sets forth a rigorous review of needs and options available. Second, in determining entitlement requests establishing needs for water, reductions due to conservation equal to the amounts projected in the Department's recommended plans are included. This means of calculating need may well establish a greater incentive to conserve than contracts such as those used with regard to the North Bay Aqueduct, since it means that Department planning does not include facilities or other measures to satisfy that increment of potential demand.

See Response 12 to this comment letter, "Water Conservation and Water Management Plans" in Chapter 1, "Mitigation for Impacts on Fish" (Option 4) in Chapter 5, and General Issue 4 in this chapter under "General Issues and Responses".

Response 20

See Responses 7 and 14 to this comment letter.

Response 21

Both the draft and final report include a preferred mitigation plan that would compensate for fish losses, so there would be no unavoidable fishery-related effects.

The discussion on mitigation has been expanded to include additional alternatives that further reduce losses of fish. Conservation and nontraditional supply are considered as part of determining existing water supplies and needs and as water supply and demand reduction alternatives. These were discussed on pages S-6 and 26 through 30, and in Appendix C (Chapter 3, "Water Supply and Demand Reduction Alternatives" and Appendix C in the final report).

Evaluation of impacts for the Banks Pumping Plant considered that various water conservation, waste water reclamation, and ground water storage programs would be implemented in addition to the pumps. Chapters 1 and 5 of the final report address energy, which is not considered significant and is more efficiently used because of the operational flexibility of the additional pumps.

Response 22

The proposed pumps were subjected to a rigorous economic analysis. Details of the analysis were included in Appendix C of the draft report. Results of the analysis (page S-6 of the draft report) demonstrated the favorable benefit/cost ratio and favorable net benefits that could be achieved by the additional pumps. In addition, the unit cost per acre-foot of water was found to be less for the additional pumps alternatives than for competing water supply alternatives.

Response 23

The response to General Issue 8 in this chapter addresses the issue of the benefit/cost ratio. Recent operating experience shows increased power benefits and greatest net benefits for four additional pumps.

Response 24

Current planning combines four additional pumps with traditional and nontraditional water development. See Chapter 6 of the final report. Also see "Planning Perspective", in Chapter 1.

Response 25

Comment noted.

Letter 32
Commenting Entity:
D. W. Kelley and Associates
January 24, 1983

See responses to Letter 30.

Letter 33
Commenting Entity:
H. S. Pete Fowler, P.E.
January 5, 1983

Response 1

The "brainstorming" ideas in this letter demonstrate considerable thought and interest in project operations. The subject of modifying forebay storage is important, especially a horizontal enlargement. However, the method of raising and lowering the elevation of the existing forebay listed in this letter would not be effective.

C—105632

C-105632

Impacts associated with flows toward the pumps are evaluated in the draft and final reports.

Response 2

Lowering the bottom of Clifton Court Forebay by 20 feet would increase the storage there, but this additional storage would not be usable based on the present intake channel invert and minimum water level design for the pumping plant structure. As stated on page 58 of the Draft Environmental Impact Report on the Proposed Additional Pumping Units, pumping when forebay levels are lower than the minimum operating level causes excessive vibration at the existing pumps. With the new pumps, the minimum operating level could possibly be lowered about 1 foot. Raising the dikes around the forebay would not provide any storage advantage, because inflow to the forebay is by gravity and is a function of water levels produced by tidal fluctuations.

Response 3

The suggested modification of the Banks Pumping Plant would not be cost effective, because it would increase the pumping lift and would require a redesigned intake channel and fish protective facility.

Response 4

There are several possibilities for horizontal enlargement of Clifton Court Forebay. The concept considered most so far is to the north, rather than to the south. Enlarging Clifton Court is an alternative for a Delta water transfer facility and is beyond the scope of this report. Current planning on transfer facilities is discussed in Chapter 6 of the final report in connection with cumulative impacts. Reasons for eliminating alternatives with an odd number (1 or 3) of new pumps were discussed on page 19 of the draft report. The reasons were based on the design of the discharge manifolds, which were constructed for an even number of pumps.

Letter 34
Commenting Entity: National Audubon Society
February 9, 1983

Responses 1, 2, and 3

See responses to General Issues 1 and 2 in this chapter, under "General Issues and Responses". Also see "Planning Perspective" in Chapter 1.

Response 4

The preferred alternative would operate within the constraints of Decision 1485. It will not preclude operational and other changes, if ongoing studies suggest the need for such changes. See responses to General Issues 1, 2, and 11 in this chapter.

Response 5

The draft report addressed effects of State Water Project operation on Delta levees, with and without additional pumps. The scour monitoring program was described on page 66, and potential impacts were evaluated for channel velocities, scour and siltation, cross-Delta flows, and levees. No significant impacts were found for the preferred alternative.

Delta levees are discussed in the "Delta Region" section of Chapter 4 in the final report. The effects of levee failures on project operation are also discussed in Chapter 4.

Aging levees are a problem. The Department has studied this issue (along with the Corps of Engineers) since 1973, and works with the Legislature to solve

them. To qualify for State funds, the landowner must spend at least $1,000 per mile of levee for annual maintenance. After qualifying, up to half the money spent by the landowner on maintaining and upgrading the levees can be reimbursed by the State when funds are available. Since 1973, the State has appropriated about $7 million for upgrading Delta levees. The program is now funded at $2 million per year.

Response 6

See responses to General Issues 1, 2, and 11 in this chapter.

Response 7

The draft report assessed impacts of the additional pumps on fish. The impact assessment has been updated to reflect more effective operation of the State Water Project. Four mitigation options were investigated. The option proposed as a condition for proceeding with the new pumps would mitigate for the incremental impact of the additional pumps and include provisions to mitigate ongoing operations of the existing pumps as well as provisions for fish that would have been in the estuary if Banks Pumping Plant had not been constructed. See responses to General Issues 3 and 4 in this chapter.

Response 8

The section "Operational Impacts, Monthly Operational Changes, No-Project Alternative" in Chapter 5 of the final report clarifies the statement on increased pumping. See Response 8 to Comment Letter 30 and response to General Issue 3.

Direct fish impacts are evaluated for the no-project alternative and other alternatives with additional pumps. Evaluations were all at the 1990 level to provide equivalent comparisons. Any impacts associated with export increases before the additional pumps are installed are not an impact of the additional pumps. The difference in direct losses represents the incremental impact of additional pumps.

Response 9

See response to General Issue 2 and Response 4 to this comment letter. Chapter 6 has been expanded to clarify cumulative impacts. The draft report discussed water quality impacts for all the Clifton Court Forebay-Banks Pumping Plant alternatives. Flow and salinity data and graphs for the early 1990s condition are presented in Appendix B of the final report.

Letter 35
Commenting Entity: G. Rosekilly
December 10, 1982

Response 1

The proposed additional pumping units are independent of the water resources plan for the State Water Project contained in Proposition 9, which was defeated in June 1982.

Response 2

Many Federal and State agencies have considered physical saltwater barrier concepts at a number of locations from San Francisco Bay upstream into the Sacramento-San Joaquin Delta. The Department of Water Resources and other agencies still have concerns with physical barriers.

The Department intends to study all practical methods of developing more water to meet the State's growing needs. A barrier may have a place in long-term planning; it might conserve water just like a new reservoir. For the near term, however, the Department is

C—105634

C-105634

committed to controlling salinity with the present hydraulic barrier. To make more efficient use of water supplies, the Department proposes to install the additional pumps and is studying possibilities to increase channel capacity for transferring project water across the Delta.

Response 3

State Water Project planning is concerned with water conservation, waste water reclamation, and desalting to provide water supplies for project contractors. Planning for future deliveries has considered adjustments for these factors and concluded that yield from the additional pumps is needed to offset deficiencies. The draft report evaluated several water supply and demand reduction alternatives.

Letter 36
Commenting Entity: Sierra Club
February 16, 1983

Response 1

Important points identified in this letter required clarification to improve this final report and facilitate decision on this project.

The Department of Water Resources has complied fully with the Corps of Engineers regulatory process pertaining to Federal permits for this and all other projects. See response to General Issue 6 in this chapter, under "General Issues and Responses". Benefits from the additional water were prorated among all project service areas for purposes of the impact assessment. The additional water for the alternatives considered (the additional pumps with no increased storage or Delta transfer facilities) would come from available Delta flows that could be exported within the limitations of Water Right Decision 1485.

All State Water Project costs allocated to water supply (about 97 percent of the total) are to be reimbursed, with interest, by the 30 contracting water agencies. Under existing law, costs allocated to recreation and fish and wildlife enhancement (about 3 percent) are repaid from other sources, including Tideland oil and gas revenues and the General Fund. These latter costs are not water subsidies, because they are for benefits other than water supply that are available to the public.

Response 2

The benefit/cost ratio is discussed in response to General Issue 8 in this chapter, under "General Issues and Responses". As a result of operating experience, energy benefits of the additional pumps are recognized to be greater than they were estimated to be when the draft was written. Although the benefit/cost ratio is better for two additional pumps, total net benefit is greater for four.

Response 3

The final report evaluates fish impacts using updated operation studies that reflect more effective operation of the State Water Project. The more effective operations shifted the timing of exports away from summer periods of high fish abundance toward winter months of unregulated flow conditions when many fish species are lower in abundance. With additional pumps, this shift is accentuated, and direct losses would be reduced for many species, including striped bass, American shad, and white catfish. However, direct losses would be increased for chinook salmon and some other species that are more abundant during winter.

Mitigation options and measures, including modified pumping to increase fish benefits, are discussed in Chapter 5 and in response to General Issue 4.

Response 4

Several factors may be responsible for the decline in fisheries. Necessary changes in State Water Project operations can be made either through operations or through changes to State Water Resources Control Board standards.

If the present decline in striped bass is caused by toxic pollution, the mitigative effect of Decision 1485 may be lessened by such pollution. The Department is continuing to budget millions for advancing knowledge about the Delta fishery. See responses to General Issues 3 and 4 in this chapter. Also see Response 12 to Comment Letter 30 and Response 17 to Comment Letter 31.

Response 5

The water management plans prepared by the Department for some of the project service areas include ground water storage. The plans are being considered by the contractors in their preparation of the water management plans required by the Urban Water Management Planning Act of 1983. Chapter 6 of the Final Environmental Impact Report on the Proposed Additional Pumping Units and Chapter II of Bulletin 132-85 both include discussions of planning for ground water storage programs.

State Water Project deliveries for agricultural use have not approached 2.5 million to 4.5 million acre-feet. Deliveries in 1984 totaled about 1.9 million acre-feet (Bulletin 132-85, Table 4). Water year 1983-84 had above normal precipitation.

Response 6

Impacts on State Water Project service areas were discussed in Chapter 5 and Appendix D of the draft report. The discussion ("Impacts on State Water Project Service Areas", Chapter 5) now includes estimates of additional lands that could be brought into production in San Joaquin Valley, and socioeconomic, growth-inducing, and environmental impacts. The discussion also includes potential mitigation measures that could be carried out depending on where development takes place (for example acquiring land for habitat protection).

Specific plans for agricultural expansion should observe the recovery plans for the San Joaquin kit fox and the blunt-nosed leopard lizard, which are described in Chapter 4 of the final report.

Response 7

The final report has been changed to recognize the fact that the Two-Agency Agreement was not executed and to describe other mitigation measures, including pumping to minimize fish losses. See "Mitigation for Impacts on Fish", Chapter 5.

See also Response 3 to this comment letter and response to General Issue 4 in this chapter, under "General Issues and Responses".

Response 8

The incremental impact of the additional pumps, operated under Corps of Engineers criteria, on annual Delta outflows was estimated as a 0.4 percent reduction (see Table S-2 in the draft report). This is based on the analysis in Table 11, Chapter 5, and is still valid for the final report. Incremental impacts on Delta outflow surges were also determined not to be significant, based on the analysis discussed on pages 62 and 63 of the draft report.

The impact of the small changes in Delta outflows on biological resources in San Francisco Bay is not known. As stated on page 83 of the draft report, the important relationship between Delta

C—105636

C-105636

outflows and biological resources in the bay is the subject of ongoing studies and monitoring. Therefore, "San Francisco Bay Fish" has been deleted from the listing of incremental impacts found insignificant. It is mentioned as an unknown impact in the final report. (See response to General Issue 11 in this chapter.)

Response 9

Concerns relating to the Suisun Marsh facilities are addressed in the final environmental impact report for the Suisun Marsh Plan of Protection (February 1984) and the agreement recently negotiated regarding the marsh.

The sections on Suisun Marsh in Chapters 4 and 5 of the final report on the additional pumping units have been updated, and the response to General Issue 7 in this chapter describes the relationship between the additional pumps and the marsh plan of protection. The additional pumps will have no significant impacts on the marsh, since it is protected by Delta outflows, physical facilities, and a monitoring program.

Response 10

Water conservation is included in demand figures used in the operation studies. It is also used in determining alternatives that could reduce the need for additional water, although it does not duplicate energy and operational benefits provided by the additional pumps.

See responses to General Issues 4 and 9 regarding water conservation, and see Response 12 to Comment Letter 31 regarding price reform.

Response 11

Transfer of Imperial Irrigation District water is a water supply alternative included in the assessment of additional pumps. See also Response 13 to Comment Letter 31 and the updated discussion in Chapter 3 of the final report.

Response 12

See Response 8 to Comment Letter 1 and Response 12 to Comment Letter 31 on the Department's pricing policy and the relationship between agricultural water policies and agricultural issues. As water becomes more expensive, the farmer has more incentive to use less. However, agricultural use limitations must be balanced against crop needs and farming efficiency.

Response 13

Department of Water Resources planning to meet its contractual obligations is expected to include eventual pumping at the full design capacity. However, the preferred alternative is a cost-effective choice, even if no additional pumping takes place.

See response to General Issue 2 in this chapter.

Response 14

See Response 1 to this comment letter.

Letter 37
Commenting Entity: Tehama Fly Fishers
January 25, 1983

Response 1

The U. S. Bureau of Reclamation and the U. S. Fish and Wildlife Service have been continually invited to participate in programs concerning water transfer through and protection of the Delta. They have elected not to participate in a fish and wildlife protection agreement.

To secure consistent Federal participation in meeting Delta protective standards, the Department of Water Resources has established a policy not to wheel Federal water if the Central Valley Project is not complying with the standards in non-emergency situations. This policy is in a letter agreement. The Department is working with the Bureau of Reclamation on a Coordinated Operation Agreement in which the Bureau would agree to meet most Decision 1485 standards, and a draft environmental impact statement/report has been prepared. The Department is also working with the Bureau on the Suisun Marsh protection plan, bay studies, and Four-Agency ecological studies.

The Department coordinates planning efforts regularly with the State Legislature and the California congressional delegation, and will continue to seek Federal participation.

Response 2

The Department of Fish and Game, funded by Department of Water Resources, is investigating several areas in the fish salvage process, including predation in Clifton Court Forebay. Estimates of striped bass and chinook salmon losses in the Draft Environmental Impact Report on the Proposed Additional Pumping Units have been expanded to include predation in the forebay and losses during handling and hauling, based on the best estimates available. Salmon estimates are based on studies at State Water Project and Central Valley Project facilities, as well as on general knowledge about the species. See Appendix B of the final report for a description of the methods used to generate the system loss estimates for striped bass and chinook salmon.

Response 3

Studies are underway by the Department of Fish and Game and U. S. Fish and Wildlife Service to determine factors affecting the survival of juvenile salmon of Sacramento River origin. Many fish are trucked from hatcheries to release sites in the estuary. In the last few years, the trend has been to truck a larger percentage of hatchery production, but management goals may conflict with this practice in some cases. For instance, release of salmon in the estuary has been shown to cause considerable straying of returning adults, which may result in inadequate returns to upstream hatcheries.

Increased pumping with additional pumps will not necessarily aggravate the problem of displacement of Sacramento River salmon from normal migration routes. The ratio of cross-Delta flows to Sacramento River flows is an indicator of such displacement. Table 5-8 of the final report shows these flow ratios for months of high salmon abundance. There are no significant changes in the flow ratios for the alternatives with additional pumps.

The analysis in the final report does show increased entrainment of juvenile salmon with additional pumps. These would be mainly salmon of San Joaquin River origin. Mitigation could consist of stream habitat restoration, barriers, predation control studies in Clifton Court Forebay, stocking, and other measures.

Response 4

Fish stocking costs associated with the additional pump alternatives are the incremental costs for striped bass and chinook salmon compared to the no-project alternative. Total costs, shown in Appendix C, Table C-11, of the draft report, are much higher. This table developed the costs for each alternative using a hatchery unit cost of 50 cents per striped bass yearling according to the proposed agreement of December 1982. Actual unit costs will probably be higher. The preferred mitigation for

this project will provide a method for adjusting the number of fish to be replaced based on actual yearly operations. Fish stocking costs will be decreased with the additional pumps when compared to the no-project alternative because of the shifts in monthly export patterns.

Response 5

It is the intent that "chinook salmon" be used or inferred throughout this report as the correct term for this species.

Letter 38
Commenting Entity:
United Anglers of California
January 11, 1983

Response 1

This comment has identified an important point requiring a change. The wording has been clarified and the term "surplus" has been omitted in the final report.

Response 2

Details of the proposed agreement of December 1982 have been eliminated in the final report, because that agreement was not executed. A new protective agreement is now discussed. See Chapter 5 "Mitigation for Impacts on Fish" and the response to General Issue 4 in this chapter, under "General Issues and Responses".

Responses 3 and 4

Striped bass eggs and larvae losses are included in the direct fish impact analysis for the final report. The estimates, based on modifications by the Department of Fish and Game to those made for the Striped Bass Working Group, rely on Department of Fish and Game surveys conducted between 1968 and 1977 (except 1974).

The Striped Bass Working Group report concluded (page 52):

"Our group has concluded that, while there is no evidence that entrainment has been the cause of the striped bass decline, entrainment losses of young fish in the diversions are large enough so that over a long period of years they could significantly reduce the bass populations. The risk is greater if there is inadequate food or in years of low Delta outflow. We believe that the current high estimates of losses at the PGandE, Central Valley Project, and State Water Project plants, and numerous small agricultural diversions are sufficiently accurate to warrant major concern. The difficulties of interpreting what those losses mean to the adult population lessen the value of more precise estimates.

"Our recommendations on entrainment are to do work aimed at reducing the loss instead of trying to provide better estimates or prove that they are or are not significant. We understand that PGandE is planning to reduce losses in their Pittsburg and Antioch Plants, and that some changes in design or operation are being considered for the CVP/SWP diversions."

Effective operation of the State Water Project with additional pumps can reduce losses of striped bass juveniles, eggs, and larvae. See responses to General Issues 3 and 4 in this chapter, under "General Issues and Responses".

Response 5

In the draft report, cumulative impacts of fish losses were considered in the calculations and negotiations that were the basis for the December 1982 proposed agreement between the Department of Water Resources and Department of Fish

and Game. Because the proposed agreement has not been signed, other mitigation measures have been proposed that focus on impacts at Banks Pumping Plant (see response to General Issue 4). These other measures include a new protective fish agreement and assume continued compliance with the protective criteria of Decision 1485. The new agreement would consider cumulative impacts of fish losses, as does Decision 1485. It will compensate for all incremental impacts of the additional pumps, include provisions for impacts of the existing pumps, and mitigate for fish that would have been in the estuary if Banks Pumping Plant had not been constructed. It is not yet known whether Decision 1485 is properly compensating for total State Water Project fish impacts. The State Water Resources Control Board may modify Decision 1485, and the State Water Project will be operated within valid revised standards.

Response 6

See Responses 3 and 5 to this comment letter. Also see response to General Issue 4 on mitigation options for the additional pumps operated under the Corps of Engineers criteria.

Response 7

The term "high surplus Delta outflows" has been changed to "high Delta outflows exceeding Decision 1485 requirements" for the final report.

Response 8

The entrainment loss estimates in the final report include loss estimates for striped bass eggs and larvae, as well as for fish large enough to be screened. See response to General Issue 3 in this chapter.

Response 9

The striped bass yearling equivalent loss represents a direct loss of fish at the Delta Complex (Banks Pumping Plant, Skinner Fish Facility, and Clifton Court Forebay). This loss does not necessarily correspond to an equivalent loss that can be related to the normal life cycle. Total Delta fish impacts are summarized, along with other important fish needs, in Chapter 5 of the final report (see Tables 5-15 through 5-20). These other needs are related to:

- Outflow and export changes in May, June, and July.
- Salinity gradients.
- Fish food sources.
- Fish nursery areas.
- Cross-Delta flow movement.
- Water velocities.
- Dissolved oxygen.

Response 10

The section "Significant Environmental Effects" has been revised to reflect the new estimates of fish losses. These new estimates are based on the updated operation studies that reflect more effective operation of the State Water Project. The new estimates show a reduction of striped bass losses with the additional pumps. The section "Mitigation for Impacts on Fish" has been expanded to describe four mitigation options. See response to General Issue 4 in this chapter, under "General Issues and Responses".

Responses 11 and 12

The final report discusses the findings of the Striped Bass Working Group and the planned export management experiments. Chapter 5 (Overview of Fish Food Supply Impacts) of the final report also discusses phytoplankton and aquatic

C—105640

C-105640

invertebrates, particularly Neomysis. The Department of Fish and Game's analysis of factors affecting Neomysis abundance indicates that diversions are the least important factor. More important are salinities, chlorophyll a, and copepod abundance. The final report classifies impacts on food supplies for young striped bass as unknown; this is consistent with the Striped Bass Working Group findings.

Response 13

Only during winter would diversions be increased under the preferred alternative operational plan. It is unknown whether increased diversions during the winter (mid-December to mid-March) would affect spring food production for larval striped bass. This is identified as an impact for which there is inadequate information in the final report. The Department is participating in studies to determine what influence export operations have on the food supply of fish in the Bay and Delta. The Striped Bass Working Group established a relationship between peak phytoplankton levels and 7-day average exports prior to the start of the bloom. According to this correlation, operating the pumps under the preferred alternative would not affect these important 7-day average export periods.

Chapter 8. CHANGES TO THE DRAFT ENVIRONMENTAL IMPACT REPORT

Various changes were made to the draft environmental impact report to update this final version. Table 8-1 summarizes the changes in all the chapters and appendices of the report. The summary of the report also reflects these changes.

Reasons for the changes are:

- General clarification, including further background information and reorganization of the report.
- New information.
- Comments received in draft report.
- Additions required by the California Environmental Quality Act for final reports.
- Two sections in Chapter 5 of the draft report have been dropped in the final report in accordance with California Environmental Quality Act Section 21100.1, which requires that information only for adoption, amendment, or enactment of a plan, policy, or ordinance of a public agency; determinations of a local agency formation commission; or for projects subject to the requirements of the National Environmental Policy Act. None of these applies to the proposed project. The dropped sections are: "Irreversible or Irretrievable Commitment of Resources," and "Relationship Between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity".

Table 8-1

CHANGES TO THE DRAFT ENVIRONMENTAL IMPACT REPORT

Chapter	Section	Changes
1 - Introduction	The Existing Central Valley Project	Added new section.
	The Existing State Water Project and Related Mitigation	Changed title and added discussion of fish and wildlife mitigation and enhancement.
	State Water Project Supply Contracts	Changed title and expanded discussion of contract shortage provisions.
	Statutes Affecting State Water Project Development	Added new section.
	State Water Project Operation	Expanded discussion of factors that affect operations, including hydraulic constraints and Coordinated Operation Agreement.
	Regulatory Permits for Banks Pumping Plant	Updated discussion of U. S. District Court decision.
	Ecological Studies	Added new section.
	Water Availability Studies and Decision 1594	Added new section.
	Proposed Agreement to Manage the Fish and Wildlife Resources of the Sacramento-San Joaquin Estuary	Modified and moved to Chapter 5, under Mitigation.

C—105642

C-105642

Table 8-1 (Continued)

Chapter	Section	Changes
	Water Conservation and Water Management Plans	Changed title and added discussion of preliminary water management plans for State Water Project contractors and the 1983 Urban Water Management Planning Act.
	State Water Project Demands and Delivery Capabilities	Added new section.
	State Water Project Power Resources	New updated section moved from Chapter 2 for clarification.
	Planning Perspective	Added new section.
	Public Participation	Added discussion of comments received on Draft Environmental Impact Report and on public hearing.
2 - Project Description	Purposes	Expanded discussion of outages. Updated and revised discussion of potential shortages.
	Future State Water Project Power Resources	Moved to Chapter 1.
	Physical Features	Changed "Clifton Court Forebay Modifications" to "Southern Delta Modifications" and modified discussion.
3 - Description and Comparison of Alternatives	Introductory Paragraph	Clarified discussion of alternative categories.
	Operational Considerations	Expanded discussion. Added subsection in "Efficient Operation of State Water Project".
	Physical and Operational Comparison of Alternative Operational Plans	Changed title, modified, and expanded discussion to reflect the updated operation studies.
	Water Supply and Demand Reduction Alternatives	Expanded and updated discussion of environmental and institutional problems. Deleted table on costs for Imperial Valley conservation. New costs with escalation and updated planning used in economic evaluation. Added Environmental Summary table. Added discussion of mitigation possibilities. Combined Toilet Dam and Showerhead Retrofit Programs into a single alternative. Deleted Mandatory Nonresidential Landscape Design, because it is included in the Department's recommended water management plans. Split Imperial Valley Conservation into a projected supply and an alternative.
	Economic Analysis	Modified discussion to reflect updated analysis. Revised Table 2 (3-4 in final report).
4 - Environmental Setting	Delta Region	Added discussions of Delta agricultural diversions, Delta levees, and effects of levee failures on project operations.
	Suisun Marsh	Expanded discussion of Plan of Protection.
	Sacramento Valley	Added new section.
	San Joaquin Valley	Added new section including discussion of agricultural drainage and salt management studies.
	San Joaquin Valley Service Area	Added description of recovery plans for blunt-nosed leopard lizard and San Joaquin kit fox.

C—105643

C-105643

Table 8-1 (Continued)

Chapter	Section	Changes
5 - Environmental Impacts of Installing and Operating Additional Pumps	Impacts of Construction	Expanded and revised discussion. Added Environmental Summary table of construction impacts.
	Operational Impacts	Expanded discussion of operation studies with new information on updated operation studies.
	Monthly Operational Changes	Revised values on historical and projected 1990 exports. Revised Table 10 on monthly and annual exports (Table 5-2 in final report). Table 5-2 shows exports at Banks Pumping Plant only.
	Daily Operational Changes at Clifton Court Forebay	Replaced Figure 8 with Table 5-3, which reflects updated operation studies.
	Impacts on Delta Outflows	Revised Table 11 on monthly and annual outflows (Table 5-4 in final report). Table 5-4 revised to reflect data from updated operation studies.
	General Impacts on Salmon and Steelhead	Expanded discussion.
	General Impacts on Striped Bass	Deleted table on striped bass indices. Expanded information on general impacts with tables. Added discussion of findings of Striped Bass Working Group and planned experiments.
	Impacts on Resident Fish	Expanded discussion of factors controlling resident fish populations in the Delta.
	Fish Food Supply Impacts	Added four new section (Overview, Phytoplankton, General, Neomysis Direct).
	Direct Impacts of the Delta Complex on Fish	Four new sections added to replace "Impacts on Fish Salvage Operations". Revised analysis of striped bass and chinook salmon to include loss in Clifton Court Forebay, losses from handling and hauling, and entrainment of striped bass eggs and larvae. Added discussion and table on salvage for other species. All tables based on updated operation studies.
	Impacts on Tracy Pumping Plant Operations	Updated discussion.
	Impacts on Suisun Marsh	Updated discussion.
	Summary of General and Direct Impacts on Bay-Delta Fishery	Added new section. Revised and added tables.
	Operational Impacts, Late 1990s	Added new section and tables.
	Impacts on State Water Project Service Areas	Clarified discussion of socio-economic, growth-inducing, and environmental impacts, including potential agricultural expansion, and mitigation possibilities.
	Relationship of the Proposed Action to Land Use Plans	Added new section.
	Energy and Capacity Impacts	Added new section.
	Summary of Impacts Under the Preferred Alternative	Revised and expanded to reflect changes discussed above.
	Unknown Impacts That Can be Potentially Significant and Related Studies	Added new section.

C—105644

C-105644

Table 8-1 (Continued)

Chapter	Section	Changes
6 - Cumulative Impacts	State Water Project and Related Planning	Revised and updated discussion, and added new section.
	Governor's Water Legislative Package	Added new section.
	Cumulative Impacts on the Bay-Delta Estuary	Revised table on potential cumulative impacts. Added discussion of post-2000 operation of pumps without added storage or improved Delta water transfer.
	Cumulative Impacts of State Water Project Deliveries	Revised tables; expanded discussion.
	Growth-Inducing Impacts of the State Water Project	Added new section.
	Other Cumulative Impacts	Added new section.
	Mitigation Measures for Cumulative Impacts	Added new section.
7 - Comments and Responses		Added new chapter.
8 - Changes to the Draft Environmental Impact		Added new chapter. Deleted old Chapter 8, "Organizations and Persons Consulted".
9 - List of Preparers		Changed chapter number; was Chapter 7 in draft report.
Appendix B - Operation Studies and Direct Impact Analysis for Fish		Changed title; described updated operation studies; added tables.
Appendix C - Benefit/Cost Analysis of Additional Pumping Units at Harvey O. Banks Delta Pumping Plant		Revised many tables to reflect analysis with updated operation studies and economic analyses.
Appendix D - Assessment of the Impacts of the Banks Pumping Plant in th State Water Project Service Areas		Expanded discussion; revised many tables to reflect analysis with updated operation studies.
Appendix E - Recommended Water Management Plans		Added new appendix.
Appendix F - Documents Incorporated by Reference		Added new appendix.

C—105645

C-105645

Chapter 9. LIST OF PREPARERS

The Final Environmental Impact Report on the
Proposed Additional Pumping Units
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C—105646

C-105646

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C—105647

C-105647

Appendix A.

SUMMARY FROM THE FINAL ENVIRONMENTAL STATEMENT FOR THE OPERATION OF THE DELTA PUMPING PLANT

Appendix A

SUMMARY FROM THE FINAL ENVIRONMENTAL STATEMENT FOR THE OPERATION OF THE DELTA PUMPING PLANT
U. S. Army Engineer District, Sacramento, California, September 1980

SUMMARY

( ) Draft (X) Final Environmental Statement

Responsible Office: U.S. Army Engineer District
Sacramento, California

1. Type of Action: (X) Administrative ( ) Legislative

2. Brief Description of Action: The California Department of Water Resources (DWR) has applied for Department of Army permits for the existence and operation of the Delta Pumping Plant, Intake Channel, Clifton Court Forebay, and appurtenant facilities. These facilities, part of the State Water Project (SWP), divert water from the Sacramento-San Joaquin Delta for conveyance via the California and South Bay Aqueducts to service areas in the South San Francisco Bay, San Joaquin Valley, and Southern California.

The Pumping Plant was designed for 11 pumps; presently 7 pumps are installed with a capability of 6,300 cfs. A fish protective facility is constructed near the beginning of the Intake Channel. To satisfy a court order, this statement covers the continued operation of the existing Delta Pumping Plant. Application for a Department of the Army Permit for installation and operation of the four additional pumps will be covered later in a supplement to this statement.

Operation of the Pumping Plant and Forebay is coordinated with other facilities of the SWP and the federal Central Valley Project to meet applicable Federal and State water quality standards for the Delta and Suisun Marsh. In August 1978, the State Water Resources Control Board (SWRCB) modified the standard with adoption of a water quality control plan and Water Rights Decision 1485. The State's position is that operation of the CVP and SWP in compliance with the Delta Plan and D-1485 will mitigate the adverse effects of CVP-SWP operations to the extent found reasonable at this time by the SWRCB. DWR will comply with the Delta Plan and D-1485, including additional SWP storage releases or export reductions to compensate for any failure of the CVP to comply.

3. Summary of Environmental Impacts

a. There has been a significant decrease in average annual outflows from the Delta caused by numerous federal, state, and local water projects. Generally, winter and spring outflows have decreased, while summer and early fall outflows have increased. The outflow reductions and related increases of salinity intrusion have significantly reduced populations of fish and other aquatic organisms and degraded habitat for waterfowl in Suisun Marsh.

b. Under present conditions, CVP and SWP pumping modified flows significantly in many Delta channels. In addition to compounding operational problems, the flow modifications adversely affect fish, chiefly through flow reversals in some channels and increased velocities in others.

The flow reversals draw millions of young fish and their food organisms to the pumps, and probably delay and confuse upstream migrant fish. The increased velocities reduce the abundance of many invertebrates which fish feed on.

c. Long-term salinity increases in tidal water adjacent to Suisun Marsh are expected to gradually cause vegetative changes in the intertidal marshes, which may increase costs for marsh management and levee maintenance, and reduce the range and density of aquatic mammals and some birds. Habitat for certain rare and endangered species would be improved. (California clapper rails, black rails, and salt-marsh harvest mice.)

d. SWP diversions affect natural tidal fluctuations and lower nearby water levels, but the drawdowns do not affect any known use of local channels for navigation. The effects of the diversions on agricultural uses of local channels are presently under investigation as a part of Delta water entitlement negotiations.

e. The SWP diversions provide good quality water to 24 contracting agencies, which encompass about 18 percent of the State's land area and contain about 63 percent of its assessed valuation and 66 percent of its population. SWP supplies help stabilize ground water levels, protect ground water quality, and save users millions of dollars annually in water quality costs. Agricultural uses of project water in the San Joaquin Valley generate at least 11,000 jobs and contribute at least $245 million annually to the State's economy.

f. Project operations also support substantial use of recreation facilities along the Aqueduct system (3.1 million recreation-days annually). It is estimated that over 200,000 recreation-days are due to export of small fish from the Delta through the Delta Pumping Plant.

g. Pumping Plant operations are largely governed by the availability and cost of on-peak energy for the entire aqueduct system, and therefore involve maximum use of off-peak energy, which can be obtained by using existing utility generating capacity. System energy requirements are related to the quantities of water delivered. Energy requirements for full usage of the existing Delta Pumping Plant amount to about 0.5 percent of statewide requirements in 1980. Net energy needs for SWP pumping represent about 2 percent of statewide requirements now and in the near future.

h. Generally, the effects of continued operation are most severe in critically dry years and least in wet years. Some major effects are: (1) reduced survival of young striped bass by an average of 23 percent; (2) reduced Neomysis abundance by 12 to 81 percent; (3) a 14 percent reduction of waterfowl food supplies in the Suisun Marsh during a critically dry year, after allowing for scheduled initial facilities to provide early protection for the more vulnerable areas.

C—105650

C-105650

i. The SWP diversions remove an estimated 10 percent of annual inflows of suspended sediment to the Delta.

j. SWP deliveries contribute to the salt balance and drainage problems in the Tulare Lake Basin in the southern part of the San Joaquin Valley.

k. Proposed mitigation measures for fish are early enlargement of the fish protective facility. Other possible measures considered are fish hatcheries, fish screens on Delta and Sacramento River diversions, and fish screens at the Clifton Court Forebay intake.

4. Alternatives Considered

a. Moderate reduction of pumping.

b. Severe reduction of pumping.

c. Cease pumping.

d. Continue with present pumping capacity.

5. Comments Received:

Parties commenting on the draft environmental statement are listed on page 130.

6. Draft Statement to EPA December 1978.

Final Statement to EPA 12 SEP 1980.

C—105651

C-105651

Appendix B

OPERATION STUDIES AND DIRECT FISH IMPACT ANALYSIS

CONTENTS -- APPENDIX B

	Page
Operation Studies	365
Water Supply Studies	365
Summary Comparison with Previous Operation Studies	367
Power Operation Studies	367
Analysis of Direct Fish Impacts	369
Screenable Sized Striped Bass and Chinook Salmon	369
Striped Bass Eggs and Larvae	369
Salvage Calculations for Other Fish	370
Summary Comparison with Previous Operation Studies	370

Tables

B-1	Required State Water Project Deficiencies	371
B-2	Estimated Firm Yield Increases	371
B-3	Estimated Increases in Ground Water Yield	371
B-4	Average Monthly Flows in Delta Channels	372
B-5	Average Monthly Salinities in Delta Channels	375
B-6	Average Monthly Salinities in Delta Channels at High Tide	378
B-7	Comparison of Major Assumptions, Previous and Updated Operation Studies	379
B-8	Comparison of Average Annual and Monthly Exports at Banks Pumping Plant, Previous and Updated Operation Studies	380
B-9	Annual Power Requirements at Banks Pumping Plant -- 3.45 Million Acre-Foot Export Level	381
B-10	Annual Power Requirements at Banks Pumping Plant -- 3.9 Million Acre-Foot Export Level	381
B-11	Explanation of Loss Estimates for Screenable Sized Striped Bass and Chinook Salmon at State Water Project Facilities	382
B-12	Direct Loss Estimates for Screenable Sized Striped Bass and Chinook Salmon -- Alternative 0-6.4	384
B-13	Direct Loss Estimates for Screenable Sized Striped Bass and Chinook Salmon -- Alternative 4-7.3(Corps)	385

Page

B-14 Estimated Screen Efficiency at the John E. Skinner Delta Fish Protective Facility for Striped Bass and Chinook Salmon, 1968 to 1980 386

B-15 Projected 1990 Entrainment of Striped Bass Eggs and Larvae, Alternative 0-6.4 387

B-16 Comparison of Direct Entrainment and Loss Estimates for Striped Bass and Chinook Salmon, Previous and Updated Operation Studies. 388

B-17 Comparison of Salvage Estimates for Selected Other Fish Species, Previous and Updated Operation Studies 389

Figures

B-1 Exports at Banks Pumping Plant 390

B-2 Delta Outflows 393

B-3 Fish Screen Velocity vs. Efficiency for Striped Bass and Chinook Salmon 396

B-4 Operation of the Enlarged John E. Skinner Fish Protective Facility 397

Attachment

1 Department of Fish and Game Memorandum 398

Appendix B

OPERATION STUDIES AND DIRECT FISH IMPACT ANALYSIS

This appendix presents details of studies made for the environmental impact report on the proposed additional pumping units at the Harvey O. Banks Delta Pumping Plant. It includes the following technical discussions and data:

- Operation studies.
- Tables on Delta flows and salinities (from the operation studies).
- Direct fish impact analysis.

This appendix also presents a summary comparison of the water supply operation studies analyzed in this final report with previous operation studies analyzed in the draft environmental impact report.

Operation Studies

Two types of operation studies were made to evaluate the economics and operational effects of additional pumps and the assumed modifications in the southern Delta:

- Monthly water supply studies of the State Water Project and Central Valley Project system.
- Monthly power operation studies of the California Aqueduct.

Water Supply Studies

Water supply studies simulate operation of the overall State Water Project and Central Valley Project system. They account for the total availability, storage, release, and use of water in the Sacramento and San Joaquin River systems, the Delta, and the aqueduct systems south of the Delta. They represent a superimposition of future water demands and development on the historical water supply for the 57-year period from water year 1922 through 1978. The studies assume coordinated operation of State Water Project and Central Valley Project facilities in accordance with the draft Coordinated Operation Agreement.

Such studies, together with flow distribution and salinity models, provide monthly data on reservoir storage and releases, Delta inflows, exports, outflows, internal Delta flows, and salinities. The water supply studies evaluated for the effects of additional pumps and the southern Delta modifications were made at the 1990 level of development, with exports based on operation of the State Water Project and Central Valley Project in compliance with Decision 1485. Five of these studies were made; each with a different assumption concerning the Banks Pumping Plant, Clifton Court Forebay, and southern Delta channel improvements. These studies with their assumptions are shown below.

C—105655

C-105655

Study No.	Corresponds to Alternatives	5820A Amended Constraints	Assumed Southern Delta Modifications
1	0-6.4, 2-6.4, 4-6.4	No	None
2	2-7.3, 4-7.3	Yes	None
3	4-10.3	Yes	None
4	2-8.5, 4-8.5	No	Yes
5	4-10.3	No	Yes

All five studies were operated to meet a State Water Project 1990-level demand of 3.16 million acre-feet. This demand reflects about a 250,000 acre-foot per year reduction due to conservation. Large shortages in both agricultural and municipal and industrial demands were taken when necessary to prevent storage in Oroville Reservoir from being drawn below a minimum operating level of about 850,000 acre-feet. The required deficiencies, in percentages, are shown in Table B-1.

Increased firm yields for the studies with additional pumps were estimated by comparing exports at South Bay Aqueduct and Dos Amigos Pumping Plant during the critical period. These comparisons are shown in Table B-2.

All five studies assumed a 1.5 million acre-foot ground water storage reservoir and an enlarged East Branch California Aqueduct. The East Branch ground water reservoir was operated as an integral component of the State Water Project.

Assumed maximum infiltration and extraction rates were:

Infiltration - 20,000 acre-feet per month
Extraction - 30,000 acre-feet per month

The exports shown in Table B-2 do not include water delivered from the ground water reservoir during the critical period. Increased ground water yields for the studies with additional pumps were estimated by comparing ground water deliveries during the critical period, as shown in Table B-3.

The increased ground water yields are due to greater storage prior to the critical period by operation of additional pumps at Banks Pumping Plant.

Studies 3 and 5 both assumed full capacity pumping (10,300 cubic feet per second). In Study 5, however, high monthly export rates were considered to be available more frequently because the restrictions of 5820A Amended do not apply. The following tabulation compares the frequencies of high monthly export rates from the two studies.

C—105656

C-105656

Export Rate (cfs)	Study 3		Study 5	
	Months	% of Time	Months	% of Time
8,000	31	4.5	109	15.9
9,000	9	1.3	99	14.5
10,000	4	0.6	87	12.7

Delta flow and salinity data from the five 1990-level operation studies are shown in Tables B-4, B-5, and B-6. Decision 1485 standards are also shown. Monthly exports at Banks Pumping Plant are shown, by year-type, in Table 5-2 and are plotted in Figure B-1.

The outflows were averaged according to the five main water year classification types in Decision 1485. The averages include some special year types, when Decision 1485 outflow standards for fish are reduced. Monthly Delta outflows are shown, by year-type, in Table 5-4 and plotted in Figure B-2. The number of main and special year types averaged are:

Main Type	No. of Years	Special Year Types for Fish	
		Name	No. of Years
Wet	19	Subnormal snowmelt	2
Above Normal	10	Subnormal snowmelt	1
Below Normal	10	Subnormal snowmelt	4
Dry	10	Dry following critical	2
Critical	8	None	-
Total	57		9

Summary Comparison with Previous Operation Studies

The foregoing 57-year operation studies are different in many respects from the previous operation studies that were analyzed in the draft environmental impact report. They incorporate updated assumptions on water development, improvements in statewide and Delta models, and represent more efficient operation of the State Water Project in maximizing diversion of unregulated Delta flows and minimizing diversions under regulated flow conditions.

The estimated firm yield increases are comparable for the two sets of operation studies. Both sets were based on Decision 1485 outflow requirements and May through July export limits. Both sets assumed the Decision 1485 standards at Collinsville in all year types and adequate facilities in Suisun Marsh, however, the updated studies are based on new estimates of flow at Emmaton and on the North Delta Water Agency contract.

Tables B-7 and B-8 compare the two sets of operation studies.

Power Operation Studies

The water supply studies provide, among other data, monthly water export estimates for the Banks and Tracy pumping plants. The resulting exports at

the Banks Pumping Plant, however, do not account for electrical power aspects of State Water Project operations, or for the shift from on-peak to off-peak pumping attributable to additional units.

To quantify the power cost savings from the additional pumps and the economic benefits, power operation studies were made for the California Aqueduct system. Whereas the water supply studies simulate monthly operation to meet a target export demand with historical hydrology, power studies simulate monthly operation to meet increasing demands with statistical hydrology over the analysis period. The power operation studies minimize annual net on-peak capacity requirements for the aqueduct system. They represent optimization of aqueduct operations under the operational variables to achieve the most uniform distribution possible of required monthly supplemental power capacity for the entire aqueduct. They are integrated with the off-aqueduct power resources projected to be available for the State Water Project.

For this final report, power optimization studies were made for alternatives 0-6.3, 2-6.4, 4-6.4, 2-7.3(Corps), and 4-7.3(Corps). These five power studies are different from the three power studies described in the draft report. These updated studies were all based on median water supply conditions in the Delta. These conditions represent a high level of unregulated Delta water supplies during winter and spring. Median water supplies are determined on a monthly basis from statistical analyses of long-term hydrologic data. The monthly supplies are constrained by factors such as pumping capacity at Banks Pumping Plant, Corps constraints, and the Decision 1485 constraints in May, June, and July. The operation studies included wheeling for the Central Valley Project. They accounted for increasing entitlement deliveries, recreation and wildlife mitigation water, evaporative and seepage losses from aqueduct and reservoirs, and storage changes south of the Delta.

The study period was 1990 to 2020. The two annual export levels in the five studies were:

Annual Export (in million-acre-feet)	Year Reached	Alternatives
3.45	2000	0-64, 2-6.4, 4-6.4
3.9	2010	2-7.3(Corps), 4-7.3(Corps)

The only difference in the first three studies is the amount of on-peak power shift to off-peak at the Banks Pumping Plant. There was no change in the operation of other pumping and power plants. In the second two studies, winter exports were increased, summer exports were reduced, and operation of other pumping and power plants was modified.

Table B-9 shows the annual power requirements at Banks Pumping Plant from the first three studies; Table B-10 shows the power requirements from the second two studies.

The State Water Project system net energy requirements and the supplemental on-peak capacity requirements (with recovery generation) from all five studies are shown below:

C—105658

C-105658

SWP System

Alternative	Net Energy 1991	(Billion kWh) 2020	Capacity 1991	(Megawatts) 2020
0-6.4	5.664	7.066	487	843
2-6.4	5.664	7.066	450	797
4-6.4	5.664	7.066	414	770
2-7.3(Corps)	5.668	8.068	459	967
4-7.3(Corps)	5.668	8.068	432	930

Analysis of Direct Fish Impacts

The projected 1990 direct fish impacts at the Delta Complex (Clifton Court Forebay, John E. Skinner Delta Fish Protective Facility, and Banks Pumping Plant) were estimated for (1) screenable sized striped bass and salmon, (2) unscreenable striped bass eggs and larvae, and (3) salvage of other fish.

Screenable Sized Striped Bass and Chinook Salmon

The calculations for screenable sized striped bass and chinook salmon involved 31 steps for each month of the year. The 31 steps are explained in Table B-11. The calculations are shown in Table B-12 for Alternative 0-6.4 (no-project) and in Table B-13 for Alternative 4-7.3(Corps) (preferred).

Table B-14 shows the estimated average monthly screen efficiencies at the Skinner Fish Facility for 1968 through 1980. The average monthly salvage densities (fish per acre-foot) for these 13 years were divided by the historical monthly efficiencies to determine the number of bass and salmon encountering the screens per acre-foot of water pumped. These latter values were used in Tables B-12 and B-13 (Steps 14 and 25) to determine the number of fish salvaged (Steps 15 and 26), the number released alive (Steps 16 and 27), the number entering Clifton Court Forebay (Steps 17 and 28), and total system losses (Steps 18 and 29). Mortality rates used in the estimates are:

	Clifton Court Forebay	Handling and Hauling (after salvage)
Striped Bass	10%	20%
Chinook Salmon	75%	47%

Salvage estimates, made from Figure B-3, show relationships between approach velocities and screening efficiencies with the enlarged fish facility. Figure B-4 was used to determine approach velocities (Steps 8 and 9).

Striped Bass Eggs and Larvae

A Department of Fish and Game memorandum dated July 12, 1983, is attached to this appendix. The memorandum presents estimates of eggs and larvae entrainment for 1968 through 1977, excluding 1974. These estimates are shown for various size ranges less than 19 millimetres at Banks Pumping Plant and at

the Federal Tracy Pumping Plant. Survival rates to age one year were applied to determine yearling equivalents.

Table B-15 shows the calculations for 1990 entrainment of striped bass eggs and larvae at the Delta Complex under Alternative 0-6.4. These estimates were calculated by multiplying the historical average egg and larva density by the projected 57-year average monthly exports during the entrainment period, April through August. These estimates used the same size ranges and the same survival rates to age one year.

Salvage Calculations for Other Fish

Average annual salvage estimates for other fish species were estimated by multiplying the projected average monthly exports from the 1990-level operation studies by the historical (1968-80) average monthly salvage densities. As salvage estimates decrease or increase, direct losses would also decrease or increase. Salvage estimates for selected other species are summarized in Table B-17.

Summary Comparison with Previous Operation Studies

Table B-16 compares the direct impacts on striped bass and chinook salmon for the no-project and preferred alternatives, as calculated from the previous operation studies and from the updated operation studies. This comparison shows:

- Less impacts on striped bass with the updated studies.
- Less impacts on striped bass with the additional pumps than with the existing pumps, based on analysis with the updated operation studies.
- A 2 percent increase in impacts on chinook salmon with the additional pumps, compared to the estimate with the previous operation studies.

Table B-17 compares the salvage estimates for selected other fish for the no-project and preferred alternatives, as calculated from the previous operation studies and from the updated operation studies. This comparison shows:

- Less impacts on all the selected species with the updated studies.
- Less impacts on most other species with the additional pumps than with the existing pumps, based on analysis with the updated operation studies. The exceptions are steelhead rainbow trout, yellowfin goby, and inland silverside.

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Table B-1

REQUIRED STATE WATER PROJECT DEFICIENCIES
(Values in Percent)

	Agricultural					Municipal and Industrial				
Year	Study 1	Study 2	Study 3	Study 4	Study 5	Study 1	Study 2	Study 3	Study 4	Study 5
1924	75	75	75	65	65	25	25	25	15	15
1925	25	25	25	25	25	0	0	0	0	0
1926	25	0	0	0	0	0	0	0	0	0
1929	40	50	50	50	50	40	25	25	25	25
1930	15	15	15	15	15	15	15	15	15	15
1931	80	75	75	65	65	30	25	25	15	15
1932	50	40	40	35	35	25	15	15	10	10
1933	70	60	60	35	35	45	60	60	35	35
1934	32	32	30	34	31	32	32	30	34	31
1935	20	20	20	20	20	20	20	20	20	20
1937	20	25	25	25	25	20	0	0	0	0
1939	25	25	25	25	25	0	0	0	0	0
1944	25	0	0	0	0	0	0	0	0	0
1947	25	0	0	0	0	0	0	0	0	0
1948	25	25	25	25	25	0	0	0	0	0
1949	25	25	25	25	0	0	0	0	0	0
1950	20	25	25	25	0	20	0	0	0	0
1960	25	25	25	25	0	0	0	0	0	0
1961	25	25	25	25	0	0	0	0	0	0
1962	25	25	25	25	0	0	0	0	0	0
1976	50	50	50	50	50	0	0	0	0	0
1977	90	85	85	85	85	40	35	35	35	35

Table B-2

ESTIMATED FIRM YIELD INCREASES
(Values in Thousand Acre-Feet)

	Study 1	Study 2	Study 3	Study 4	Study 5
Total Critical Period Export	12,797	13,180	13,224	13,982	14,049
Difference From Study 1	--	383	427	1,185	1,252
Approximate Increase in State Water Project Yield	--	57	64	178	188

Table B-3

ESTIMATED INCREASES IN GROUND WATER YIELD
(Values in Thousand Acre-Feet)

	Study 1	Study 2	Study 3	Study 4	Study 5
Total Critical Period Ground Water Deliveries	1,216	1,275	1,276	1,500	1,500
Difference From Study 1	--	59	60	284	284
Approximate Increase in Ground Water Yield	--	9	9	43	43

Table B-4

AVERAGE MONTHLY FLOWS IN DELTA CHANNELS
1990-LEVEL OPERATION STUDY, 57-YEAR HYDROLOGIC PERIOD (1922 THROUGH 1978)
(Values in Cubic Feet per Second)

Year Type	Study*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
SACRAMENTO RIVER AT SACRAMENTO													
No Decision 1485 flow standards at this station.													
Wet	1	15,508	20,832	37,816	51,845	58,370	46,186	36,770	34,865	25,246	20,478	15,592	12,542
(19-year	2	16,188	21,301	38,264	52,401	58,496	46,129	36,914	34,815	25,220	19,795	14,588	12,949
average)	3	16,223	21,396	38,449	52,542	58,520	46,138	36,914	34,828	25,218	19,562	14,587	13,007
	4	14,222	20,552	39,877	54,107	58,608	46,386	36,881	34,752	24,665	19,370	15,229	10,300
	5	14,114	20,644	40,906	54,236	58,667	46,374	36,894	34,773	24,665	19,177	15,191	13,092
Below	1	13,788	15,943	18,910	17,935	32,198	26,007	16,437	15,447	16,553	17,524	14,531	10,456
Normal	2	14,631	16,231	19,393	18,272	32,303	26,236	16,693	15,271	15,962	16,397	13,102	10,492
(10-year	3	14,650	16,226	19,217	18,355	32,566	26,030	16,241	15,356	15,910	16,301	13,102	10,497
average)	4	13,530	14,787	18,233	18,716	32,818	26,005	16,320	15,021	15,221	17,265	15,115	10,443
	5	13,533	15,001	17,726	17,898	32,789	26,021	16,357	15,159	15,532	17,633	15,444	10,720
Critical	1	12,990	13,674	15,286	13,609	14,000	10,677	7,762	8,244	9,540	11,057	9,699	8,315
(8-year	2	12,966	13,980	15,349	13,940	14,342	10,563	7,569	8,236	9,556	10,966	9,427	8,317
average)	3	12,948	13,978	15,349	13,934	14,364	10,533	7,569	8,236	9,556	10,968	9,490	8,327
	4	12,377	11,688	13,163	14,922	15,199	10,490	8,470	8,390	9,598	11,130	10,962	8,327
	5	12,423	11,711	12,671	12,665	15,708	11,633	8,359	8,376	9,613	11,216	12,271	8,344
GEORGIANA SLOUGH AND DELTA CROSS CHANNEL													
No Decision 1485 flow standards at this station.													
Wet	1	6,280	6,733	6,497	6,414	6,897	6,149	6,383	6,049	7,050	8,090	6,659	5,765
(19-year	2	6,471	6,835	6,581	6,492	6,910	5,879	6,424	6,034	7,042	7,890	6,364	5,884
average)	3	6,481	6,846	6,610	6,514	6,913	5,880	6,424	6,036	7,042	7,822	6,364	5,901
	4	5,897	6,599	6,410	6,691	6,922	5,912	6,422	6,013	6,880	7,765	6,552	5,936
	5	5,869	6,612	6,527	6,471	6,928	5,904	6,419	6,019	6,880	7,709	6,541	5,926
Below	1	6,130	6,761	6,768	5,034	4,598	4,950	6,906	6,616	6,940	7,224	6,348	5,154
Normal	2	6,377	6,846	6,872	5,116	4,609	4,987	6,981	6,565	6,767	6,894	5,929	5,164
(10-year	3	6,382	6,844	6,819	5,118	4,636	4,926	6,849	6,589	6,751	6,866	5,959	5,166
average)	4	6,054	6,423	6,532	5,703	4,662	5,458	6,872	6,491	6,549	7,149	6,519	5,150
	5	6,055	6,485	6,380	5,463	4,659	5,462	6,883	6,532	6,641	7,256	6,615	5,231
Critical	1	5,896	6,096	6,569	6,077	6,192	5,218	4,364	4,505	4,885	5,330	4,932	4,526
(8-year	2	5,889	6,186	6,587	6,174	6,292	5,185	4,308	4,503	4,890	5,303	4,852	4,527
average)	3	5,884	6,186	6,587	6,173	6,299	5,176	4,308	4,503	4,890	5,304	4,870	4,530
	4	5,716	5,515	5,947	6,462	6,543	5,164	4,572	4,548	4,902	5,351	5,302	4,530
	5	5,730	5,522	5,803	5,801	6,693	5,498	4,539	4,544	4,907	5,376	5,685	4,535
DELTA CROSS CHANNEL													
Decision 1485 flow standards at this station are: To minimize cross-Delta movement of salmon, gates are closed when Delta outflow index is greater than 12,000 cfs during the period January 1 through April 15. To minimize diversion of young striped bass into the central Delta, the same standard applies for up to 20 days from April 16 through May 31, but for no more than 2 out of 4 consecutive days, at the discretion of the Department of Fish and Game.													
Wet	1	3,798	3,702	1,717	189	0	507	1,710	1,573	3,565	5,096	4,168	3,588
(19-year	2	3,918	3,756	1,755	209	0	242	1,737	1,563	3,560	4,966	3,977	3,665
average)	3	3,925	3,757	1,765	217	0	242	1,737	1,563	3,559	4,922	3,976	3,676
	4	3,547	3,597	1,418	233	0	249	1,738	1,548	3,454	4,885	4,098	3,699
	5	3,531	3,601	1,429	0	0	242	1,734	1,553	3,454	4,849	4,091	3,692
Below	1	3,825	4,23[illegible]	3,936	2,301	397	1,386	4,328	4,140	4,350	4,535	3,966	3,192
Normal	2	3,985	4,289	3,990	2,349	397	1,399	4,377	4,107	4,238	4,320	3,694	3,198
(10-year	3	3,989	4,288	3,955	2,342	397	1,360	4,291	4,123	4,228	4,302	3,694	3,199
average)	4	3,776	4,015	3,769	2,890	397	1,894	4,306	4,059	4,097	4,485	4,077	3,189
	5	3,776	4,055	3,670	2,735	397	1,987	4,313	4,085	4,156	4,555	4,139	3,242
Critical	1	3,673	3,803	4,109	3,791	3,865	3,234	2,680	2,771	3,018	3,306	3,048	2,785
(8-year	2	3,669	3,861	4,121	3,854	3,930	3,212	2,643	2,770	3,021	3,288	2,996	2,785
average)	3	3,665	3,861	4,121	3,853	3,934	3,206	2,643	2,770	3,021	3,289	3,008	2,787
	4	3,557	3,426	3,706	4,040	4,093	3,198	2,814	2,799	3,029	3,320	3,288	2,787
	5	3,566	3,430	3,612	3,611	4,190	3,415	2,793	2,797	3,032	3,336	3,536	2,790

* Study 1 covers Alternatives 0-6.4, 2-6.4, and 4-6.4
Study 2 covers Alternatives 2-7.3(Corps) and 4-7.3(Corps)
Study 3 covers Alternative 4-10.3(Corps)
Study 4 covers Alternatives 2-8.5 and 4-8.5
Study 5 covers Alternative 4-10.3

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Table B-4 (continued)

AVERAGE MONTHLY FLOWS IN DELTA CHANNELS
1990-LEVEL OPERATION STUDY, 57-YEAR HYDROLOGIC PERIOD (1922 THROUGH 1978)
(Values in Cubic Feet per Second)

Year Type	Study*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
SAN JOAQUIN RIVER AT SAN ANDREAS LANDING													
No Decision 1485 flow standards at this station.													
Wet	1	8,426	8,450	9,291	12,736	13,470	11,391	11,113	9,295	8,998	7,698	6,287	6,157
(19-year	2	8,617	8,552	9,326	12,711	13,401	11,118	11,182	9,280	8,996	7,527	6,052	6,259
average)	3	8,627	8,563	9,327	12,644	13,268	11,250	11,240	9,281	8,996	7,469	6,052	6,270
	4	8,043	8,316	9,090	12,867	13,412	11,237	11,215	9,267	8,877	7,429	6,196	6,274
	5	8,015	8,329	9,159	12,671	13,464	11,302	11,253	9,274	8,877	7,381	6,187	6,260
Below	1	8,825	8,128	7,646	6,157	7,758	6,760	7,631	6,997	6,698	6,468	5,935	5,149
Normal	2	9,072	8,213	7,710	6,195	7,696	6,778	7,703	6,942	6,565	6,177	5,565	5,156
(10-year	3	9,077	8,211	7,653	6,171	7,648	6,728	7,615	6,967	6,553	6,152	5,565	5,157
average)	4	8,749	7,790	7,450	6,783	7,704	7,209	7,602	6,932	6,410	6,402	6,086	5,144
	5	8,750	7,852	7,303	6,651	7,625	7,203	7,614	6,946	6,485	6,495	6,165	5,201
Critical	1	7,845	7,231	6,622	6,425	6,517	5,391	4,926	4,589	4,459	4,712	4,615	4,510
(8-year	2	7,838	7,320	6,629	6,501	6,582	5,371	4,893	4,587	4,462	4,689	4,546	4,511
average)	3	7,832	7,320	6,626	6,500	6,585	5,363	4,893	4,587	4,462	4,690	4,561	4,514
	4	7,665	6,649	6,136	6,736	6,787	5,344	5,046	4,616	4,470	4,728	4,941	4,513
	5	7,679	6,656	6,051	6,180	6,931	5,580	5,027	4,613	4,473	4,748	5,287	4,517

SACRAMENTO RIVER AT RIO VISTA

Decision 1485 flow standards at this station (for salmon migration) are:

Year Type	Jan	Feb 1-Mar 15	Mar 16-Jun 30	Jul	Aug	Sep 1-Dec 31
Wet	2,500	3,000	5,000	3,000	1,000	5,000
Below Normal	2,500	2,000	3,000	2,000	1,000	2,500
Critical	1,500	1,000	2,000	1,000	1,000	1,500

Wet	1	9,443	14,861	39,541	69,089	73,536	49,050	39,030	28,498	17,022	10,944	8,058	6,238
(19-year	2	9,933	15,228	39,905	69,567	73,649	49,264	39,132	28,464	17,003	10,461	7,348	6,525
average)	3	9,958	15,312	40,062	69,686	73,671	49,273	39,132	28,475	17,002	10,296	7,347	6,566
	4	8,541	14,715	41,690	71,073	73,750	49,488	39,101	28,422	16,611	10,160	7,800	6,652
	5	8,461	14,794	42,601	d71,423	73,802	49,484	39,118	28,436	16,611	10,024	7,774	6,627
Below	1	7,329	8,996	12,308	13,483	30,009	21,708	9,149	8,184	8,337	8,855	7,319	4,772
Normal	2	7,925	9,199	12,688	13,737	30,103	21,901	9,329	8,060	7,916	8,055	6,305	4,794
(10-year	3	7,938	9,196	12,565	13,818	30,339	21,755	9,010	8,120	7,879	7,987	6,305	4,797
average)	4	7,146	8,179	11,869	13,544	30,565	21,199	9,066	7,883	7,392	8,669	7,729	4,759
	5	7,149	8,330	11,512	13,015	30,539	21,210	9,092	7,981	7,611	8,929	7,961	4,956
Critical	1	6,801	7,322	8,595	7,864	7,954	5,356	2,953	3,035	3,418	4,308	3,929	3,277
(8-year	2	6,784	7,539	8,639	8,098	8,196	5,273	2,812	3,025	3,429	4,241	3,736	3,278
average)	3	6,771	7,537	8,639	8,094	8,212	5,252	2,812	3,025	3,427	4,242	3,781	3,286
	4	6,368	5,916	7,094	8,793	8,802	5,224	3,448	3,132	3,457	4,349	4,815	3,284
	5	6,401	5,932	6,747	7,197	9,162	6,029	3,369	3,122	3,465	4,410	5,741	3,295
SAN JOAQUIN RIVER BELOW OLD RIVER													
No Decision 1485 flow standards at this station.													
Wet	1	1,433	1,179	386	1,380	2,603	1,900	1,521	1,489	1,542	83	-107	153
(19-year	2	1,433	1,179	336	1,278	2,522	1,898	1,548	1,489	1,548	112	- 47	136
average)	3	1,433	1,179	308	1,189	2,386	2,029	1,606	1,489	1,548	123	- 47	130
	4	1,433	1,179	272	1,234	2,521	1,984	1,584	1,498	1,590	139	- 91	98
	5	1,433	1,179	223	1,258	2,567	2,057	1,625	1,498	1,590	148	- 89	94
Below	1	1,883	1,257	160	245	805	337	- 44	164	- 38	-179	-149	43
Normal	2	1,883	1,257	121	202	732	318	- 47	161	3	-140	-100	40
(10-year	3	1,883	1,257	117	176	658	328	- 3	161	5	-137	-100	39
average)	4	1,883	1,257	201	202	688	278	- 39	224	64	-169	-169	42
	5	1,883	1,257	205	310	612	267	- 38	198	48	-184	-186	18
Critical	1	1,418	1,122	- 88	- 91	- 57	28	431	210	80	- 23	- 36	31
(8-year	2	1,418	1,122	-100	-112	- 93	41	455	211	78	- 19	- 25	31
average)	3	1,418	1,122	-103	-111	- 96	42	455	211	78	- 19	- 28	30
	4	1,418	1,122	47	-164	-139	36	343	195	74	- 28	- 80	30
	5	1,418	1,122	106	- 60	-144	- 63	358	196	72	- 33	-118	29

* Study 1 covers Alternatives 0-6.4, 2-6.4, and 4-6.4
Study 2 covers Alternatives 2-7.3(Corps) and 4-7.3(Corps)
Study 3 covers Alternative 4-10.3(Corps)
Study 4 covers Alternatives 2-8.5 and 4-8.5
Study 5 covers Alternative 4-10.3

C—105663

C-105663

Table B-4 (continued)

AVERAGE MONTHLY FLOWS IN DELTA CHANNELS
1990-LEVEL OPERATION STUDY, 57-YEAR HYDROLOGIC PERIOD (1922 THROUGH 1978)
(Values in Cubic Feet per Second)

Year Type	Study*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
SAN JOAQUIN RIVER AT ANTIOCH													
No Decision 1485 flow standards at this station.													
Wet	1	-330	-901	2,109	7,652	8,066	4,988	5,215	5,550	4,792	-437	-766	-518
(19-year	2	-386	-1,003	1,562	7,065	8,064	4,769	5,542	5,528	4,815	- 76	-214	-590
average)	3	-374	-993	1,342	6,628	8,291	6,004	6,200	5,529	4,817	63	-211	-619
	4	-526	-1,653	411	7,227	8,038	5,679	5,612	5,595	5,331	279	-573	-889
	5	-1,055	-2,248	-254	6,882	8,530	6,460	6,094	5,604	5,331	383	-551	-917
Below	1	877	-1,149	-262	-1,246	1,738	-1,367	-201	2,804	749	-1,470	-1,152	-202
Normal	2	730	-1,204	-642	-1,644	1,009	-802	14	2,699	1,289	-1,060	-639	-227
(10-year	3	737	-1,205	-681	-1,812	314	-642	395	2,731	1,340	-1,026	-639	-232
average)	4	541	-1,227	143	-1,280	558	-793	- 44	3,276	1,921	-1,382	-1,357	-205
	5	- 44	-1,263	311	-427	-391	-1,103	- 13	3,023	1,646	-1,555	-1,505	-400
Critical	1	1,107	-997	-1,589	-1,337	-1,422	-315	1,998	1,584	1,176	425	642	936
(8-year	2	1,048	-1,147	-1,667	-1,607	-1,796	-104	2,174	1,592	1,163	503	839	934
average)	3	1,066	-1,149	-1,685	-1,604	-1,817	-102	2,174	1,592	1,163	501	777	921
	4	446	-784	- 30	-2,285	-2,362	-165	1,338	1,454	1,124	279	73	930
	5	- 69	-767	443	-1,090	-2,576	-931	1,446	1,468	1,113	198	-338	911
TRACY PUMPING PLANT EXPORTS													
Decision 1485 flow standards at this station, to minimize diversion of young striped bass from the Delta, are that mean monthly diversions may not exceed 3,000 cfs during May and June of all year types.													
Wet	1	4,106	4,219	4,214	4,212	4,231	4,359	4,470	2.992	3,008	4,603	4,603	4,538
(19-year	2	4,071	4,219	4,214	4,212	4,231	4,359	4,470	2,992	3,008	4,603	4,603	4,538
average)	3	4,071	4,219	4,214	4,212	4,231	4,359	4,470	2,992	3,008	4,600	4,603	4,511
	4	4,220	4,202	4,214	4,212	4,231	4,359	4,470	2,992	2,988	4,600	4,603	4,538
	5	4,220	4,202	4,214	4,212	4,231	4,359	4,470	2,992	2,988	4,600	4,603	4,538
Below	1	4,084	4,218	4,228	4,212	4,231	4,359	4,470	2,992	3,008	4,557	4,603	4,538
Normal	2	4,082	4,180	4,228	4,212	4,231	4,359	4,470	2,992	2,969	4,504	4,603	4,538
(10-year	3	4,082	4,180	4,228	4,212	4,231	4,359	4,470	2,992	2,969	4,504	4,603	4,538
average)	4	4,168	4,220	4,228	4,212	4,231	4,359	4,470	2,992	2,864	4,540	4,603	4,538
	5	4,152	4,220	4,228	4,212	4,231	4,359	4,470	2,992	2,880	4,548	4,603	4,538
Critical	1	3,869	4,006	4,220	4,210	4,218	3,155	2,849	2,832	2,538	2,849	3,029	3,674
(8-year	2	3,867	4,008	4,220	4,210	4,215	2,932	2,849	2,832	2,542	2,849	3,029	3,674
average)	3	3,869	4,008	4,220	4,210	4,215	2,932	2,849	2,832	2,542	2,849	3,029	3,674
	4	3,940	4,092	4,220	4,210	4,215	3,041	2,863	2,832	2,525	2,849	3,029	3,674
	5	3,940	4,092	4,220	4,210	4,215	2,863	2,823	2,832	2,517	2,849	3,029	3,674

* Study 1 covers Alternatives 0-6.4, 2-6.4, and 4-6.4
Study 2 covers Alternatives 2-7.3(Corps) and 4-7.3(Corps)
Study 3 covers Alternative 4-10.3(Corps)
Study 4 covers Alternatives 2-8.5 and 4-8.5
Study 5 covers Alternative 4-10.3

C—105664

C-105664

Table B-5

AVERAGE MONTHLY SALINITIES IN DELTA CHANNELS
1990-LEVEL OPERATION STUDY, 57-YEAR HYDROLOGIC PERIOD (1922 THROUGH 1978)
(Values in Milligrams per Liter Chlorides)

Year Type	Study*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
SACRAMENTO RIVER AT RIO VISTA													
No Decision 1485 salinity standards at this station. Water quality criteria are in North Delta Water Agency contract.													
Wet (19-year average)	1	16	14	11	10	10	11	11	11	12	13	15	17
	2	15	14	11	10	10	11	11	11	12	13	15	17
	3	15	14	11	10	10	10	11	11	12	13	15	17
	4	17	15	11	10	10	11	11	11	12	13	15	17
	5	17	15	11	10	10	10	11	11	12	13	15	17
Below Normal (10-year average)	1	17	16	14	14	11	12	14	14	14	16	17	19
	2	16	16	14	14	11	12	14	14	14	16	17	19
	3	16	16	15	14	11	12	14	14	14	16	17	19
	4	17	17	14	14	11	12	15	14	14	16	17	19
	5	17	17	15	14	11	12	15	14	14	16	17	19
Critical (8-year average)	1	17	17	16	16	16	19	20	20	20	20	20	21
	2	17	17	16	16	17	18	20	20	20	20	20	21
	3	17	17	16	16	17	19	20	20	20	20	20	21
	4	18	19	16	16	16	19	20	20	20	20	19	21
	5	18	19	16	16	17	19	20	20	20	20	18	21
OLD AND MIDDLE RIVER AT NORTH BACON ISLAND													
No Decision 1485 salinity standards at this station.													
Wet (19-year average)	1	42	39	26	29	24	20	18	21	28	18	21	25
	2	42	39	26	28	24	24	17	21	28	18	19	25
	3	42	39	26	27	23	27	18	21	28	18	19	25
	4	40	43	25	27	26	21	18	21	28	18	21	27
	5	42	46	25	28	23	24	18	21	28	18	21	27
Below Normal (10-year average)	1	39	47	41	46	24	20	16	15	17	26	32	27
	2	40	47	41	46	23	20	16	15	17	25	29	28
	3	40	47	40	46	23	20	17	15	17	25	29	28
	4	37	50	40	48	23	19	17	16	17	25	34	26
	5	52	36	47	23	23	20	17	16	17	26	35	27
Critical (8-year average)	1	34	53	51	50	41	36	26	19	16	22	24	17
	2	34	54	49	52	44	33	26	19	16	22	23	17
	3	34	54	49	52	44	33	26	19	16	22	23	17
	4	29	46	34	59	49	31	23	19	16	23	31	18
	5	29	47	30	50	48	38	23	18	17	23	40	18
BANKS PUMPING PLANT													
Decision 1485 salinity standards at this station are 250 mg/L maximum mean daily chlorides. State Water Project objectives are 100 mg/L monthly average chlorides.													
Wet (19-year average)	1	43	41	35	45	29	24	24	24	27	21	24	27
	2	44	41	34	42	28	25	24	24	27	21	23	27
	3	44	41	34	40	27	26	24	24	27	21	23	27
	4	42	45	34	41	28	25	24	24	28	21	24	29
	5	44	48	34	42	29	26	25	24	28	21	24	29
Below Normal (10-year average)	1	41	49	50	59	30	23	21	20	20	29	35	30
	2	42	49	49	58	29	23	20	20	21	29	32	31
	3	42	49	49	58	28	23	21	20	21	29	32	31
	4	39	52	50	60	28	22	21	21	22	29	37	29
	5	40	54	47	61	28	23	21	21	22	29	38	30
Critical (8-year average)	1	37	56	60	63	45	41	38	26	23	30	30	22
	2	37	56	57	64	49	39	39	26	23	29	30	22
	3	37	56	58	64	49	39	39	26	23	29	30	22
	4	31	49	46	70	53	37	32	26	23	30	37	22
	5	32	50	43	64	53	42	33	26	24	30	45	22

* Study 1 covers Alternatives 0-6.4, 2-6.4, and 4-6.4
Study 2 covers Alternatives 2-7.3(Corps) and 4-7.3(Corps)
Study 3 covers Alternative 4-10.3(Corps)
Study 4 covers Alternatives 2-8.5 and 4-8.5
Study 5 covers Alternative 4-10.3

C-105665

C-105665

Table B-5 (continued)

AVERAGE MONTHLY SALINITIES IN DELTA CHANNELS
1990-LEVEL OPERATION STUDY, 57-YEAR HYDROLOGIC PERIOD (1922 THROUGH 1978)
(Values in Milligrams per Liter Chlorides)

Year Type	Study*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
TRACY PUMPING PLANT													
Decision 1485 salinity standards at this station 250 mg/L maximum mean daily chlorides.													
Wet	1	52	53	65	56	45	44	52	55	46	43	49	54
(19-year	2	53	53	66	56	45	45	52	55	46	42	47	54
average)	3	53	53	65	56	45	45	52	55	46	42	47	54
	4	50	56	65	56	45	44	52	55	46	42	48	55
	5	52	58	66	58	45	45	52	55	46	42	48	55
Below	1	50	60	75	75	57	52	64	65	52	48	56	56
Normal	2	51	59	76	76	58	53	65	65	52	48	54	56
(10-year	3	51	59	76	76	58	52	64	65	52	48	54	56
average)	4	48	61	75	76	58	52	65	64	52	48	58	55
	5	49	63	72	75	58	52	65	65	52	48	59	56
Critical	1	48	65	84	88	71	78	77	63	52	55	63	54
(8-year	2	48	66	82	89	73	79	78	63	52	55	63	54
average)	3	48	66	83	89	73	79	78	63	52	55	63	54
	4	43	59	75	91	74	78	77	63	52	56	68	54
	5	43	60	71	89	74	86	78	63	54	56	75	54
OLD RIVER AT ROCK SLOUGH (2.5 MILES EAST OF CONTRA COSTA CANAL INTAKE)													
Decision 1485 salinity standards for municipal and industrial at this station are 250 mg/L maximum mean daily chlorides, and 150 mg/L at least 66% of the calendar year in wet years, 48% in below normal years, and 42% in critical years. Salinities at Rock Slough and at Contra Costa Canal Intake may be different due to local degradation.													
Wet	1	58	49	27	30	24	21	19	22	26	21	26	33
(19-year	2	60	50	28	28	24	24	19	22	26	20	22	33
average)	3	60	50	28	27	24	37	18	22	26	20	22	34
	4	54	56	28	27	40	22	19	22	26	19	25	37
	5	58	63	29	28	23	24	18	22	26	19	25	38
Below	1	52	66	58	57	25	25	18	16	19	37	48	37
Normal	2	56	65	59	58	24	25	19	16	19	36	41	38
(10-year	3	56	65	58	58	24	24	19	15	19	36	41	38
average)	4	49	69	56	63	24	23	19	17	18	37	51	35
	5	52	74	47	58	25	24	20	16	18	38	55	38
Critical	1	41	75	79	71	63	54	26	20	17	27	29	18
(8-year	2	41	77	74	75	70	48	27	20	17	27	28	18
average)	3	41	77	75	75	70	48	27	20	17	27	28	18
	4	30	59	43	89	79	45	23	19	17	30	44	18
	5	31	62	34	70	79	61	24	19	18	30	63	18
SAN JOAQUIN RIVER AT SAN ANDREAS LANDING													
Decision 1485 salinity standards for agriculture at this station (from April 1 through August 15) are a maximum 14-day running average of mean daily electrical conductivity (in millimhos) of: wet years and below normal years, 0.45 (70 mg/L chlorides); critical years, 0.87 (149 mg/L chlorides).													
Wet	1	41	38	23	25	19	17	16	20	24	17	19	23
(19-year	2	42	39	24	25	19	18	16	19	23	17	17	23
average)	3	42	38	24	24	18	19	16	19	23	17	17	24
	4	39	42	23	24	18	17	16	20	23	16	19	26
	5	41	45	24	24	18	18	16	20	23	16	19	26
Below	1	38	46	39	43	22	19	16	14	16	25	30	26
Normal	2	40	46	39	43	21	19	16	14	16	24	27	27
(10-year	3	40	46	39	43	21	19	16	14	16	24	27	27
average)	4	36	49	38	45	21	18	16	15	16	24	32	25
	5	38	51	34	44	21	19	16	15	16	25	33	26
Critical	1	33	52	49	47	39	34	24	17	13	20	20	16
(8-year	2	34	53	47	49	42	31	25	17	13	19	19	15
average)	3	34	53	47	49	43	31	25	17	13	19	19	15
	4	28	45	31	56	47	30	21	17	13	21	28	16
	5	29	46	28	47	47	37	22	17	14	21	38	16

* Study 1 covers Alternatives 0-6.4, 2-6.4, and 4-6.4
Study 2 covers Alternatives 2-7.3(Corps) and 4-7.3(Corps)
Study 3 covers Alternative 4-10.3(Corps)
Study 4 covers Alternatives 2-8.5 and 4-8.5
Study 5 covers Alternative 4-10.3

C—105666

C-105666

Table B-5 (continued)

AVERAGE MONTHLY SALINITIES IN DELTA CHANNELS
1990-LEVEL OPERATION STUDY, 57-YEAR HYDROLOGIC PERIOD (1922 THROUGH 1978)
(Values in Milligrams per Liter Chlorides)

Year Type	Study*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
SAN JOAQUIN RIVER AT ANTIOCH													

Decision 1485 salinity standards at this station for municipal and industrial are the same as, and are a substitute for, those at Old River at Rock Slough. When the CVP and SWP impose deficiencies, a relaxation provision for striped bass spawning from April 1 through May 5 of all year types is:

Deficiency (in MAF)	EC	Chlorides	
0	1.5	408	
0.5	1.9	533	
1.0	2.5	720	
1.5	3.4	1,000	
2.0	4.4	1.313	(Representative critical year deficiency.)

Year Type	Study*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Wet (19-year average)	1	781	480	105	32	21	31	51	46	70	148	334	652
	2	751	468	106	30	21	30	48	46	70	150	337	635
	3	749	465	105	29	21	30	46	46	70	150	337	634
	4	884	610	123	27	20	31	47	46	70	148	335	655
	5	921	661	137	26	20	28	45	46	70	149	336	662
Below Normal (10-year average)	1	841	672	482	375	55	81	165	216	276	431	663	957
	2	812	636	477	378	59	85	160	216	277	462	731	1,006
	3	811	636	480	381	61	89	160	217	277	465	733	1,007
	4	876	814	554	404	56	89	172	217	275	434	648	942
	5	900	838	558	417	61	102	187	220	277	430	639	933
Critical (8-year average)	1	1,016	951	746	645	634	801	1,015	1,192	1,333	1,409	1,480	1,559
	2	1,029	942	745	657	660	803	1,008	1,191	1,332	1,409	1,486	1,566
	3	1,029	942	747	659	661	805	1,010	1,192	1,333	1,410	1,487	1,567
	4	1,075	1,160	849	683	683	815	1,014	1,192	1,333	1,414	1,404	1,482
	5	1,078	1,167	847	691	683	804	1,006	1,188	1,332	1,412	1,290	1,367

JERSEY POINT ON SAN JOAQUIN RIVER

Decision 1485 salinity standards for agriculture at this station are a maximum 14-day running average mean daily EC (millimhos) of: Wet years = 0.45 (76 mg/L chlorides) 4/1-8/15; Below normal years = 0.45 (76 mg/L) 4/1-6/20 and 0.74 (163 mg/L) 6/20-8/15; Critical years = 2.20 (590 mg/L) 4/1-8/15.

Year Type	Study*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Wet (19-year average)	1	173	101	33	18	17	18	19	20	22	29	53	129
	2	166	99	33	18	17	18	19	20	22	29	54	125
	3	166	99	33	18	17	18	19	20	22	29	54	125
	4	201	135	35	18	17	18	19	20	22	28	53	130
	5	209	146	37	18	17	18	19	20	22	29	53	132
Below Normal (10-year average)	1	189	143	99	77	20	24	28	36	47	75	132	208
	2	182	133	97	77	21	24	28	36	47	83	149	222
	3	182	133	97	78	21	25	28	36	47	83	150	222
	4	199	182	119	85	21	24	30	36	47	76	128	204
	5	204	189	120	88	21	25	32	37	47	75	126	201
Critical (8-year average)	1	242	222	159	130	127	169	231	236	329	352	371	392
	2	246	219	158	133	133	170	228	286	329	352	372	394
	3	246	220	159	133	134	170	229	286	329	352	373	394
	4	257	280	191	140	139	173	230	286	329	353	350	370
	5	256	281	192	142	139	170	228	285	328	353	317	335

* Study 1 covers Alternatives 0-6.4, 2-6.4, and 4-6.4
Study 2 covers Alternatives 2-7.3(Corps) and 4-7.3(Corps)
Study 3 covers Alternative 4-10.3(Corps)
Study 4 covers Alternatives 2-8.5 and 4-8.5
Study 5 covers Alternative 4-10.3

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C-105667

Table B-6

AVERAGE MONTHLY SALINITIES IN DELTA CHANNELS AT HIGH TIDE
1990-LEVEL OPERATION STUDY, 57-YEAR HYDROLOGIC PERIOD (1922 THROUGH 1978)
(Values in Milligrams per Liter Chlorides)

Year Type	Study*	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
EMMATON ON SACRAMENTO RIVER													
Decision 1485 salinity standards for agriculture at this station are a maximum 14-day running average mean daily EC (millimhos) of: Wet years = 0.45 (88 mg/L chlorides) 4/1-8/15; Below normal years = 0.45 (88 mg/L) 4/1-6/20 and 1.14 (294 mg/L) 6/20-8/15; Critical years = 2.78 (785 mg/L) 4/1-8/15.													
Wet	1	261	149	46	18	15	15	17	17	19	21	56	146
(19-year	2	256	145	46	17	15	16	16	17	19	21	57	142
average)	3	256	145	45	17	15	16	16	17	19	21	57	142
	4	305	205	53	16	15	16	16	17	19	21	56	147
	5	316	225	57	16	15	15	16	17	19	21	56	148
Below	1	282	217	133	96	20	20	28	34	45	83	155	282
Normal	2	274	199	128	96	21	21	27	34	45	92	182	312
(10-year	3	274	200	129	97	22	22	28	34	45	93	184	312
average)	4	294	277	179	114	21	22	30	35	45	84	150	273
	5	302	287	182	118	22	26	34	36	45	83	146	268
Critical	1	393	355	244	175	171	238	358	482	570	623	646	676
(8-year	2	403	352	241	178	179	240	352	479	568	623	649	680
average)	3	403	352	241	178	180	241	354	480	569	623	649	680
	4	418	445	317	200	191	247	358	482	570	626	614	628
	5	410	442	316	204	192	241	353	480	569	626	565	560
COLLINSVILLE ON SACRAMENTO RIVER													
Decision 1485 salinity standards for this station and other stations west of Collinsville for Suisun Marsh at high tide and in all year types are:													
EC (mmhos) (monthly average of both daily high tides):							Oct 19.0	Nov/Dec 15.5	Jan 12.5	Feb/Mar 8.0	Apr/May 11.0		
Chlorides (mg/L)							6,300	5,100	4,100	2,550	3,600		
Wet	1	2,088	1,320	308	72	28	67	149	138	222	528	1,042	1,776
(19-year	2	2,024	1,280	306	65	29	66	140	138	224	533	1,103	1,662
average)	3	2,019	1,273	305	61	28	63	133	136	224	533	1,102	1,740
	4	2,335	1,626	368	54	27	65	136	136	224	527	1,095	1,782
	5	2,424	1,742	403	50	25	54	128	134	223	530	1,098	1,797
Below	1	2,244	1,807	1,309	1,026	190	261	612	773	927	1,336	1,825	2,492
Normal	2	2,168	1,722	1,298	1,051	208	270	591	775	933	1,404	1,987	2,386
(10-year	3	2,166	1,723	1,307	1,059	214	278	594	773	931	1,410	1,992	2,618
average)	4	2,324	2,113	1,479	1,098	198	292	633	775	926	1,343	1,792	2,455
	5	2,387	2,163	1,492	1,121	215	339	668	675	930	1,235	1,769	2,432
Critical	1	2,597	2,387	1,947	1,719	1,727	2,142	2,675	3,145	3,435	3,604	3,649	3,743
(8-year	2	2,629	2,370	1,942	1,744	1,784	2,146	2,653	3,137	3,432	3,603	3,661	3,756
average)	3	2,631	2,371	1,946	1,747	1,786	2,152	2,658	3,139	3,058	3,128	3,662	3,756
	4	2,747	2,819	2,191	1,803	1,832	2,177	2,672	3,145	3,436	3,619	3,512	3,596
	5	2,765	2,834	2,182	1,822	1,830	2,147	2,654	3,139	3,433	3,621	3,302	3,383

* Study 1 covers Alternatives 0-6.4, 2-6.4, and 4-6.4
Study 2 covers Alternatives 2-7.3(Corps) and 4-7.3(Corps)
Study 3 covers Alternative 4-10.3(Corps)
Study 4 covers Alternatives 2-8.5 and 4-8.5
Study 5 covers Alternative 4-10.3

C—105668

C-105668

Table B-7

COMPARISON OF MAJOR ASSUMPTIONS, PREVIOUS AND UPDATED OPERATION STUDIES

	Previous Studies	Updated Studies
Simulation Period	50 years (1922-1971)	57 years (1922-1978)
American River:		
Auburn Reservoir	Yes	No
Folsom South Demands	168,000 acre-feet	135,000 acre-feet
Decision 1400 Flows	Yes	Yes
New Melones Reservoir Operational Storage	1.2 million acre-feet	2.4 million acre-feet
Lake Oroville Minimum Operational Storage (approximate)	1.5 million acre-feet	0.85 million acre-feet
Delta Export Demands:		
CVP, Including Contra Costa Canal	3,580,000 acre-feet	3,399,000 acre-feet
SWP, Including North Bay	3,247,000 acre-feet	3,160,000 acre-feet
	6,827,000 acre-feet	6,559,000 acre-feet
CVP-SWP Coordination	Sharing surplus supplies and transportation capacity.	Coordinated Operation Agreement sharing split. CVP wheeling when capacity available.
CVP Deficiencies	1924 - - - - - - - - - - 25% 1931 to 1934 - - - - - 25%	1924 - - - - - - - - - - 25% 1929, 31, 33, 34, 76 - 25% 1977 - - - - - - - - - - 50%
Delta Consumptive Use	1977 values (DWR)	1981 values

The previous studies had no specific ground water facilities; intermittent deliveries for ground water storage were added, as described in Appendix B of the draft report. Intermittent yield potential was estimated on an average annual basis.

C—105669

C-105669

Table B-8

COMPARISON OF AVERAGE ANNUAL AND MONTHLY EXPORTS AT BANKS PUMPING PLANT
PREVIOUS AND UPDATED OPERATION STUDIES
(Values in Acre-Feet)

	Previous Studies (50-Year Average)		Updated Studies (57-Year Average)	
	0-6.3	4-7.3(Corps)	0-6.4	4-7.3(Corps)
October	286,000	286,000	297,000	312,000
November	301,000	301,000	331,000	347,000
December	337,000	353,000	375,000	401,000
January	376,000	419,000	386,000	427,000
February	347,000	361,000	350,000	388,000
March	351,000	339,000	359,000	370,000
Subtotal, October-March	1,998,000	2,059,000	2,098,000	2,245,000
April	335,000	336,000	291,000	286,000
May	168,000	168,000	151,000	155,000
June	152,000	152,000	137,000	130,000
July	237,000	237,000	192,000	158,000
August	362,000	362,000	164,000	102,000
September	292,000	292,000	129,000	134,000
Subtotal, April-September	1,546,000	1,547,000	1,064,000	965,000
TOTAL	3,544,000	3,606,000	3,162,000	3,209,000

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Table B-9

ANNUAL POWER REQUIREMENTS AT BANKS PUMPING PLANT —
3.45 MILLION ACRE-FOOT EXPORT LEVEL

	1991	1995	2000	2005	2010	2015	2020
Alternative 0-6.4							
Capacity (megawatts)	148	148	157	157	157	157	157
Energy (million kilowatt-hours)							
On-Peak	374	438	454	454	451	453	453
Off-Peak	559	569	571	571	570	571	571
Alternative 2-6.4							
Capacity (megawatts)	102	102	111	111	111	111	111
Energy (million kilowatt-hours)							
On-Peak	243	290	304	304	302	302	302
Off-Peak	690	717	721	721	719	721	721
Alternative 4-6.4							
Capacity (megawatts)	74	74	74	74	74	74	74
Energy (million kilowatt-hours)							
On-Peak	153	171	185	185	183	184	184
Off-Peak	780	836	840	840	838	840	840

Table B-10

ANNUAL POWER REQUIREMENTS AT BANKS PUMPING PLANT —
3.9 MILLION ACRE-FOOT EXPORT LEVEL

	1991	1995	2000	2005	2010	2015	2020
Alternative 2-7.3(Corps)							
Capacity (megawatts)	157	148	167	176	176	176	176
Energy (million kilowatt-hours)							
On-Peak	245	289	338	388	428	430	430
Off-Peak	710	717	724	732	728	739	739
Alternative 4-7.3(Corps)							
Capacity (megawatts)	130	121	139	139	139	139	139
Energy (million kilowatt-hours)							
On-Peak	162	206	255	291	319	320	321
Off-Peak	793	800	807	830	848	848	849

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C-105671

Table B-11

EXPLANATION OF LOSS ESTIMATES FOR SCREENABLE SIZED STRIPED BASS AND CHINOOK SALMON AT STATE WATER PROJECT EXPORT FACILITIES (For Tables B-12 and B-13)

Step	Explanation
1	Total monthly pumping quantities in acre-feet for period under consideration. Note that May is split to reflect operation of the fish facility for chinook salmon the first half and for striped bass the second half.
2	Quantity pumped off-peak, in acre-feet.
3	Quantity pumped on-peak, in acre-feet.
4	Off-peak proportion. Step 2 divided by Step 1.
5	On-peak proportion. Step 3 divided by Step 1.
6	Off-peak quantity converted to pumping rate (cubic feet per second).
7	On-peak quantity converted to pumping rate (cubic feet per second).
8	Off-peak rate converted to velocity (feet per second), from Figure B-5.
9	On-peak rate converted to velocity (feet per second), from Figure B-5.
10	Off-peak efficiency for striped bass, based on Figure B-4. Note that May is split to reflect efficiency for yearlings and young-of-the- year.
11	On-peak efficiency for striped bass, based on Figure B-4.
12	Weighted efficiency for striped bass. Step 4 times Step 10, plus Step 5 times Step 11.
13	Striped bass per acre-foot encountering the fish screen at the Skinner Fish Facility, 1968-1980. This historical period is used to determine density of fish.
14	Number of striped bass encountering the fish screen at the Skinner Fish Facility. Step 13 times Step 1.
15	Number of striped bass salvaged. Step 14 times Step 12.
16	Number of striped bass released alive. Step 15 times 0.8 to account for 20 percent mortality in handling and hauling.
17	Number of striped bass entering Clifton Court Forebay. Step 14 divided by 0.9 to account for a 10 percent mortality in Clifton Court Forebay.
18	Total export system striped bass loss. Step 17 minus Step 16.
19	Yearling equivalent factor. Yearling Equivalent (YE) Factor is e^{-zt}; where e = natural log, z = 0.0117 (normal mortality rate), t = number of days from mid-month to March 1. In March, April, and May, all striped bass lost are yearlings, thus, e^{-zt} = 1.000. Monthly factors are:

	t	-zt	YE Factor
January	44	-0.5148	0.59762
February	14	-0.1638	0.84891
March			1.000
April			1.000
May			1.000
June	258	-3.0186	0.04887
July	228	-2,6676	0.06942
August	197	-2.3049	0.09977
September	166	-1.9422	0.14339
October	136	-1.5912	0.20368
November	105	-1.2285	0.29273
December	75	-0.8775	0.41582

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C-105672

Table B-11 (continued)

EXPLANATION OF LOSS ESTIMATES FOR SCREENABLE SIZED STRIPED BASS AND CHINOOK SALMON AT STATE WATER PROJECT EXPORT FACILITIES (For Tables B-12 and B-13)

Step	Explanation
	An additional Yearling Equivalent Factor of 0.034 is also needed for young-of-the-year in May.
20	Striped bass yearling equivalent loss. Step 18 times Step 19.
21	Off-peak efficiency for chinook salmon, based on Figure B-4.
22	On-peak efficiency for chinook salmon, based on Figure B-4.
23	Weighted efficiency for chinook salmon. Step 4 times Step 21, plus Step 5 times Step 22.
24	Chinook salmon per acre-foot encountering the fish screen at the Skinner Fish Facility, 1968 to 1980.
25	Number of chinook salmon encountering the fish screen at the Skinner Fish Facility. Step 24 times Step 1.
26	Number of chinook salmon salvaged. Step 25 times Step 23.
27	Number of chinook salmon released alive. Step 26 times 0.53 to account for 47 percent mortality in handling and hauling.
28	Number of chinook salmon entering Clifton Court Forebay. Step 25 divided by 0.25 to account for 75 percent mortality in Clifton Court Forebay.
29	Total export system chinook salmon loss. Step 28 minus Step 27.
30	Yearling equivalent factor (losses in April, May, June, and July converted to yearlings at the rate of six fingerlings equal one yearling).
31	Chinook salmon yearling equivalent loss. Step 29 times Step 30.

C-105674

Table B-12

DIRECT LOSS ESTIMATES FOR SCREENABLE SIZED STRIPED BASS AND CHINOOK SALMON -- ALTERNATIVE 0-6.4
(57-Year Average Monthly Export)

	Jan	Feb	Mar	Apr	May 1-14		May 15-31		June	July	August	Sep	Oct	Nov	Dec	Total
1 Total Ac-Ft	386,500	350,300	359,400	290,900	75,700		75,700		137,200	191,800	164,300	128,800	297,300	330,700	374,600	3,163,400
2 Off-Peak Ac-Ft	196,000	177,000	196,000	190,000	75,700		75,700		137,200	191,800	164,300	128,000	196,000	190,000	196,000	
3 On-Peak Ac-Ft	190,500	173,300	163,400	100,900	-		-		-	-	-	-	101,300	140,700	178,600	
4 Off-Peak Prop	0.51	0.51	0.55	0.65	1.0		1.0		1.0	1.0	1.0	1.0	0.66	0.57	0.52	
5 On-Peak Prop	0.49	0.49	0.45	0.35	-		-		-	-	-	-	0.34	0.43	0.48	
6 Off-Peak cfs	6,375	6,374	6,375	6,386	4,925		4,925		4,612	6,247	5,347	4,329	6,375	6,386	6,375	
7 On-Peak cfs	6,197	6,241	5,315	3,391	-		-		-	-	-	-	3,295	4,729	5,809	
8 Off-Peak Vel	3.0	3.0	3.0	3.0	2.9		1.6		1.5	2.1	1.8	1.4	2.1	3.0	3.0	
9 On-Peak Vel	2.9	2.8	3.0	2.9	-		-		-	-	-	-	1.0	2.9	2.7	
Striped Bass					Yearling	Young/Yr	Yearling	Young/Yr								
10 Off-Peak Eff	0.750	0.750	0.750	0.750	0.752	0.25	0.840	0.25	0.670	0.691	0.864	0.851	0.809	0.750	0.750	
11 On-Peak Eff	0.752	0.762	0.750	0.767	-	-	-	-	-	-	-	-	0.876	0.755	0.769	
12 Weighted Eff	0.751	0.756	0.750	0.756	0.752	0.25	0.840	0.25	0.670	0.691	0.864	0.851	0.832	0.752	0.759	
13 Fish/Ac-Ft Exp	0.8880	0.5312	0.2721	0.2042	0.3408	10.92	0.2957	10.92	106.721	65.1298	11.0133	0.8959	0.5801	0.6875	0.7344	
14 Total Fish Exp	343,212	186,079	97,793	59,402	25,799	826,644	22,384	826,644	14,642,121	12,491,896	1,809,485	115,392	172,464	227,356	275,106	
15 Total Salvaged	257,752	140,676	73,345	44,908	19,401	206,661	18,803	206,661	9,810,221	8,631,900	1,563,395	98,199	143,490	170,972	208,806	
16 Released Alive	206,202	112,541	58,676	35,926	15,521	165,329	15,042	165,329	7,848,177	6,905,520	1,250,716	78,559	114,792	136,778	167,045	17,276,153
17 Total Fish-CCF	381,347	206,754	108,659	66,002	28,666	918,493	24,871	918,493	16,269,023	13,879,884	2,010,539	128,213	191,627	252,618	305,673	35,690,862
18 Total Fish Loss	175,145	94,213	49,983	30,076	13,145	753,164	9,829	753,164	8,420,846	6,974,364	759,823	49,654	76,835	115,840	138,628	18,414,709
19 YE Factor	0.59762	0.84891	1.0000	1.0000	1.0000	0.034	1.0000	0.034	0.04887	0.06942	0.09977	0.14339	0.20368	0.29273	0.41582	
20 YE Loss	104,670	79,979	49,983	30,076	13,145	25,6086	9,829	25,608	411,527	484,160	75,808	7,120	15,650	33,910	57,644	1,424,717
Chinook Salmon																
21 Off-Peak Eff	0.732	0.732	0.732	0.777		0.770		0.717	0.705	0.734	0.665	0.640	0.682	0.732	0.732	
22 On-Peak Eff	0.725	0.722	0.732	0.623		-		-	-	-	-	-	0.620	0.728	0.715	
23 Weighted Eff	0.729	0.727	0.732	0.775		0.770		0.717	0.705	0.734	0.665	0.640	0.661	0.730	0.724	
24 Fish/Ac-Ft Exp	0.0498	0.0173	0.0382	0.1691		0.3565		0.3866	0.1504	0.0138	0.0008	0.0016	0.047	0.0278	0.0420	
25 Total Fish Exp	19,248	6,060	13,729	49,191		26,987		29,266	20,635	2,647	131	206	13,973	9,193	15,733	206,999
26 Total Salvaged	14,032	4,406	10,050	38,123		20,780		20,984	14,548	1,943	87	132	9,236	6,711	11,391	
27 Released Alive	7,437	2,335	5,326	20,205		11,013		11,122	7,710	1,030	46	70	4,895	3,557	6,037	80,783
28 Total Fish-CCF	76,992	24,240	54,916	196,764		107,948		117,064	82,540	10,588	524	824	55,892	36,772	62,932	827,996
29 Total Fish Loss	69,555	21,905	49,590	176,559		96,935		105,942	74,830	9,558	478	754	50,997	33,215	56,895	747,213
30 YE Factor	1.0000	1.0000	1.0000	0.167		0.167		0.167	0.167	0.167	1.0000	1.0000	1.0000	1.0000	1.0000	
31 YE Loss	69,555	21,905	49,590	29,485		16,188		17,692	12,497	1,596	478	754	50,997	33,215	56,895	360,847

YE = Yearling Equivalent
CCF = Clifton Court Forebay

C-105674

Table B-13

DIRECT LOSS ESTIMATES FOR SCREENABLE SIZED STRIPED BASS AND CHINOOK SALMON — ALTERNATIVE 4-7.3
(57-Year Average Monthly Export)

	Jan	Feb	Mar	Apr	May 1-14		May 15-31		June	July	August	Sep	Oct	Nov	Dec	Total
1 Total Ac-Ft	426,600	387,800	369,900	286,200	77,450		77,450		130,400	157,700	102,000	133,800	312,200	347,100	400,800	3,209,400
2 Off-Peak Ac-Ft	296,000	268,000	296,000	286,200	77,450		77,450		130,400	157,700	102,000	133,800	296,000	288,000	296,000	
3 On-Peak Ac-Ft	130,600	119,800	73,900	-	-		-		-	-	-	-	16,200	59,100	104,800	
4 Off-Peak Prop	0.69	0.69	0.80	1.0	1.00		1.00		1.0	1.0	1.0	1.0	0.95	0.83	0.74	
5 On-Peak Prop	0.31	0.31	0.20	-	-		-		-	-	-	-	0.05	0.17	0.26	
6 Off-Peak cfs	9,628	9,652	9.628	9,620	9,620		5,039		4,383	5,130	3,318	4,497	9,628	9,680	9,628	
7 On-Peak cfs	4,248	4,314	2,403	-	-		-		-	-	-	-	527	1,986	3,409	
8 Off-Peak Vel	3.1	3.1	3.1	3.1	3.0		1.7		1.4	1.7	1.1	1.5	3.1	3.1	3.1	
9 On-Peak Vel	3.3	3.3	2.9	-	-		-		-	-	-	-	0.2	2.4	2.7	
Striped Bass					Yearling	Young/Yr	Yearling	Young/Yr								
10 Off-Peak Eff	0.740	0.740	0.740	0.740	0.748	0.25	0.831	0.25	0.679	0.728	0.917	0.045	0.740	0.740	0.740	
11 On-Peak Eff	0.730	0.730	0.754	-	-	-	-	-	-	-	-	-	0.926	0.785	0.768	
12 Weighted Eff	0.737	0.737	0.743	0.740	0.748	0.25	0.831	0.25	0.679	0.728	0.917	0.845	0.749	0.748	0.747	
13 Fish/Ac-Ft Exp	0.8880	0.5312	0.2721	0.2042	0.3408	10.92	0.2957	10.92	106.721	65.1298	11.0133	0.8959	0.5801	0.6875	0.7344	
14 Total Fish Exp	378,821	205,999	100,650	58,442	26,395	845,754	22,902	845,754	13,916,418	10,270,969	1,123,357	119,871	181,107	238,631	294,348	
15 Total Salvaged	279,191	151,822	74,783	43,247	19,743	211,439	19,032	211,439	9,449,248	7,477,265	1,030,118	101,291	135,649	178,496	219,878	
16 Released Alive	223,353	121,458	59,826	34,598	15,794	169,151	15,226	169,151	7,559,398	5,981,812	824,094	81,033	108,519	142,797	175,902	15,682,112
17 Total Fish-CCF	420,912	228,888	111,833	64,936	29,328	939,727	25,447	939,727	15,462,687	11,412,188	1,248,174	133,190	201,230	265,146	327,053	31,810,466
18 Total Fish Loss	197,559	107,430	52,007	30,338	13,534	770,576	10,221	770,576	7,903,289	5,436,376	424,080	52,157	92,711	122,349	151,151	16,128,354
19 YE Factor	0.59762	0.84891	1.0000	1.0000	1.0000	0.034	1.0000	0.034	0.04887	0.06942	0.09977	0.14339	0.20368	0.29273	0.41582	
20 YE Loss	118,065	91,198	52,007	30,338	13,534	26,200	10,221	26,200	386,234	376,977	42,310	7,479	18,883	35,815	62,852	1,298,313
Chinook Salmon																
21 Off-Peak Eff	0.738	0.738	0.738	0.782		0.774		0.715	0.700	0.715	0.622	0.647	0.738	0.738	0.738	
22 On-Peak Eff	0.749	0.749	0.725	-		-		-	-	-	-	-	0.574	0.698	0.715	
23 Weighted Eff	0.741	0.741	0.735	0.782		0.774		0.715	0.700	0.715	0.622	0.647	0.735	0.730	0.734	
24 Fish/Ac-Ft Exp	0.0498	0.0173	0.0382	0.1691		0.3565		0.3866	0.1504	0.0138	0.0008	0.0016	0.0470	0.0278	0.0420	
25 Total Fish Exp	21,245	6,709	14,130	48,396		27,611		29,942	19,612	2,176	82	214	14,673	9,649	16,834	
26 Total Salvaged	15,743	4,971	10,386	37,846		21,371		21,409	13,728	1,556	51	138	1,071	7,043	12,356	
27 Released Alive	8,344	2,635	5,505	20,058		11,327		11,347	7,276	825	27	73	5,677	3,733	6,549	83,376
28 Total Fish-CCF	84,980	26,836	56,520	193,584		110,444		119,768	78,448	8,704	328	856	58,692	38,596	67,336	845,092
29 Total Fish Loss	76,636	24,201	51,015	173,526		99,117		108,421	71,172	7,879	301	783	53,015	34,863	60,782	761,716
30 YE Factor	1.0000	1.0000	1.0000	0.167		0.167		0.167	0.167	0.167	1.0000	1.0000	1.0000	1.0000	1.0000	
31 YE Loss	76,636	24,701	51,015	28,979		16,553		18,106	11,886	1,316	301	783	53,015	34,863	60,782	378,436

YE = Yearling Equivalent
CCF = Clifton Court Forebay

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Table B-14

ESTIMATED SCREEN EFFICIENCY AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY FOR STRIPED BASS AND CHINOOK SALMON
1968 TO 1980

	Jan	Feb	Mar	Apr	May 1-14	May 15-31	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Acre-Feet	160,327	112,941	97,457	78,557	39,421	47,869	97,183	109,416	162,942	135,805	111,310	125,859	158,041
Off-Peak Acre-Feet	128,262	91,482	83,813	73,844	37,056	44,997	88,437	96,286	148,277	124,941	95,727	110,756	140,656
On-Peak Acre-Feet	32,065	21,459	13,644	4,713	2,365	2,872	8,746	13,130	14,665	10,864	15,583	15,103	17,385
Off-Peak Proportion	0.80	0.81	0.86	0.94	0.94	0.94	0.91	0.88	0.91	0.92	0.86	0.88	0.89
On-Peak Proportion	0.20	0.19	0.14	0.06	0.06	0.06	0.09	0.12	0.09	0.08	0.14	0.12	0.11
Off-Peak cfs	4,172	3,295	2,726	2,482	2,669	2,669	2,973	3,132	4,823	4,200	3.114	3,723	4,575
On-Peak cfs	1,043	773	444	158	170	170	294	427	477	365	507	508	565
Off-Peak Velocity	2.4	1.9	3.2	2.9	3.1	1.6	1.7	1.8	2.8	2.5	1.8	2.2	2.7
On-Peak Velocity	1.2	0.9	0.5	0.2	0.2	0.1	0.2	0.3	0.3	0.2	0.3	0.6	0.7
Striped Bass													
Off-Peak Efficiency*	0.78	0.81	0.74	0.75	0.74*	0.82*	0.28	0.37	0.44	0.78	0.81	0.79	0.76
On-Peak Efficiency*	0.85	0.86	0.89	0.90	0.90*	0.91*	0.45	0.58	0.88	0.90	0.90	0.87	0.87
Monthly Efficiency*	0.79	0.82	0.76	0.76	0.72*	0.83*	0.30	0.40	0.48	0.79	0.82	0.80	0.77
Salvage/Ac-Ft*	0.7015	0.4356	0.2068	0.1552	0.2454	0.2454	32.0163	26.0519	5.2864	0.7078	0.4757	0.5500	0.5655
Encounter Screens/Ac-Ft*	0.8880	0.5312	0.2731	0.2042	0.3408	0.2957	106.7210	65.1298	11.0133	0.8959	0.5801	0.6875	0.7344
Chinook Salmon													
Off-Peak Efficiency	0.71	0.68	0.75	0.77	0.78*	0.71*	0.71	0.72	0.73	0.71	0.67	0.70	0.72
On-Peak Efficiency	0.64	0.62	0.60	0.64	0.64*	0.63*	0.64	0.64	0.59	0.58	0.59	0.60	0.61
Monthly Efficiency	0.70	0.67	0.73	0.76	0.77*	0.71*	0.70	0.71	0.72	0.70	0.66	0.69	0.71
Salvage/Ac-Ft*	0.0349	0.0116	0.0279	0.1285	0.2745*	0.2745*	0.1053	0.0098	0.0006	0.0011	0.0310	0.0192	0.0298
Encounter Screens/Ac-Ft*	0.0498	0.0173	0.0382	0.1691	0.3565*	0.3866*	0.1504	0.0138	0.0008	0.0016	0.0470	0.0278	0.0420

Assumptions: November 1 - May 14, Bays 3A and 3B open at pumping rates less than 3,150 cubic feet per second.
Bays 1, 2, 3A, and 3B open at rates above 3,150 cubic feet per second.
May 15 - October 31, Bays 1, 2, 3A, and 3B open at all pumping rates.

* In May, efficiencies are for yearling striped bass only; densities are 30 percent of striped bass actually salvaged.

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Table B-15

PROJECTED 1990 ENTRAINMENT OF STRIPED BASS EGGS AND LARVAE
ALTERNATIVE 0-6.4

Date	1968-1977 (-1974) Density per Cubic Metre					1990 SWP Exports (cubic metres)*	1990 Entrainment				
	Eggs	3-6mm	7-10mm	11-14mm	15-18mm		Eggs	3-6mm	7-10mm	11-14mm	15-18mm
4/01 - 4/10	0.00222	0.01974	0.00232			119,578,095	0.265	2,360	0.277	-	-
4/11 - 4/20	0.02091	0.07804	0.00528			119,578,095	2,500	9,332	0.631	-	-
4/21 - 4/30	0.10882	0.15926	0.01865	0.00051		119,578,095	13,012	19,044	2,230	0.061	-
5/01 - 5/10	0.38683	0.30850	0.02142	0.00046		60,217,073	23,294	18,577	1,290	0.028	-
5/11 - 5/20	0.06614	1.68840	0.10922	0.00111		60,217,073	3,983	101,671	6,577	0.067	-
5/21 - 5/30	0.06101	4.73822	0.42032	0.00606	0.00022	60,217,073	3,674	285,322	25,310	0.365	0.013
5/31 - 6/09	0.04212	2.14153	0.55540	0.02201	0.00359	56,979,050	2,400	122,022	31,646	1,254	0.205
6/10 - 6/19	0.01856	1.32065	0.20380	0.02965	0.00636	56,401,532	1,047	74,487	11,495	1,672	0.359
6/20 - 6/29	0.00425	0.62156	0.09113	0.01431	0.00613	56,401,532	0.240	35,057	5,140	0.807	0.346
6/30 - 7/09	0.00755	0.37964	0.05587	0.00653	0.00310	74,297,886	0.561	28,206	4,151	0.485	0.230
7/10 - 7/19		0.33817	0.02273	0.00551	0.00117	76,286,373	-	25,798	1,734	0.420	0.089
7/20 - 7/29			0.00194	0.00021	0.00045	76,286,373	-	-	0.148	0.016	0.002
7/30 - 8/08			0.00181	0.00014	0.00006	67,539,978	-	-	0.122	0.009	0.004
8/09 - 8/18			0.00007			65,353,379	-	-	0.005	-	-
					Totals (in millions)		50.976	721.876	90.756	5.184	1.248
					Grand Total = 870.040						
					Survival Rate		0.000047	0.000124	0.000338	0.002509	0.006415
					Yearly Equivalent		2,396	89,513	30,675	13,007	8,006
					Annual YE = 161,368						
					Grand Total = 143,597						

* Cubic Metres = Cubic Feet per Second times 24,458.6

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Table B-16

COMPARISON OF DIRECT ENTRAINMENT AND LOSS ESTIMATES FOR STRIPED BASS AND CHINOOK SALMON, PREVIOUS AND UPDATED OPERATION STUDIES
(Average Annual Values, in Million Fish per Year)

	Previous Studies (50-Year Average)		Updated Studies (57-Year Average)	
	0-6.3	4-7.3(Corps)	0-6.4	4-7.3(Corps)
Striped Bass				
Juveniles				
Entrainment	44.642	44.714	35.691	31.810
Released Alive	21.796	20.836	17.276	15.682
Loss	22.846	23.878	18.415	16.128
Yearling Equivalents	1.718	1.824	1.425	1.298
Eggs and Larvae				
Entrainment Loss	974	974	870	856
Yearling Equivalents	0.161	0.161	0.144	0.140
Total Yearling Equivalents	1.879	1.985	1.569	1.438
Difference	--	0.106	--	-0.131
Chinook Salmon				
Entrainment	0.902	0.913	0.828	0.845
Released Alive	0.089	0.091	0.081	0.083
Loss	0.813	0.822	0.747	0.762
Yearling Equivalents	0.361	0.370	0.361	0.378
Difference	--	0.009	--	0.017

C-105678

C-105678

Table B-17

COMPARISON OF SALVAGE ESTIMATES FOR SELECTED OTHER FISH SPECIES*
PREVIOUS AND UPDATED OPERATION STUDIES
(Average Annual Values, in Fish per Year)

	Previous Studies (50-Year Average)		Updated Studies (57-Year Average)	
	0-6.3	4-7.3(Corps)	0-6.4	4-7.3(Corps)
Anadromous Fish				
Steelhead Rainbow Trout	7,800	7,900	7,600	7,900
American Shad	1,809,500	1,823,600	1,446,500	1,347,500
White Sturgeon	4,700	4,700	3,300	2,900
Green Sturgeon	2,000	2,000	1,300	1,200
Resident Game Fish				
White Catfish	1,744,900	1,746,800	1,331,300	1,224,200
Channel Catfish	42,900	43,200	34,800	30,500
Black Crappie	30,400	30,500	24,300	23,100
Bluegill	18,200	18,300	11,000	10,400
Starry Flounder	5,700	5,700	4,600	4,100
Resident Non-Game Fish				
Threadfin Shad	4,412,000	4,444,000	3,119,500	2,812,800
Sacramento Splittail	192,500	194,700	168,600	166,500
Hardhead	24,600	24,600	20,300	18,900
Carp	35,400	35,400	28,800	25,000
Bigscale Logperch	9,900	9,900	8,400	8,000
Longfin Smelt	114,700	114,800	97,600	92,500
Delta Smelt	1,004,400	1,014,500	855,100	813,200
Prickly Sculpin	146,000	146,200	123,300	120,900
Yellowfin Goby	116,800	119,100	115,600	119,200
Inland Silverside	21,600	22,600	20,800	21,700

* Losses increase or decrease with salvage estimates.

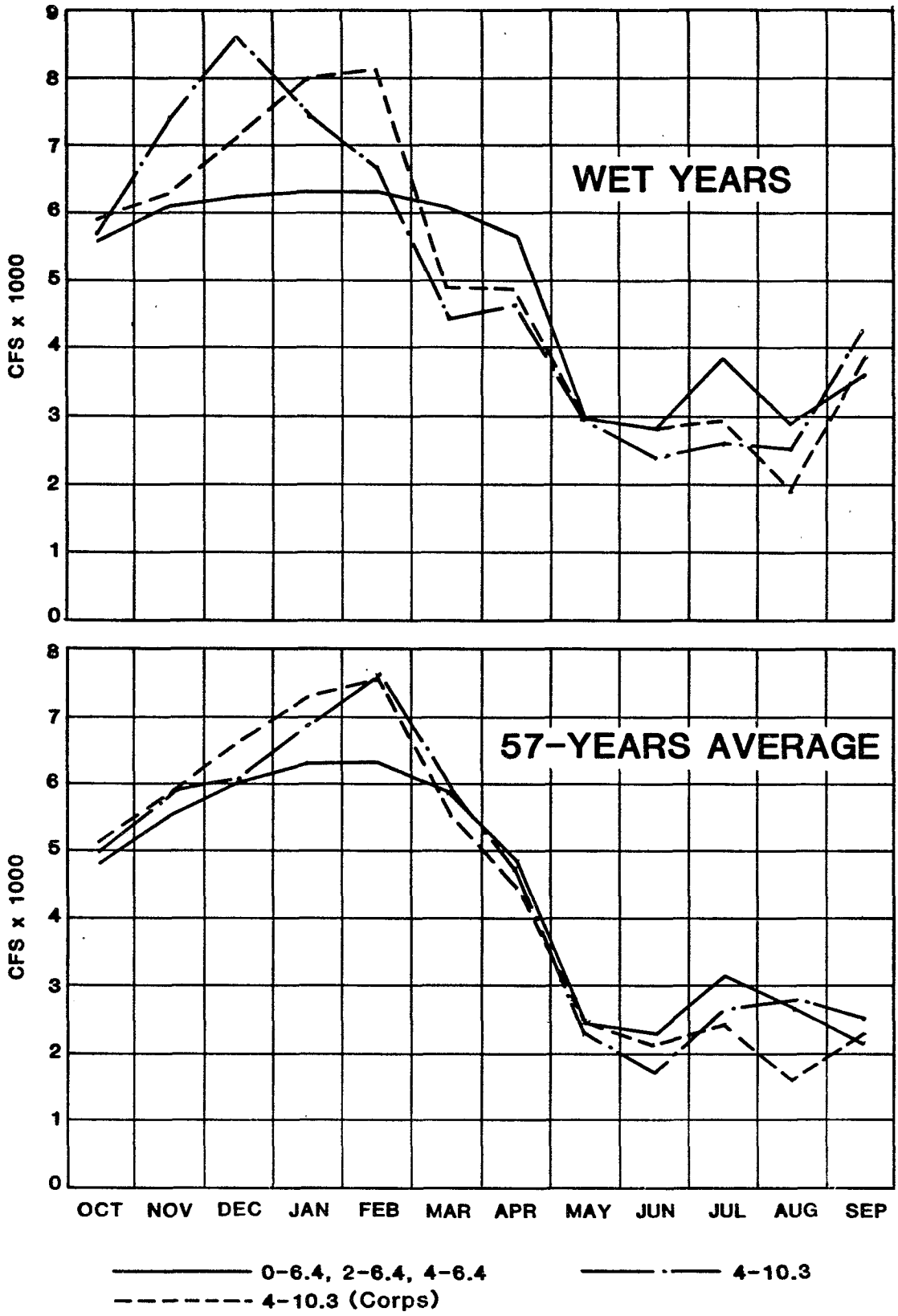

FIGURE B-1. EXPORTS AT BANKS PUMPING PLANT

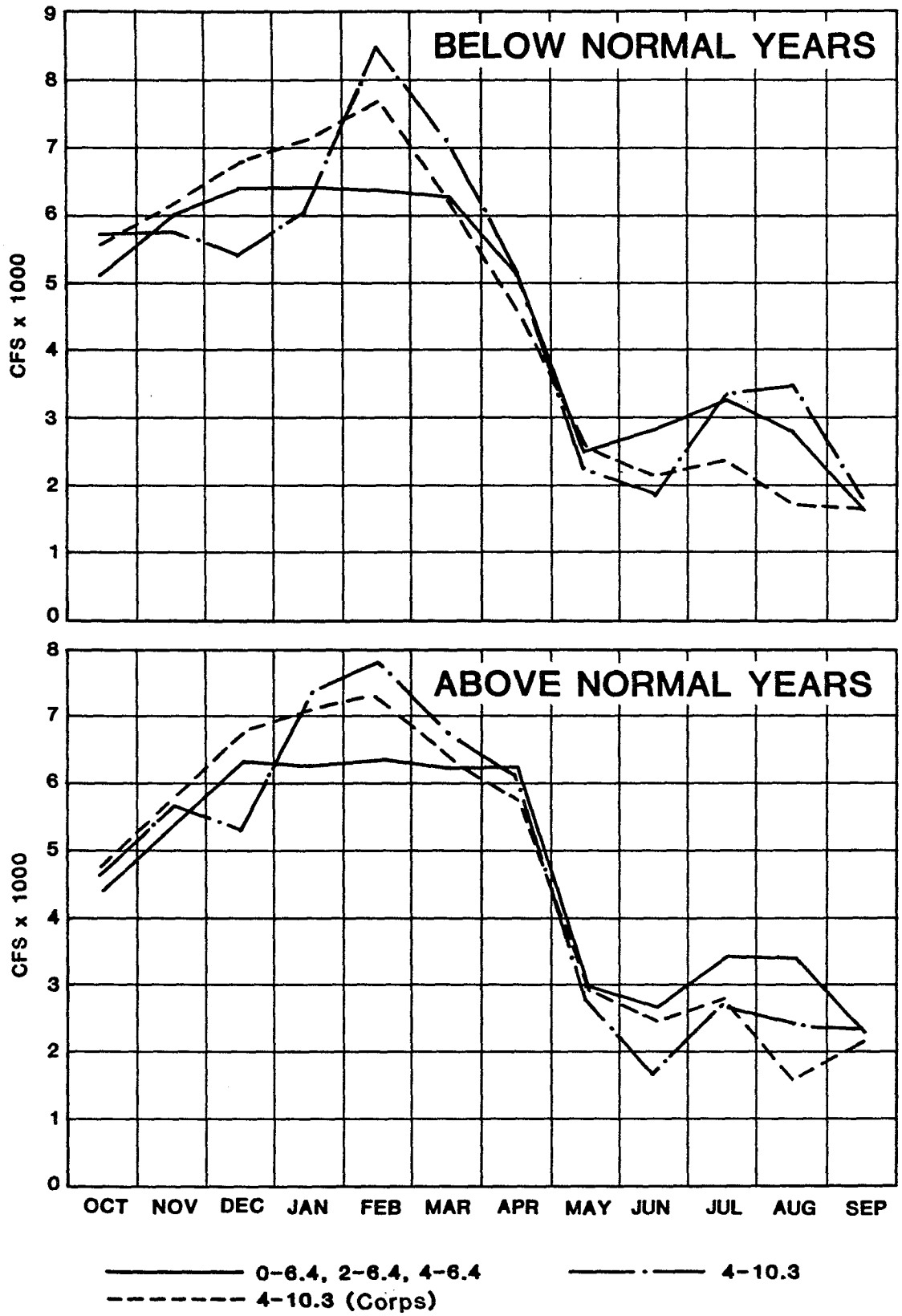

FIGURE B-1. EXPORTS AT BANKS PUMPING PLANT

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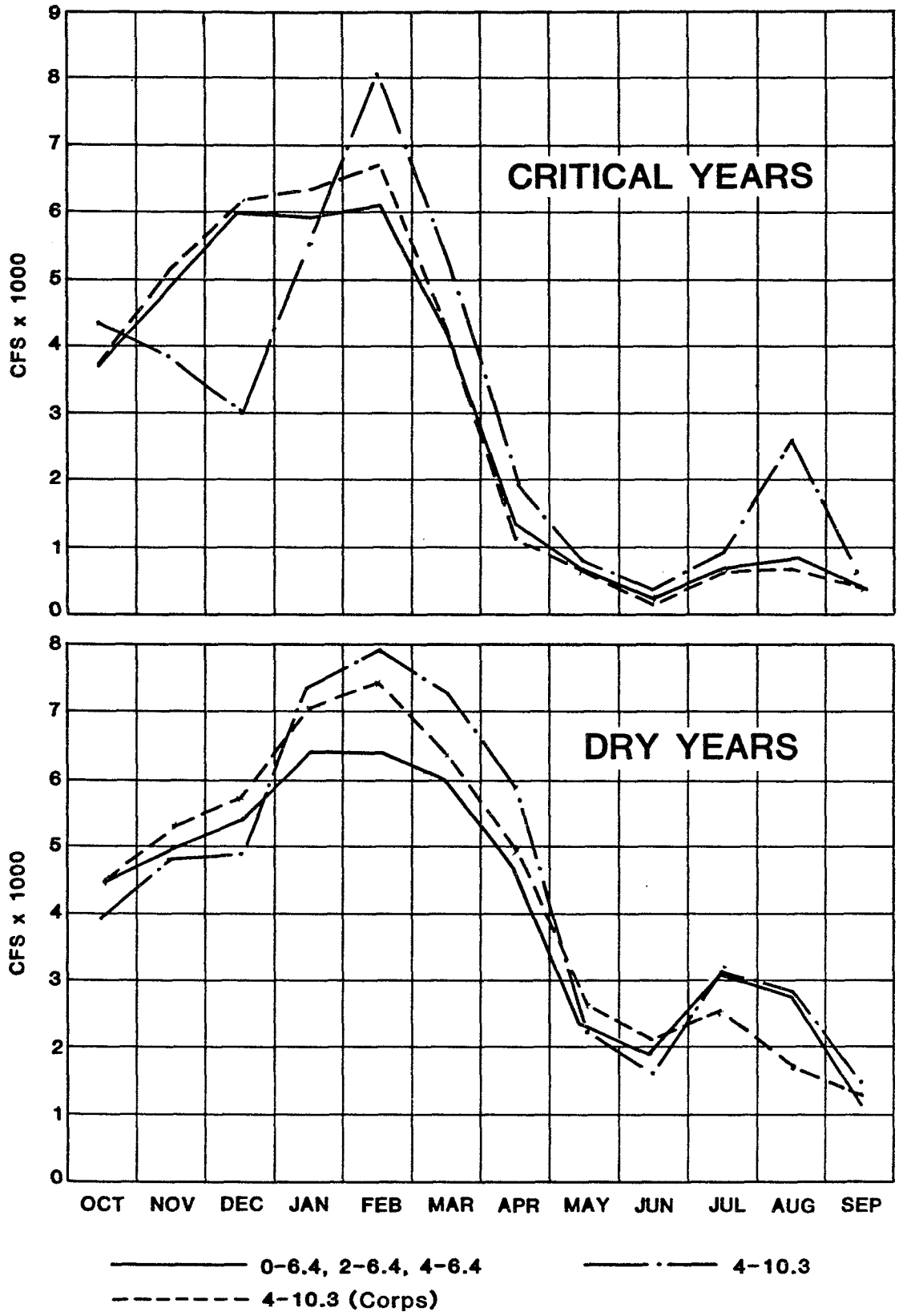

FIGURE B-1. EXPORTS AT BANKS PUMPING PLANT

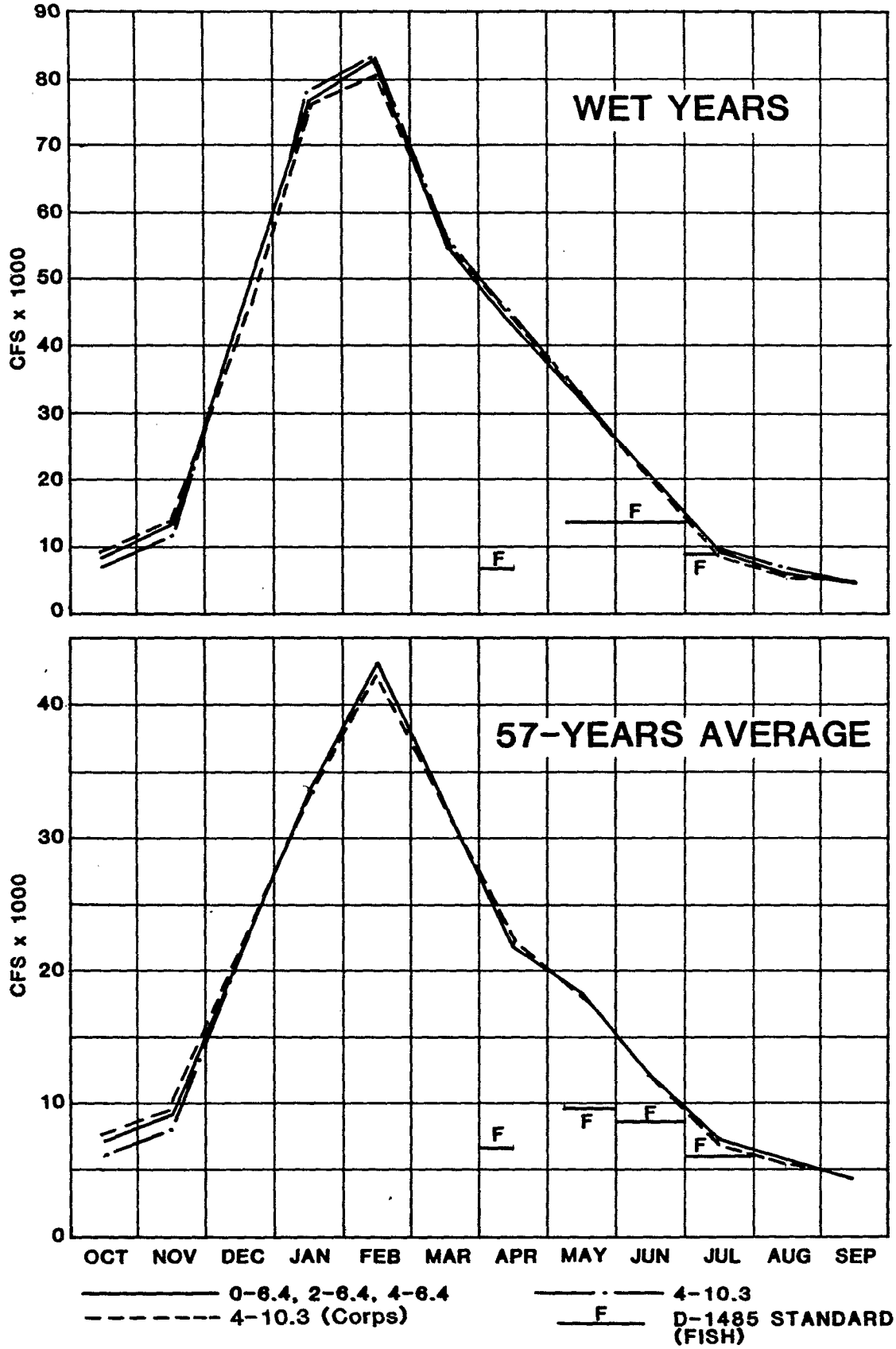

FIGURE B-2. DELTA OUTFLOWS

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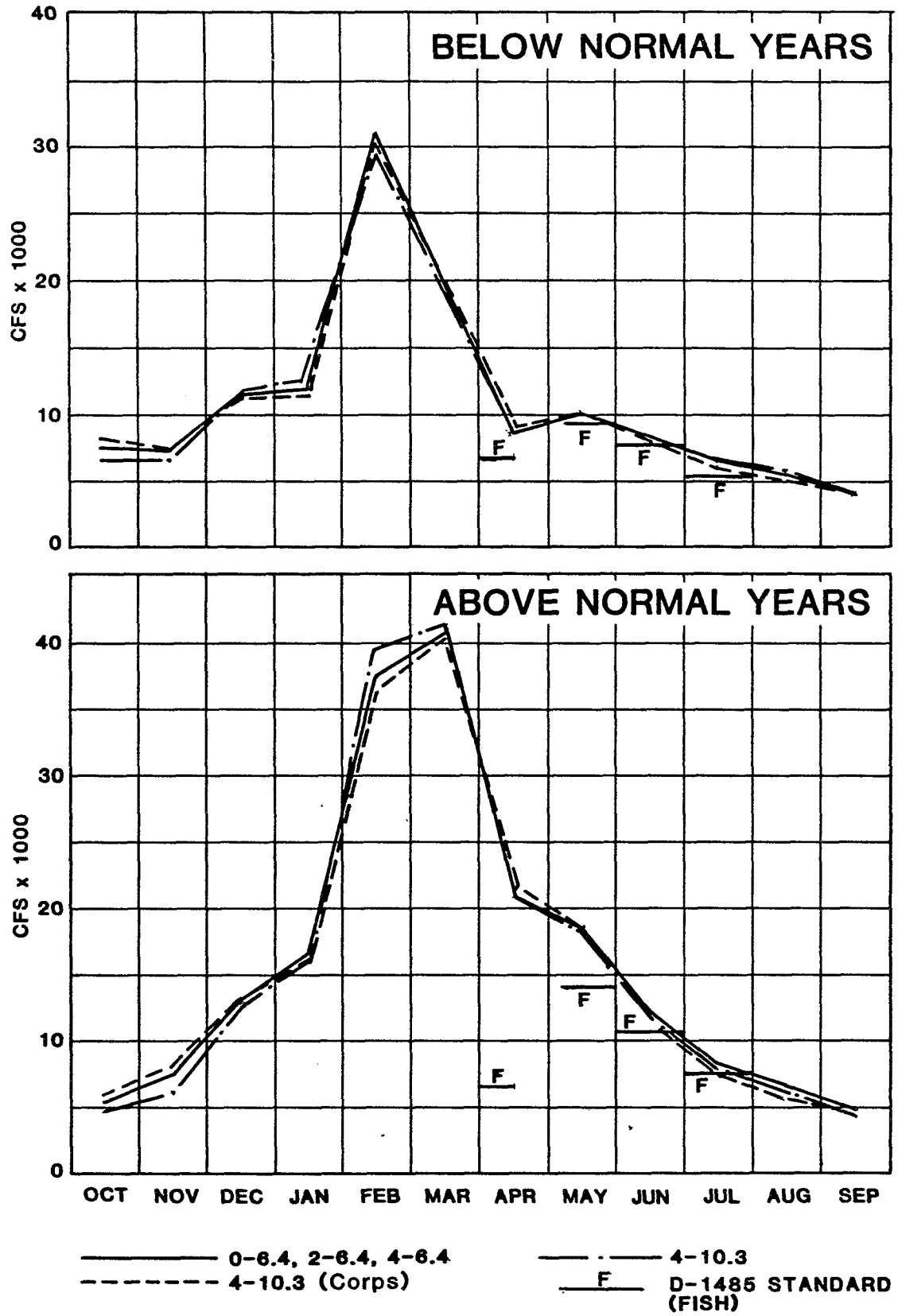

FIGURE B-2. DELTA OUTFLOWS

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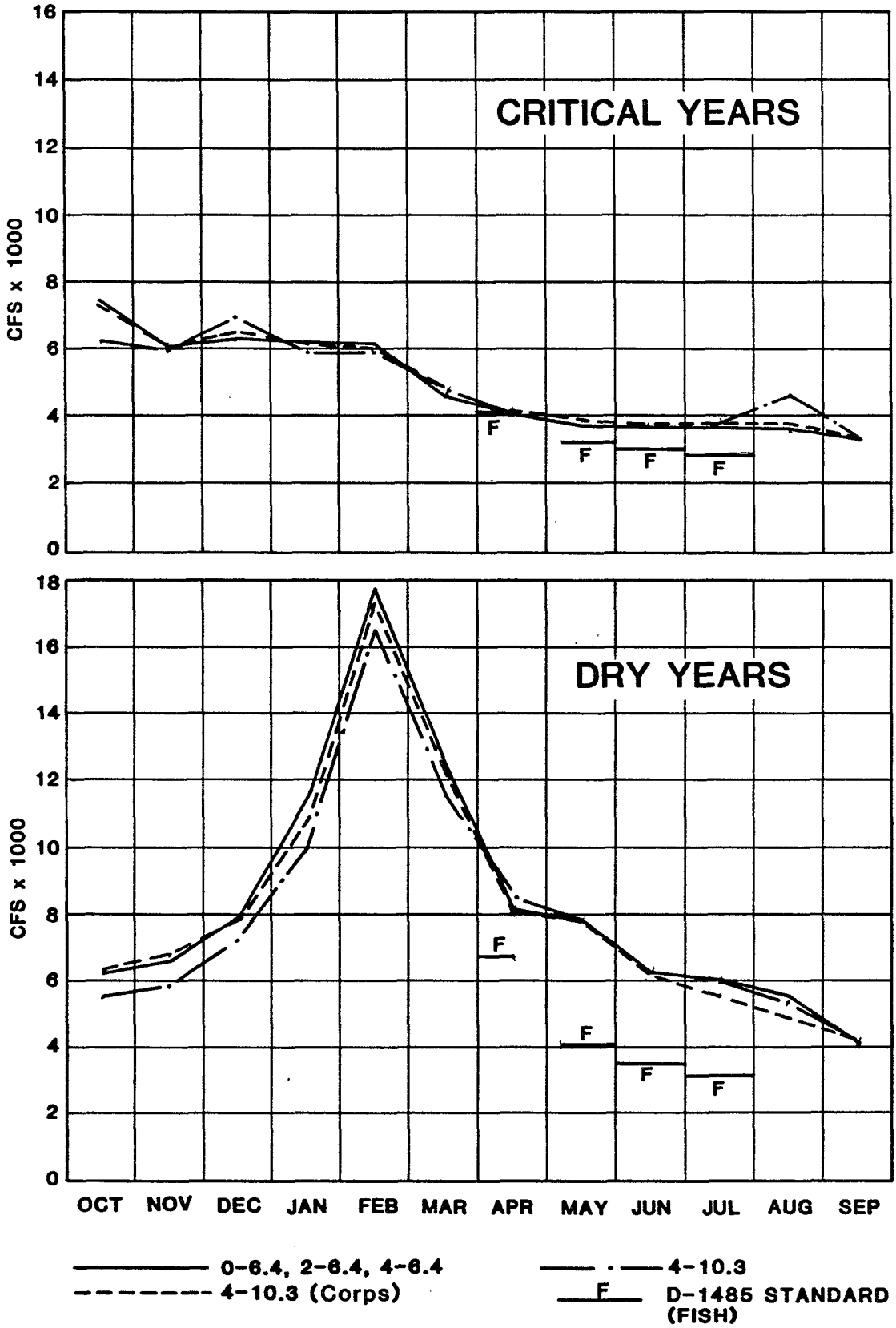
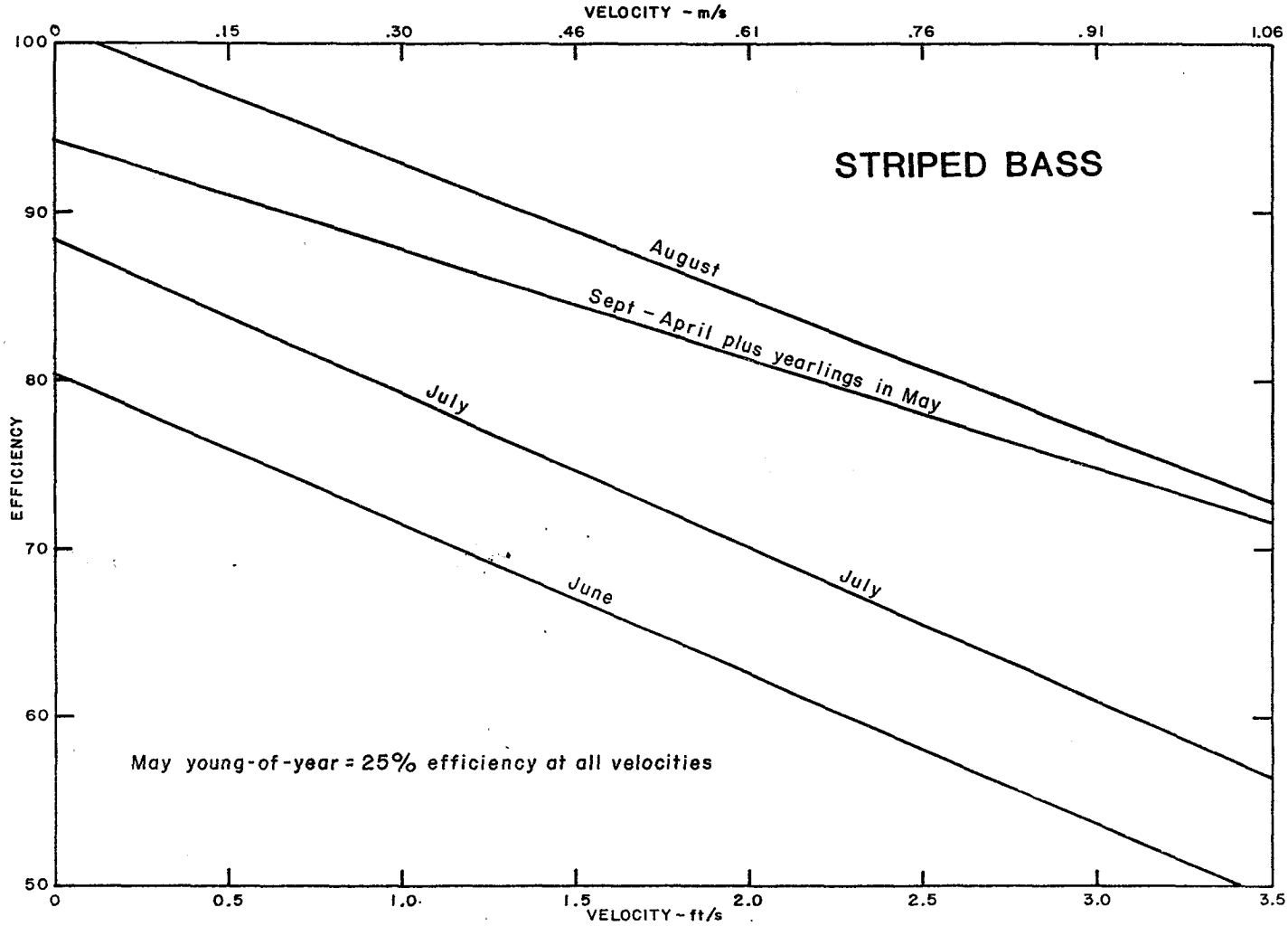
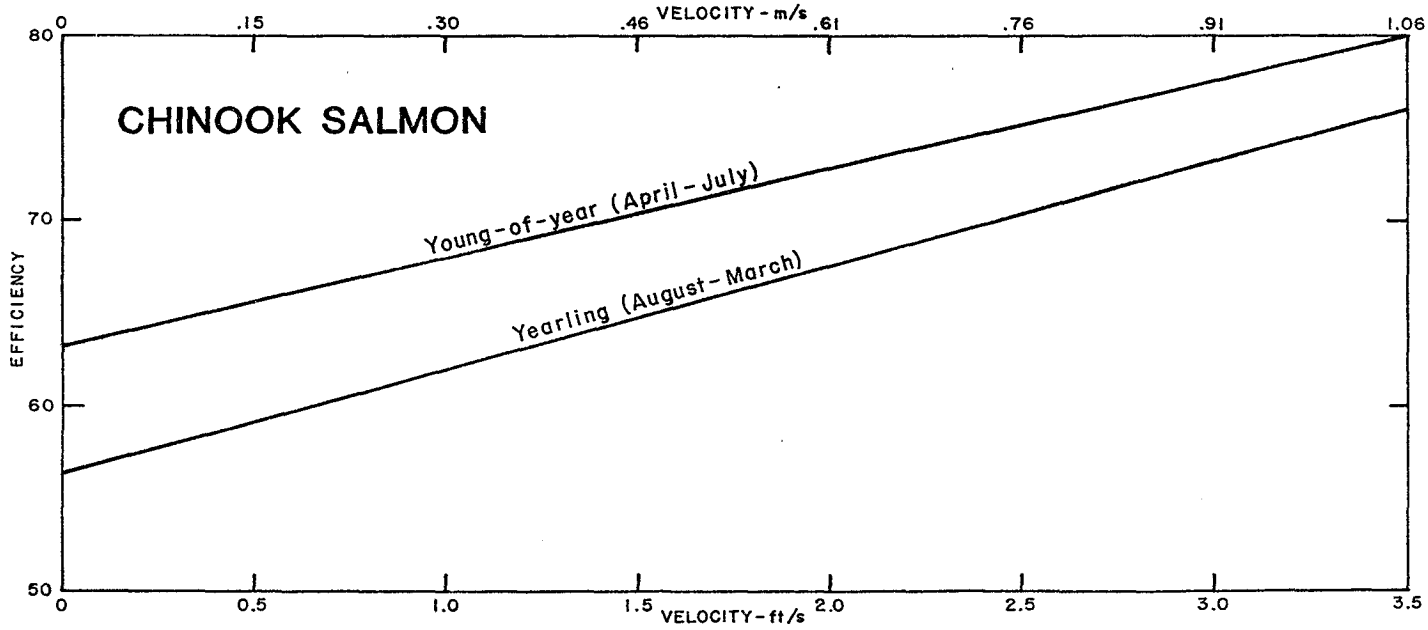


FIGURE B-2. DELTA OUTFLOWS

FIGURE B-3
FISH SCREEN VELOCITY VS EFFICIENCY FOR STRIPED BASS AND CHINOOK SALMON
(ENLARGED FISH FACILITY)





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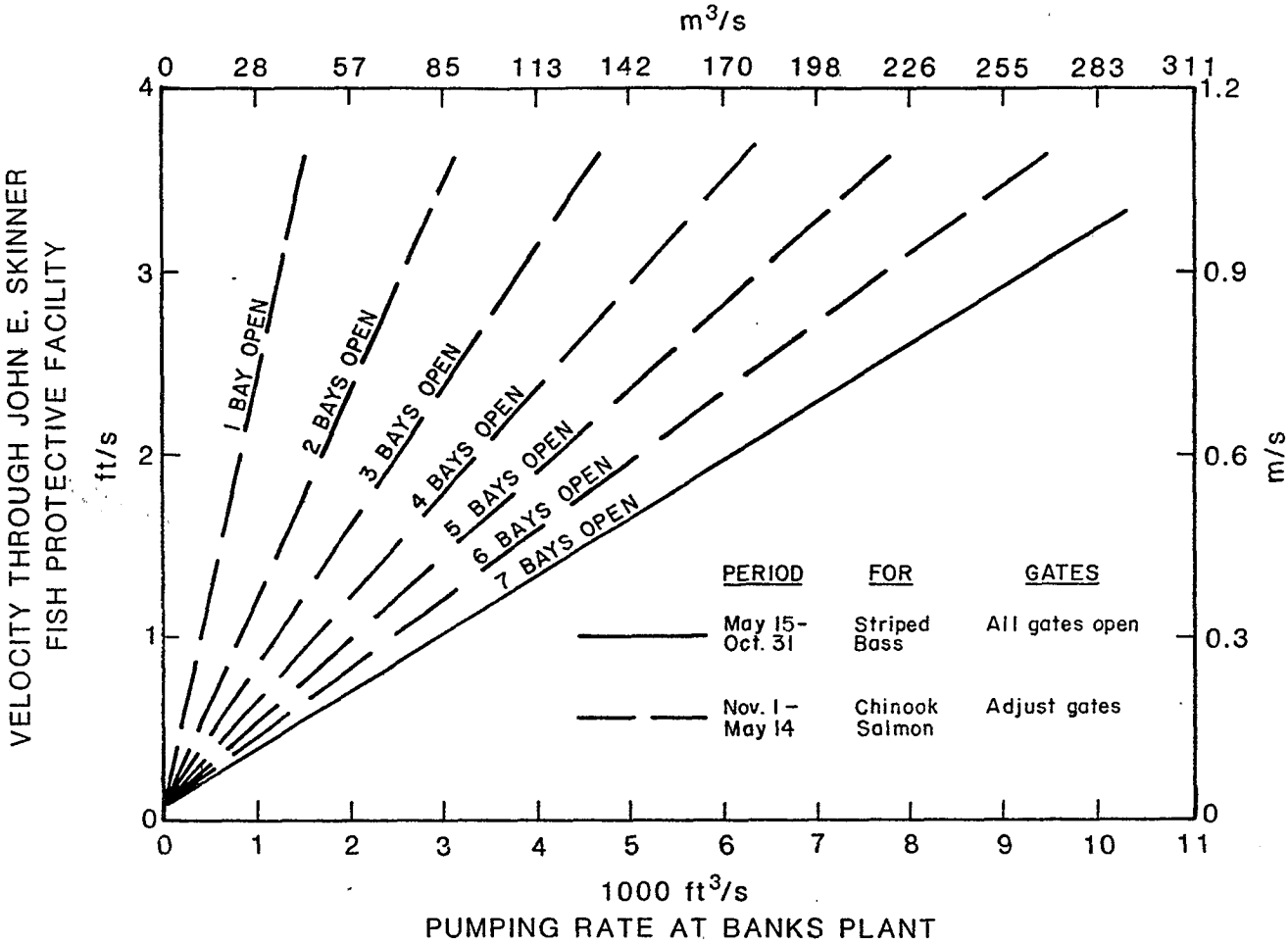

FIGURE B-4 OPERATION OF THE ENLARGED JOHN E. SKINNER FISH PROTECTIVE FACILITY

NOTES: 7 Bays each approximately 21' wide and 21' deep
Bays 1 & 2 can be operated separately or together
Bays 3A & 3B are operated together
Bays 4A & 4B are operated together
Bay 5 is operated separately

C-105687

State of California

ATTACHMENT 1

The Resources Agency

Memorandum

To : Files

Date : July 12, 1983

From : **Department of Fish and Game**

Subject: Estimated entrainment of striped bass eggs and larvae less than 19 mm in length at State Water Project and Central Valley Project facilities in the Sacramento-San Joaquin Delta, California, 1968-1977.

Introduction

Striped bass are entrained with water diverted by State Water Project (SWP) and Central Valley Project (CVP) export facilities in the southern Delta. Although records are kept of fish large enough to be screened, there is no direct measure of the magnitude of egg and larval losses. This report estimates the loss of eggs and larvae based upon the density of eggs and larvae available to be entrained and the amount of water being exported. The procedure for making the estimate is described and the number of striped bass eggs and larvae 18 mm or less in length that are estimated to have been entrained for the years 1968 through 1977, excluding 1974, for which no data exists, is provided. The estimates are based on egg and larvae samples collected by the Department of Fish and Game and export and Delta flow conditions reported by the Department of Water Resources (DWR 1983).

Methods

Export and Delta Flow Conditions

Water available for export by the SWP and CVP travels to the pumps from either the central Delta south in Old and Middle rivers (and several smaller channels) or from the upper San Joaquin River west in Old River and Grantline Canal. Water from these two sources that reach the export pumps were estimated from known flow characteristics and channel depletions based on the procedure described in Appendix A for ten day periods beginning April 1 of each year, 1968-1977, excluding 1974. The result of this procedure is an estimate of SWP and CVP exports, expressed in cubic meters, that is drawn from the central Delta.

Egg and Larvae Density

Surveys to determine the abundance of striped bass eggs and larvae in the Delta were conducted annually from 1966 to 1977, except in 1974. These surveys were designed to index the abundance of eggs and larvae rather than to provide an absolute measure of their abundance, so that abundances between years could be compared. The surveys were also designed to make mortality rate estimates for young bass (Stevens 1977). A single ten minute oblique net tow was made at each of 32 stations throughout the Delta using nets and net frames as described by Miller (1977). Sampling was conducted every second day during the striped bass spawning period beginning each year in April or May and continuing until June or July. The volume of water strained per tow was measured and catches

of eggs and larvae were divided by the volume strained to calculate densities at each station.

Surveys conducted in 1968 through 1973 were done with a net that was found to be less efficient, particularly for small larvae, than the net used in 1975 through 1977. Data for larvae greater than 6 mm in length from surveys using the less efficient net have been corrected to the efficiency of the nets used in later years, as described in Miller, 1977. Densities of the smallest larvae (3-6 mm) were estimated for 1968 through 1973 by multiplying the density of 7-10 mm bass in those surveys by the ratio of the 3-6 mm to 7-10 mm bass found in the 1975 and 1976 surveys.

To estimate the density of eggs and larvae subject to entrainment at SWP and CVP export facilities in the south Delta, densities at sample stations approximately one tidal excursion above and below the mouth of Old River were averaged. This area is represented by DFG stations 49, 51, 53, 55, 57, 59 and 60. Data from these stations was broken down by size group (eggs, 3-6 mm larvae, 7-10 mm larvae, 11-14 mm larvae, and 15-18 mm larvae). Mean densities for each size group (expressed as eggs or larvae per cubic meter) were calculated by 10-day periods (encompassing 5 survey days) throughout each year's survey period. These 10-day intervals started as early as April 1 and ended as late as August 18, depending on variations in the spawning season.

In several years, the survey did not cover the entire striped bass spawning period. In those years, mean densities for each size range were plotted for the time periods actually sampled and abundance trends were extrapolated for time periods prior to the beginning or after the end of the survey. The decrease in density after the end of the survey or before the survey started was assumed to follow the same pattern as shown in the actual survey period.

Export flow estimated to originate from the central Delta (mouth of Old River) was then multiplied by the estimated egg and larvae density in that area to compute an estimate of SWP and CVP entrainment for each 10-day period and each year.

Results

Total estimated annual CVP and SWP entrainment of striped bass eggs and larvae less than 19 mm in length from 1968 to 1977 (excluding 1974) ranged from a high of 4.5 billion (1972) to a low of 2.4 million (1969) and averaged 1.4 billion (Table 1 and Appendix A, Table A-2).*

CVP Entrainment

Annual estimated entrainment at the CVP Tracy Pumping Plant ranged from a high of 2.9 billion (1972) to a low of 1.7 million (1969) and averaged 920 million (Table 1). Entrainment was highest for the smallest larvae and decreased for each larger size group, averaging 775 million for larvae 3-6 mm, 96 million for larvae 7-10 mm, 6.5 million for larvae 11-14 mm, and 1.5 million for larvae 15-18 mm (Table 2). Striped bass egg entrainment averaged 42 million.

*Appendix A to this memorandum is not included. Appendix A consists of the detailed flow allocations and egg and larvae loss estimates.

SWP Entrainment

Annual estimated entrainment at the SWP H. O. Banks Delta Pumping Plant ranged from a high of 1.6 billion (1972) to a low of 700,000 (1969) and averaged 437 million (Table 1). Entrainment averaged 372 million for larvae 3-6 mm, 45 million for larvae 7-10 mm, 2.3 million for larvae 11-14 mm, and 500,000 for larvae 15-18 mm (Table 3). Striped bass egg entrainment averaged 17 million.

Discussion

Although the estimates contained in this report are believed to reflect reasonably accurately the magnitude of entrainment, they are subject to several biases.

Sampling biases:

1. The surveys upon which the egg entrainment estimates are based substantially underestimate the actual density of eggs in the survey area, for some unknown reason (Stevens 1977).

2. Estimates of larvae density may also be in error because the nets are not totally efficient.

3. The spatial distribution of larvae within the channel may be different than at mid-channel where sampling was done using an oblique tow. For example, larvae as small as 10 mm have been found to actively seek slower water velocities (H.K. Chadwick, pers. comm.) and would thus be under-represented in density data used to estimate entrainment.

Entrainment biases:

1. Entrainment estimates were made under the assumption that water of upper San Joaquin River origin contained no eggs and larvae. Since adult striped bass migrate above Vernalis in the San Joaquin River, at least under some high flow conditions, this assumption would cause entrainment losses to be underestimated in those years.

2. Some larvae as small as 10 mm are salvaged at SWP and CVP fish protective facilities, although the louver screens have very low efficiencies for striped bass less than about 19 mm. Those larvae returned alive to the Delta in normal salvage operations would decrease entrainment loss estimates.

3. Travel time for the mouth of Old River to the pumps was not considered in the compulation methodology. Mortality between the time eggs and larvae went from the mouth of Old River to the pumps would result in fewer but larger larvae being exported, and thus the actual number of eggs and larvae estimated to have been entrained would be too high.

There is no data available to verify the magnitude of the various biases involved, but biases due to the assumption regarding water of upper San Joaquin River origin and the number of larvae salvaged at the fish protective facilities are probably minor and would tend to offset one another. Biases involving sample efficiencies for eggs and larvae are probably of a larger magnitude, and therefore the entrainment estimates contained in this report should be considered approximate.

Striped bass eggs and larvae of different ages have different probabilities of surviving any given length of time. The loss of one larvae 15 mm in length, for instance, would have the same effect on the number of bass reaching adulthood as the loss of several smaller larvae. The survival rate to some standard time for various sized or aged eggs and larvae, therefore, is a more meaningful comparison of the effect entrainment has on the population as a whole than the actual number of eggs and larvae entrained, assuming that the population cannot compensate for losses incurred.

Entrainment losses for larvae estimated in this report have been converted to an equivalent number of one year old fish using published survival rates (EA 1981). Egg survival rate was estimated by calculating the potential number of eggs spawned compared to the estimated number of age one fish in the estuary (D. Steven, pers. comm.). The analysis shows an average annual entrainment loss for the years analyzed for combined CVP-SWP operations of 227,000 striped bass yearling equivalents (Table 4). The annual yearling equivalent loss estimates range from 719,000 (1972) to 1,300 (1969) fish.

Alan Baracco

Alan Baracco
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Bay-Delta Fishery Project

References

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TABLE 1. Total entrainment of striped bass eggs and larvae less than 19 mm at CVP Tracy Pumping Plant and SWP H. O. Banks Delta Pumping Plant, 1968-1977, excluding 1974 (in millions).

Year	CVP	SWP	Combined
1968	1397.9	480.4	1878.3
1969	1.7	0.7	2.4
1970	1598.5	185.0	1783.5
1971	526.2	251.8	778.0
1972	2878.6	1648.8	4527.4
1973	1127.6	1125.1	2252.7
1975	159.7	74.5	234.2
1976	452.4	55.0	507.4
1977	141.0	108.4	249.4
AVERAGE	920.4	436.7	1357.1

TABLE 2. Entrainment of striped bass eggs and larvae in various size ranges less than 19 mm at the CVP Tracy Pumping Plant, 1968-77, excluding 1974 (in millions).

Year	Eggs	3-6 mm	7-10 mm	11-14 mm	15-18 mm	Total
1968	150.2	1090.6	136.8	16.4	3.9	1397.9
1969			1.5	0.2		1.7
1970	21.7	1388.6	167.9	16.0	4.3	1598.5
1971	3.4	461.7	55.0	4.8	1.3	526.2
1972	62.3	2500.9	300.1	13.1	2.2	2878.6
1973	0.2	1000.4	119.1	6.7	1.2	1127.6
1975	1.9	132.9	23.4	1.0	0.5	159.7
1976	102.2	319.3	30.8	0.1		452.4
1977	37.2	78.9	24.9	0.03		141.0
AVERAGE	42.1	774.8	95.5	6.5	1.5	920.4

C—105692

C-105692

TABLE 3. Entrainment of striped bass eggs and larvae in various size ranges less than 19 at the SWP H. O. Banks Delta Pumping Plant, 1968-77, excluding 1974 (in millions).

Year	Eggs	<7 mm	7-10 mm	11-14 mm	15-18 mm	Total
1968	31.8	414.8	31.3	2.2	0.3	480.4
1969			0.6	0.1		0.7
1970	4.1	148.9	27.6	3.3	1.1	185.0
1971	0.9	221.6	26.4	2.3	0.6	251.8
1972	39.8	1431.9	170.5	5.7	0.9	1648.8
1973	0.2	993.5	123.8	6.5	1.1	1125.1
1975	2.2	62.6	9.4	0.2	0.1	74.5
1976	13.9	37.6	3.5	0.01		55.0
1977	60.6	33.0	14.8	0.02		108.4
AVERAGE	17.1	371.5	45.3	2.3	0.5	436.7

C—105693

C-105693

TABLE 4. Striped bass yearling equivalent loss at SWP and CVP export facilities, 1968-1977 (excluding 1974).

		Eggs	3-6 mm	7-10 mm	11-14 mm	15-18 mm	Total
Survival rate to AGE 1		.000047	.000124	.000338	.002509	.006415	
			YEARLING EQUIVALENTS				
SWP	1968	1494	51433	10576	5537	2013	71053
	1969			193	160		353
	1970	193	18458	9315	8302	7288	43556
	1971	44	27477	8916	5858	3838	46133
	1972	1871	177552	57628	14307	5928	257286
	1973	8	123196	41848	16283	7134	188469
	1975	104	7762	3193	402	423	11884
	1976	654	4667	1182	26		6529
	1977	2848	4092	4999	41		11980
	AVERAGE	802	46071	15317	5657	2958	70805
CVP	1968	7061	135233	46255	41074	25228	254851
	1969			522	449		971
	1970	1021	172185	56767	40135	27747	297855
	1971	159	57255	18579	12098	8549	96640
	1972	2926	310114	101446	32934	14348	461768
	1973	9	124046	40253	16772	7690	188770
	1975	90	16476	7894	2426	3298	30184
	1976	4802	39593	10403	300		55098
	1977	1749	9789	8423	66		20027
	AVERAGE	1980	96077	32282	16250	9651	156241
SWP-CVP 1968-77 AVERAGE		2782	142148	47599	21907	12609	227046

C—105694

C-105694

Appendix C.

BENEFIT/COST ANALYSIS OF ADDITIONAL PUMPING UNITS AT HARVEY O. BANKS DELTA PUMPING PLANT

CONTENTS — APPENDIX C

	Page
Introduction	409
Study Approach	409
Study Parameters	410
Capital and Fixed Annual Costs	411
Pumping Units	411
Southern Delta Modifications	412
Median Year Analysis -- Purchase	412
Firm Yield Analysis -- Purchase	413
State Water Project Urban Water Supply	413
Analysis of Alternatives	414
Description of Alternatives	415
Other Alternatives	417
Annual Costs	417
Combined Analysis -- Purchased Energy and Capacity	418
Combined Analysis -- Plant Construction	419
Sensitivity Analysis for Plant Construction	419

Tables

C-1	Alternative Operational Plans Evaluated for Banks Pumping Plant	420
C-2	Banks Pumping Plant Firm and Ground Water Yield Allocations by Service Area and Use	421
C-3	Capital and Fixed Annual Costs of Additional Pumping Units and Southern Delta Modifications	422
C-4	Value of State Water Project Firm Yield Augmentation for Alternatives 2-7.3(Corps) and 4-7.3(Corps)	423
C-5	Supply and Demand Projections -- Los Angeles, Santa Ana, and San Diego Hydrologic Study Areas	424
C-6	Alternatives for Balancing Supply with Demand, Metropolitan Water District Service Area	425
C-7	Economic Analysis of Additional Pumping Units, Purchased Capacity and Energy	426

		Page
C-8	Analysis of Remaining Alternative Operational Plans, Purchased Capacity and Energy	427
C-9	Combined Economic Analysis of Additional Pumping Units, Plant Construction.	428
C-10	Sensitivity Analysis, Effects of Plant Construction Values on Economic Analysis	429

C—105697

C-105697

Appendix C

BENEFIT-COST ANALYSIS OF ADDITIONAL PUMPING UNITS AT THE HARVEY O. BANKS DELTA PUMPING PLANT

Introduction

Analyses were made of the economic justification of installing and operating additional pumping units at the Harvey O. Banks Delta Pumping Plant of the State Water Project. These analyses were based on examining quantifiable (measurable in dollars) costs and benefits from a statewide perspective. Economic justification analyses address the question of efficient allocation of resources, based on comparing the benefits of a project to the costs of committing specific resources to build and operate that project, irrespective of to whom the benefits or costs may accrue.

Study Approach

The purposes of installing and operating additional pumps are to:

- Minimize on-peak power requirements to improve the efficient use of existing power generating facilities and reduce costs for the State Water Project.
- Provide standby pumping capacity to compensate for outages of the existing units.
- Increase reliability of State Water Project supply deliveries.

The complete analysis consisted of the following steps:

- Establishing study parameters.
- Determining capital and fixed annual costs for the additional pumping units and southern Delta modifications for alternatives beyond the criteria.
- Analyzing incremental firm yield.
- Analyzing median year.
- Combining the results of the firm yield analysis and the median year analysis for comparison with the fixed annual costs.

Ten operational alternatives for the Banks Pumping Plant and Clifton Court Forebay were evaluated on a firm yield basis, assuming no Delta water transfer facility. Five operational alternatives were evaluated on a median year basis.

The no-project alternative (continued operation with the seven units) was the base condition for evaluating benefits and costs of the nine alternatives with additional units. The alternatives are combinations of additional pumping units and maximum monthly diversion rates or capabilities in thousand cubic feet per second. The no-project alternative is designated 0-6.4.

The alternatives evaluated are listed in Table C-1, along with incremental firm and ground water yields, and whether southern Delta hydraulic improvements are required. The five alternatives evaluated on a median year basis are also shown.

Table C-2 shows the firm yield and ground water yield allocations by service area and use.

Study Parameters

Benefits and costs were determined by computer programs written to permit rapid evaluation of changes in the study parameters. The parameters used in the two analyses are shown below:

General Parameters

Discount Rate - 8-3/8 percent
Post-1985 Cost Escalation

- 4 percent for general inflation.
- 6 percent for construction, operation and maintenance, and energy and capacity values.

Two sets of unit values for energy and capacity were used:

- Low values for purchase--this is the most likely.
- Higher values for plant construction--these values were used for sensitivity analysis.

Parameters for Firm Yield Analysis

State Water Project Agricultural Supply Unit Value -- Shown below are the unit values of incremental water supplied to agriculture in the State Water Project service areas in 1985 dollars per acre-foot.

1990	$162	2000	$209	2020	$217
1995	$192	2010	$214	2035	$219

These unit values were estimated by a Department of Water Resources' economic computer model. The values rise over time due to the increase in demand for water. Cropping pattern changes and increased irrigated area in response to expanding agricultural markets will cause the demand for water to increase.

State Water Project Municipal and Industrial Supply Unit Value (Metropolitan Water District*) -- These are the corresponding unit values for water supplied to the Metropolitan Water District service area for urban use, as described later under "Firm Yield Analysis".

State Water Project Municipal and Industrial Supply Unit Value (Other) -- Unit values for State Water Project urban use outside the Metropolitan Water District service area are also discussed later.

Capacity and Energy Unit Values -- These unit values were used to determine costs of State Water Project energy, local energy for distribution and treatment, and costs of water supply alternatives. These are shown below.

	Purchase	Plant Construction
1990 Energy Cost	$.02/kWh	$.03/kWh
1990 Capacity Cost	$.015/kWh	$.06/kWh
Annualized Energy and Capacity Cost	$.044/kWh	$.098/kWh

Parameters for Median Year Analysis

Unit values for energy and capacity assessments of the additional pumps in the median year analysis are shown below.

Variables	Start Year	Purchase	Plant Construction
Capacity	1997	$90/kW	$345/kW
Banks Pumping Plant, on-peak/ off-peak energy differential	1991	$0.01/kWh	$0.01/kWh
State Water Project System, net energy	1991	$0.02/kWh	$0.03/kWh

Capital and Fixed Annual Costs

The capital and fixed annual equivalent costs are shown in Table C-3.

Pumping Units

The capital costs for four additional units are based on cost projections for Department of Water Resources Bulletin 132-84 (Table 19) for the years 1985

*As approximated by the Los Angeles, Santa Ana, and San Deigo Hydrologic Study areas.

to 1990. The capital costs in Table C-3 include escalation* and interest during construction. Similar allowances were made for two additional units. Minimum costs for operation, maintenance, and replacement are added to the annual costs of capital recovery to obtain total fixed annual costs.

Southern Delta Modifications

Reconnaissance level cost estimates have been made for southern Delta modifications under Alternative 4-10.3. These modifications were assumed to consist of a second intake to Clifton Court Forebay and dredging and other improvements in Victoria Canal, Middle River, and Old River. Estimated total cost is $47.6 million at 1985 price levels.

For Alternatives 2-8.5 and 4-8.5, it was assumed that the capacities of the second intake and the dredging would be less than for Alternative 4-10.3. Total cost would be about $33.3 million.

It was assumed that the work would be done during the 3-year period. Interest during construction is added to obtain the total annual costs of capital recovery for the southern Delta modifications. Those annual costs were added to those for the pumping units.

Median Year Analysis - Purchase

The long-range median year operation studies of the California Aqueduct system, described in Appendix B, were the basis for the energy and capacity assessments of the additional pumps. Shown below are the 1990 annual equivalent benefits and costs for the additional pumps, based on the unit costs for purchase (values in 1,000 1985 dollars).

*After adjustment for inflation.

Item of Benefit	2-6.4	4-6.4	2-7.3 (Corps)	4-7.3 (Corps)
Cost Savings				
Capacity at Banks Pumping Plant	3,926	6,819	3,926	6,819
Peak Energy at Banks Pumping Plant	2,113	3,771	2,113	3,771
Subtotal	6,039	10,590	6,039	10,590
Cost Savings for Increased Water Deliveries				
Peak Energy at Banks Pumping Plant	--	--	786	1,105
State Water Project Capacity	--	--	13,000	10,268
State Water Project Net Energy	--	--	14,424	14,424
Total Cost of Delivery	--	--	28,210	25,797
Cost of Delivery with Alternative 2-7.3*	--	--	28,210	28,210
Cost Differential (Savings)	--	--	0	2,413
Total Net Benefits	6,039	10,590	6,039	13,003

*Delivery cost for the most costly alternative (2-7.3).

Firm Yield Analyses - Purchase

The firm yield analysis included the augmentation of firm yield through ground water storage in Southern California. Increased firm yield and ground water yield estimates are shown in Appendix B, Tables B-2 and B-3.

Table C-4 shows the parameters, benefits, and costs for a firm yield augmentation of 66,000 acre-feet under alternatives 2-7.3(Corps) and 4-7.3(Corps). The parameters include purchased energy and capacity. This table is from the computer printout. In this case, the estimated annual benefits are $3,618,000 for agricultural supply and $18,513,000 for urban supply, a total benefit of $22,131,000. The total annual costs are $7,351,000, and the net benefits are $14,780,000. Similar tables for greater firm yield augmentation amounts with other alternatives are available in the Central District files.

The determination of benefits and costs is described below.

State Water Project Urban Water Supply

For this analysis, the municipal water supply benefit of additional State Water Project yield was assumed to be constrained by (equal to) the cost of reasonable alternatives to sustain the existing standard of living in the absence of that yield. Such alternatives could be either those supply augmentation options that would not involve additional storage facilities, or

those water conservation options that would not impair the maintenance of present conveniences or esthetic and health conditions. Because it was assumed that ongoing planning levels of conservation would be achieved with or without the additional pumps, the conservation measures considered available as options were considered extraordinary. Because of uncertainties related to health, urban waste water reclamation beyond that amount assumed in ongoing planning was not considered. In addition, industrial conservation measures beyond those assumed for ongoing planning were not considered because of the relatively small amount of water involved and the extreme complexity of assessing further conservation options.

Analysis of Alternatives

Sixty-eight percent of the State Water Project urban yield will ultimately be allocated to the Metropolitan Water District service area. This service area is essentially equivalent to the area covered by the Los Angeles, Santa Ana, and San Diego Hydrologic Study Areas. A detailed analysis was made of alternatives balance demand and supply. Table C-5 shows the likely demand and supply scenario without the additional pumps. The supplies and demands are mainly those shown in Bulletin 160-83, however, a Department projection of supplies from Imperial Valley is added. This scenario was based on the assumption that population in this area would increase as follows:*

Year	Population
1990	15,051,000
2000	16,550,000
2010	17,821,000
2020	18,981,000
2035	19,950,000

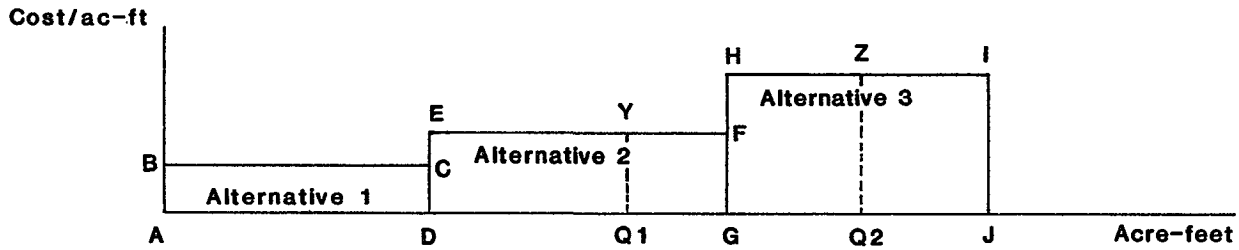
It was also assumed that the ongoing planning estimates of urban per-capita water use for 2010, with conservation, would be maintained through 2035.

Table C-6 shows the alternatives assumed to be available to balance supply and demand for this scenario. Unit costs, as well as water supply quantities developed or demand amounts reduced, are given for each alternative. The unit costs account for the yield estimates, cost escalation, capital recovery, operation and maintenance, electrical power, and water quality. Unit costs are shown for both energy assumptions, purchase, and construction. These unit costs for energy and capacity are the same used for the economic analysis of the additional pumps.

It is likely that the sequence in which these alternatives would be employed would be primarily a function of their unit cost. If so, the availability of the incremental yield from the new pumps would eliminate the need for the most

*Based on extrapolated Department of Water Resources projections; based, in turn, on Department of Finance Second Interim E-150 projections (April 1981).

costly alternative (or reduce the extent to which it must be implemented to balance supply with demand). The benefit of the new pumps is, therefore, based on the unit cost of the "last" alternative (or, if the new pumps would eliminate or reduce the need for more than one alternative, the weighted average unit cost of those alternatives) needed in lieu of the yield provided by the pumps. The following diagram illustrates this:



Where: Q1 = Contribution needed from alternatives to balance supply with demand with the new pumps.

Q2 = Contribution needed from alternatives to balance supply with demand without the new pumps.

Area ABCD = Total Cost of Alternative 1.
Area DEFG = Total Cost of Alternative 2.
Area GHIJ = Total Cost of Alternative 3.
Area Q1YFG + Area GHZQ2 = Benefit of New Pumps.

The average unit urban water supply to State Water Project service areas outside the Metropolitan Water District service area was assumed to be constrained to the unit cost of providing landscape design for new homes prior to the year 2000. For 2000 and afterward, it was assumed to be constrained by the vendability value of $312 per acre-foot. This value was derived by averaging the 1980-81 retail cost of residential water for four Southern California cities with high-cost water.* It has been adjusted for 1985 price levels.

Description of Alternatives

The following is a discussion of each of the alternatives listed in Table C-6. The first two alternatives, additional toilet dam and showerhead retrofit, and free residential landscape design, were developed from research by the Office of Water Conservation, Department of Water Resources. Costs and rates of adoption and retention were based on experience with conservation programs and on expert opinion. Information used to develop the Imperial Valley conservation-transfer alternative was obtained from the Future Water Supply

* Department of Water Resources Memorandum, "Requested Analysis of the Value of SoCal Urban Water", December 29, 1981.

Section of the Southern District, Department of Water Resources. Work done for the Southern District report, "Investigation Under California Water Code Section 275 of Use of Water by Imperial Irrigation District", December 1981, was the basis for the information provided. The four desalting alternatives were developed using work done by the Water Reclamation and Supply Section, Division of Planning, Department of Water Resources.

Additional Toilet Dam and Showerhead Retrofit. This would be a one-time free device installation program that would supplement distribution methods in the Department's recommended water management plans. The estimated initial cost of such a program is $105 million for the devices, publicity, program management, and installation. A 15-year life and a cost of $39 per household were assumed.

Installation and retention rates were based on a 1977 Department of Water Resources demonstration program for the Ventura County Community of Oak Park.

Water savings for the toilet dams and low-flow showerheads were from the Department of Water Resources Bulletin 191, "A Pilot Water Conservation Program", October 1978. All of the free low-flow showerhead devices would be expected to be replaced by 2000 with owner purchases showerheads that would be low-flow due to State mandated manufactoring regulations.

Free Residential Landscape Design. This would be a service offered to owners of new homes. Cost per design is estimated at $78. One-third of 40,000 designs are expected to be adopted each year through the year 2000. After 2000, half of 10,000 designs would be adopted. Water savings were estimated at 0.2 acre-foot per landscape.

Additional Imperial Valley Conservation-Transfer. The costs and yield of this alternative are based on the two most costly canal lining methods in the Department of Water Resources' report on use of water by the Imperial Irrigation District. The net energy cost of this exchange program would be about 2 100 kWh per acre-foot. Substitution of the lower quality Colorado River water (700 mg/L total dissolved solids (TDS)) would have an adverse impact on urban water users. Costs would be increased for replacing damaged plumbing and appliances and for softening water. Urban water quality costs were quantified at the rate of $0.3049 per mg/L TDS per acre-foot, based on a 1980 study.*

San Joaquin Valley Drainage Water Desalting. A program of desalting brackish agricultural drainage water in the San Joaquin Valley would allow further reuse of that water locally as a substitute for water imported from the Delta. Thus greater quantities could be made available to the South Coastal service area. The desalted supply would not be a direct substitute for imports, however, due to water quality. Because of leaching requirements, it was estimated that the 500 mg/L TDS of the desalted water would be about 94 percent as effective for crop irrigation needs as the 280 mg/L TDS of State Water Project imports. Estimates of the quantities of water available for desalting were obtained from the San Joaquin Valley Interagency Drainage Program Report, June 1979. Brackish water recovery was assumed to be 80 percent. It was assumed that the

* Kleinman and Brown, "Colorado River Salinity", U. S. Department of the Interior, 1980, p. 15.

C—105705

C-105705

desalted water would be blended with fresh water and used for irrigation near the desalting plant, minimizing transportation cost. It was assumed that future desalters would use about 2 170 kWh per acre-foot, two-thirds of the energy for a 25 million gallon per day plant built with conventional technology.

Imperial Valley Drainage Water Desalting. In this case, Imperial Irrigation District would use desalted agricultural drainage water in lieu of Colorado River deliveries. As with the Imperial Valley conservation-transfer alternative, Metropolitan Water District would then divert a corresponding amount through the Colorado River Aqueduct. The cost of transportation through the aqueduct, as well as the cost of substituting the lower quality Colorado River water for urban use, was taken into account. The benefit to irrigated agriculture of using the higher quality desalted water (500 mg/L TDS) rather than the Colorado River water (700 mg/L TDS) was not, however, subtracted from the cost of this alternative.

Riverside County Drainage Water Desalting. Water provided from this source was assumed to be directly available for urban use. The quality penalty (substitution of 500 mg/L TDS desalted water for 280 mg/L TDS Project water) was taken into account.

Ground Water Desalting. Following is a list of the locations and quantities of desalted water available from this source of supply:

County	Annual Yield (Acre-Feet)
San Luis Obispo	1,000
Santa Barbara	10,000
Ventura	10,000
Los Angeles	16,000
Riverside	11,000
Orange	3,000
San Diego	20,000
San Bernardino	2,000
Total	73,000

The cost of ground water pumping and the cost of substituting the lower quality desalted water (500 mg/L TDS) for Project water (presently 280 mg/L TDS) were included in the cost of this source of supply.

Other Alternatives

Other supply augmentation and demand management alternatives exist, such as desalting sea water and mandating that new houses have ultra-low water using toilets (0.5 to 1.6 gallons per flush). These other options were investigated and found to cost substantially more than those presented in Table C-6.

Annual Costs

The annual costs for use of the incremental yield are discussed below.

State Water Project Energy Costs. California Aqueduct energy costs for delivery of the additional yield amounts from the Delta were determined in the computer program, based on the unit State Water Project energy and capacity costs shown under "Study Parameters."

Local Costs for Distribution and Treatment. Once the additional yield of the new pumps is delivered to State Water Project contractors for municipal and industrial use, it requires pretreatment, distribution pumping, and post-treatment. For agricultural purposes, pumping to the farm headgate is sometimes required. Pumping costs for on-farm distribution and sprinkler irrigation pressurization are accounted for in the Department of Water Resources quadratic approximation model. PGandE unit energy costs previously discussed were used for this evaluation.

The unit energy requirements for municipal and industrial water were taken from a Department of Water Resources Southern District report, "Effect of Conservation on Southern District Urban Water Demand for 1980, 1990, and 2000" (1977). These values were:

- Pretreatment — 37.2 kWh per acre-foot
- Local Distribution — 203.0 kWh per acre-foot
- Post-Treatment — 96.6 kWh per acre-foot

For agricultural local distribution, a unit energy value of 140 kWh per acre-foot (equivalent to a 90-foot lift) was assumed, based on water district pumping costs and water deliveries.

Metropolitan Water District Energy Recovery. The Metropolitan Water District of Southern California is constructing energy recovery capacity within its distribution system. This capacity is expected to produce 585 kilowatt-hours per acre-foot of State Water Project deliveries to Metropolitan Water District. (Actual generation will depend on the flow and head conditions within the system.) The value of this energy is based on the same unit costs, and was deducted from the local energy costs.

Local Costs for Ground Water Operations. Estimated yields (extractions), recharge amounts, and unit and total costs for storing, and recovering ground water supplies during the study period are shown below. Average recharge amounts were computed by dividing the yield amount by 7 years (1922 to 1928) prior to the critical period. (Yields in 1,000 Acre-feet, Unit Costs in Dollars per Acre-feet, Costs in 1,000 1985 Dollars.)

Alternative	Yield (Extract)	Recharge	Total	Unit Cost	Total Costs
2-7.3, 4-7.3, 4-10.3 (Corps)	9.0	1.3	10.3	$102	$1,051
2-8.5, 4-8.5, 4-10.3	43.0	6.0	49.0	102	4,998

Combined Analysis - Purchased Energy and Capacity

Table C-7 summarizes the combined firm yield and median year analysis for alternatives 2-6.4, 4-6.4, 2-7.3(Corps), and 4-7.3(Corps). The sum of net

median year and net firm yield benefits are compared to the fixed annual costs for additional pumps (Table C-3) to determine overall benefit-cost ratios and net benefits. The values in this table are for purchased energy and capacity.

Table C-8 shows the firm yield analysis for the remaining five alternative operational plans. The table also includes the median year benefits for capacity and peak energy at the Banks Pumping Plant from on-peak/off-peak pumping shifts. The totals are compared with the fixed annual costs from Table C-3. The values in the table are also for purchased energy and capacity.

Combined Analysis - Plant Construction

Table C-9 shows the combined firm yield and median year analysis for alternatives 2-6.4, 4-6.4, 2-7.3(Corps), and 4-7.3(Corps) with energy and capacity values for plant construction. Again, the sum of net median year and net firm yield benefits are compared to the fixed annual costs of the additional pumps.

Sensitivity Analysis for Plant Construction

Table C-10 is a summary of the sensitivity analysis for plant construction versus purchased capacity and energy. It compares key values in the economic analysis for the two energy assumptions. The effects of the plant construction values are to increase the overall net benefits for additional pumps. Alternative 4-7.3(Corps) has the highest overall net benefits.

Table C-1

ALTERNATIVE OPERATIONAL PLANS EVALUATED FOR THE BANKS PUMPING PLANT

Plan Designation	Number of Additional Pump Units	Maximum Monthly Export (cfs)	Hydraulic Improvements to Southern Delta	Conditions of Maximum Monthly Export	Comments	Median Year Analysis	Estimated Incremental Firm Yield Increase (1000 AF/Yr)	Estimated Incremental Ground Water Firm Yield Increase† (1000 AF/Yr)
0-6.4	0	6,400	None	When water supplies available	No-project alternative	Yes	--	--
2-6.4	2	6,400	None			Yes	--	--
4-6.4	4	6,400	None			Yes	--	--
2-7.3 (Corps)*	2	7,300	None	When water supplies and San Joaquin River flows available from mid-December to mid-March		Yes	57	9
2-8.5 (Corps)*	2	8,500	None			No	64	9
4-7.3 (Corps)*	4	7,300	None		Preferred Alternative Lower Limit	Yes	57	9
4-10.3 (Corps)*	4	10,300**	None		Preferred Alternative Upper Limit	No	64	9
2-8.5	2	8,500	Yes	When water supplies available		No	178	43
4-8.5	4	8,500	Yes			No	178	43
4-10.3	4	10,300***	Yes			No	188	43

† Could be higher depending on occurrence of outages that could be compensated for by the additional pumps.

* Public Notice 5820A-Amended, U. S. Army Corps of Engineers. Daily diversions would not exceed 13,870 acre-feet; three-day average diversions would not exceed 13,250 acre-feet. In addition, increase diversions by one-third the San Joaquin River at Vernalis during the period from mid-December to mid-March when the flow exceeds 1,000 cubic feet per second.

** In a 57-year operation study, early 1990s, 10,000 cfs achieved in only 4 months or 0.6 percent of the time.

***In a 57-year operation study, early 1990s, 10,000 cfs achieved in 87 months or 12.7 percent of the time.

Table C-2

BANKS PUMPING PLANT FIRM YIELD AND GROUND WATER YIELD ALLOCATIONS BY SERVICE AREA AND USE (In 1,000 Acre-Feet)

Service Area	Alternative: 2-7.3(Corps) and 4-7.3(Corps)			2-8.5(Corps) 4-10.3(Corps)			2-8.5 and 4-8.5			4-10.3		
	Uses			Uses			Uses			Uses		
	Total	Ag.	M&I	Total	Ag.	M&I	Total	Ag.	M&I	Total	Ag.	M&I
North Bay	1.1	0	1.1	1.2	0	1.2	3.5	0	3.5	3.7	0	3.7
South Bay	3.0	0	3.0	3.3	0	3.3	10.0	0	10.0	10.4	0	10.4
Central Coastal	1.3	0	1.3	1.4	0	1.4	4.4	0	4.4	4.6	0	4.6
San Joaquin	21.3	19.4	1.9	23.6	21.5	2.1	71.4	64.9	6.5	74.6	67.8	6.8
Southern California	39.3	0	39.3	43.5	0	43.5	131.7	0	131.7	137.7	0	137.7
(MWD)*	(31.6)	(0)	(31.6)	(35.0)	(0)	(35.0)	(106.0)	(0)	(106.0)	(110.8)	(0)	(110.8)
Total	66.0	19.4	46.6	73.0	21.5	51.5	221.0	64.9	156.1	231.0	67.8	163.2

Ag. = Agricultural; M&I = Municipal and Industrial

Service area allocations of additional firm yield and ground water yield developed by installation of proposed pumping units (in percent) are:

Southern California	59.6
San Joaquin	32.3
Central Coastal	2.0
South Bay	4.5
North Bay	1.6

Of San Joaquin service area allocation, 90.9 percent is allocated to agricultural uses.

*Yield allocated to Metropolitan Water District is 80.5 percent of the Southern California service area amount.

Table C-3

CAPITAL AND FIXED ANNUAL COSTS OF ADDITIONAL PUMPING UNITS AND SOUTHERN DELTA MODIFICATIONS
(Values in Thousand 1985 Dollars)

	2-6.4 2-7.3(Corps) 2-8.5(Corps)	4-6.4 4-7.3(Corps) 4-10.3(Corps)	2-8.5	4-8.5	4-10.3
Capital Costs					
Pumping Units	19,051	37,085	19,051	37,085	37,085
Escalation and Interest During Construction	4,669	9,090	4,669	9,090	9,090
Subtotal	23,720	46,175	23,720	46,175	46,175
Southern Delta Modifications	--	--	33,300	33,300	47,600
Interest During Construction	--	--	2,763	2,763	4,003
TOTAL	23,720	46,175	59,783	82,238	97,778
Annual Equivalent Costs					
Capital Recovery	2,023	3,938	5,098	7,013	8,339
Operation, Maintenance, and Replacement	94	164	94	164	164
TOTAL	2,117	4,102	5,192	7,177	8,503

C-105711

C-105711

Table C-4

VALUE OF STATE WATER PROJECT FIRM YIELD AUGMENTATION FOR ALTERNATIVES 2-7.3(CORPS) AND 4-7.3(CORPS) (Annualized Values at 1985 Price Levels)

Study Parameters

Discount Rate = 8.375%

Yield =	66	66	66	66	66	66
M&I Yield Allocation = 70.6%						
SWP Ag Supply Unit Value =	162	192	209	214	217	219
SWP M&I Supply Unit Value (MWD) =	434	437	465	565	668	674
SWP M&I Supply Unit Value (Other) =	195	312	312	312	312	312

Energy Escalation (Real) = 2

1990 SWP Energy Cost/KWH = 20

1990 SWP Capacity Cost/KWH = 15

Annualized SWP Energy and Capacity Cost/KWH = 44

Study Results

Benefits ($1,000)

SWP Ag Supply =	3,618
Value/AF =	187
SWP M&I Supply =	18,513
Value/AF =	398
Total =	22,131
Benefit/AF =	336

Costs ($1,000)

California Aqueduct Energy =	6,297
Local System Energy =	823
MWD Energy Recovery =	-819
Ground Water Operations =	1,051
Total =	7,351

Net Benefit = 14,780

Table C-5

SUPPLY AND DEMAND PROJECTIONS
LOS ANGELES, SANTA ANA, AND SAN DIEGO HYDROLOGIC STUDY AREAS
(Thousands of Acre-Feet)

Supply Source	Year 1990	2000	2010	2020	2030	2035
Local Surface	159	159	159	159	159	159
Imports by Local Water Agencies	975	975	975	975	975	975
Ground Water	962	962	962	962	962	962
Federal Water Development	20	20	20	20	20	20
Waste Water Reclamation	190	315	400	400	400	400
Imperial Valley Conservation/Transfer	100	200	250	250	250	250
SWP Imports, Existing Facilities	1,066	927	863	863	863	863
Total Supply	3,472	3,560	3,629	3,629	3,629	3,629
Demand with Conservation	3,751	3,912	4,123	4,277	4,378	4,416
Projected Shortage, Existing Facilities	279	352	494	648	749	787

Table C-6

ALTERNATIVES FOR BALANCING SUPPLY WITH DEMAND, METROPOLITAN WATER DISTRICT SERVICE AREA

Alternative	Cost per Acre-Foot		Yield (1,000 Acre-Feet)				
	Purchase ($0.044/KWH)	Construction ($0.098/KWH)	1990	2000	2010	2020	2035
Additional Toilet Dam and Showerhead Retrofit	123	123	98	60	0	0	0
Free Residential Landscape Design	195	195	22	48	60	73	91
San Joaquin Valley Drainage Water Desalting	434*	574**	190	276	319	319	319
Additional Imperial Valley Conservation and Transfer	465*	595**	330	255	180	180	180
Riverside County Drainage Water Desalting	532*	671**	42	42	42	42	42
Ground Water Desalting	579*	719**	73	73	73	73	73
Imperial Valley Drainage Water Desalting	674*	919**	302	302	302	302	302

* $15/acre-foot local treatment and distribution included.
** $33/acre-foot local treatment and distribution included.

Table C-7

ECONOMIC ANALYSIS OF ADDITIONAL PUMPING UNITS, PURCHASED CAPACITY AND ENERGY (1990 Present Worth Values in 1,000 1985 Dollars)

Item	2-6.4	4-6.4	2-7.3 (Corps)	4-7.3 (Corps)
Capital Costs				
Pumping Units	19,051	37,085	19,051	37,085
Escalation and Interest during Construction	4,669	9,090	4,669	9,090
TOTAL	23,720	46,175	23,720	46,175
Annual Equivalent Costs				
Capital Recovery	2,023	3,938	2,023	3,938
OM&R	94	164	94	164
TOTAL Costs	2,117	4,102	2,117	4,102
Annual Equivalent Benefits				
Median Year Analysis				
1. Cost Savings for Capacity and Energy at Banks Pumping Plant for operations with 6,400 cfs maximum monthly export	6,039	10,590	6,039	10,590
2. Added differential cost savings for SWP system, alternative 4-7.3 compared to alternative 2-7.3	--	--	--	2,413
TOTAL Cost Savings	6,039	10,590	6,039	13,003
Firm Yield Analysis				
Water Supply	--	--	22,131	22,131
Less Increased Costs for Delivery, Distribution, Treatment, and Ground Water Operations	--	--	<7,351>	<7,351>
Sub-Total	0	0	14,780	14,780
TOTAL, Median and Firm	6,039	10,590	20,819	27,783
Overall Benefit/Cost Ratio	2.8	2.6	9.8	6.8
Overall Net Benefits	3,922	6,488	18,702	23,681

Table C-8

ANALYSIS OF REMAINING ALTERNATIVE OPERATIONAL PLANS, PURCHASED CAPACITY AND ENERGY
(1990 Present Values in Thousand 1985 Dollars)

	2-8.5 (Corps)	4-10.3 (Corps)	2-8.5	4-8.5	4-10.3
Fixed Annual Costs (Table C-3)	2,117	4,102	5,192	7,177	8,503
Firm Yield, Annual Equivalent Benefits					
Agricultural Supply	4,002	4,002	12,115	12,115	12,663
Municipal and Industrial Supply	20,461	20,461	57,842	57,842	60,037
Total	24,463	24,463	69,957	69,957	72,700
Firm Yield, Annual Equivalent Costs					
State Water Project Energy	6,964	6,964	21,084	21,084	22,038
Local Energy*	4	4	12	12	12
Ground Water Operations	1,051	1,051	4,998	4,998	4,998
Total	8,019	8,019	26,094	26,094	27,048
Firm Yield, Net Benefit	16,444	16,444	43,863	43,863	45,652
Median Year Shift Benefits at Banks Pumping Plant	6,039	10,590	6,039	10,590	10,590
Total, Median and Firm	22,483	27,034	49,902	54,453	56,242
Overall Net Benefits	20,366	22,932	44,710	47,276	47,739

* Local energy costs are reduced by Metropolitan Water District energy recovery.

Table C-9

COMBINED ECONOMIC ANALYSIS OF ADDITIONAL PUMPING UNITS, PLANT CONSTRUCTION
(1990 Present Values in Thousand 1985 Dollars)

	Alternative			
	2-6.4	4-6.4	2-7.3 (Corps)	4-7.3 (Corps)
Fixed Annual Costs (Table C-3)	2,117	4,102	2,117	4,102
Median Year, Annual Equivalent Benefits				
Cost Savings				
Capacity at Banks Pumping Plant	15,050	26,140	15,050	26,140
Peak Energy at Banks Pumping Plant	2,113	3,771	2,113	3,771
Subtotal	17,163	29,911	17,163	29,911
Added Differential Cost Savings Compared to Alternative 2-7.3(Corps)	--	--	0	6,106
Total Net Benefits	17,163	29,911	17,163	36,017
Firm Yield, Annual Equivalent				
Water Supply Benefits	--	--	26,597	26,597
Less Increased Costs	--	--	-14,985	-14,985
Net Benefits	--	--	11,612	11,612
Total Median and Firm	17,163	29,911	28,775	47,629
Overall Benefit/Cost Ratio	8.1	7.3	13.6	11.6
Overall Net Benefits	15,046	25,809	26,658	43,527

C-105717

Table C-10

SENSITIVITY ANALYSIS, EFFECTS OF PLANT CONSTRUCTION VALUES ON ECONOMIC ANALYSIS
(Annualized 1990 Values in Thousand 1985 Dollars)

	2-6.4		4-6.4		2-7.3(Corps)		4-7.3(Corps)	
	Purchase	Construction	Purchase	Construction	Purchase	Construction	Purchase	Construction
Median Year, Total Net Benefits	6,039	17,163	10,590	29,911	6,039	17,163	13,003	36,017
Firm Yield, Net Benefits	--	00	00	00	14,780	11,612	14,780	11,612
Total, Median and Firm	6,039	17,163	10,590	29,911	20,819	28,775	27,783	47,629
Fixed Cost of Pumps	2,117	2,117	4,102	4,102	2,117	2,117	4,102	4,102
Overall Net Benefits	3,922	15,046	6,488	25,809	18,702	26,658	23,681	43,527

Appendix D.

ASSESSMENT OF THE IMPACTS OF THE BANKS PUMPING PLANT IN THE STATE WATER PROJECT SERVICE AREAS

CONTENTS -- APPENDIX D

	Page
Assumptions	439
Summary	442
Economic Impacts	447
Agricultural Impacts	448
Social Impacts	449
Environmental Impacts	455
Air Quality	455
Hydrology and Water Quality	460
Biological Environment	463
Pesticide Use	472
Land Use	474
Cumulative Socioeconomic Impacts	479
Comparison of SWP Cumulative Socioeconomic Impacts With State Projections	480
Cumulative Environmental Impacts	480
Air Quality	494
Hydrology	495
Water Quality	495
Biological Environment	496
Land Use	496

Figures

1	SWP Service Areas and Contracting Agencies	443
2	Hydrologic Basins of California	444
3	California Air Basins	445
4	Service Area Emissions Totals	458

Page

Tables

D-1 Delta Pumping Plant Increased Firm Yield and Intermittent Ground Water Yield. 438

D-2 Delta Pumping Plant Firm and Ground Water Yield Allocations by Service Area and Use 441

D-3 Net Water Use and Supply, 1990 - 2000 446

D-4 Summary - Average Annual Direct, Indirect and Induced Income Impacts: Firm Yield Allocations 451

D-5 Summary - Average Annual Direct, Indirect and Induced Employment Impacts: Firm Yield Allocations. 452

D-6 Summary - Average Annual Population Impacts: Firm Yield Allocations 453

D-7 Summary - Average Annual Housing Unit Impacts: Firm Yield Allocations. 454

D-8 Summary - Average Annual Direct, Indirect and Induced Income and Employment Impacts: Intermittent Ground Water Yield Allocations 456

D-9 Summary - Average Annual Population and Housing Unit Impacts: Intermittent Ground Water Yield Allocations. 457

D-10 1980-1989 Average Annual Impacts: Income 481

D-11 1980-1989 Average Annual Impacts: Employment 482

D-12 1980-1989 Average Annual Impacts: Population, Households and Housing. 483

D-13 1990-1999 Average Annual Impacts: Income 484

D-14 1990-1999 Average Annual Impacts: Employment 485

D-15 1990-1999 Average Annual Impacts: Population, Households and Housing. 486

D-16 2000-2009 Average Annual Impacts: Income 487

D-17 2000-2009 Average Annual Impacts: Employment 488

D-18 2000-2009 Average Annual Impacts: Population, Households and Housing. 489

D-19 2020+ Average Annual Impacts: Income. 490

D-20 2020+ Average Annual Impacts: Employment 491

C—105721

C-105721

Tables

Page

D-21 2020+ Average Annual Impacts: Population, Households and Housing. 492

D-22 Comparisons of Delta Pumping Plant and Cumulative SWP Economic Direct, Indirect and Induced Impacts with 1990 California Projections 493

D-23 Areas With Potential to Exceed Air Quality Standards . . . 494

ASSESSMENT OF THE IMPACTS OF THE
DELTA PUMPING PLANT IN THE STATE
WATER PROJECT SERVICE AREAS

The purpose of this study is to estimate the service area economic, social and environmental impacts occurring from the expansion of the Delta Pumping Plant (DPP).[1/]

Five operational studies were conducted to examine the yield potentials of DPP expansion alternatives (Table D-1). The first study is the "no action" alternative, in which there is no increased SWP yield resulting from the DPP expansion. Operational studies 2 and 3 assume the installation of two or four additional pumps, which would be operated under U. S. Corps of Engineers (Corps) pumping restrictions. The increased firm yield of operational studies 2 and 3 would be 57,000 acre-feet and 64,000 acre-feet, respectively. If the additional two or four pumps are installed, but are not operated under Corps restrictions, then the firm yield of the SWP would increase to 178,000 acre-feet and 188,000 acre-feet (operational studies 4 and 5 respectively).

In addition to increased firm yield, there would be an increased capability of diverting intermittent winter unregulated flows with the pump expansion. If this capability is combined with ground water storage in the San Joaquin Valley and Southern California service areas, then there will also be an increased intermittent groundwater yield associated with the pump expansion. For operational studies 2 and 3, this is about 9,000 acre-feet per year;

1/ The official name of the Delta Pumping Plant is the Harvey O. Banks Delta Pumping Plant.

Table D-1: Delta Pumping Plant Increased Firm Yield and Intermittent Ground Water Yield

Operation Study	No. of Additional Pumps	Assumed Southern Delta Works	Maximum Monthly Exports (cfs)	U.S.C.E. Constraints	Increased Firm Yield (thousands of acre-feet)	Increased Ground Water Yield 1/ (thousands of acre-feet)
1	0	None	6,400	Not Applicable	--	--
2	2 or 4	None	7,300	Yes	57.0	9.0
3	4	None	up to 10,300	Yes	64.0	9.0
4	2 or 4	2nd Intake Dredged Channels	8,500	No	178.0	43.0
5	4	2nd Intake Dredged Channels	10,300	No	188.0	43.0

1/ All five operation studies assumed a 1,200 cfs East Branch enlargement and a 1.5 MAF East Branch groundwater reservoir. Groundwater basin yield increases occur due to increased storage and extractions during critical periods.

C-105724

C-105724

for studies 4 and 5, it amounts to about 43,000 acre-feet. Groundwater yield is allocated only to the Southern California and San Joaquin Valley service areas because these are the only two service areas that would receive significant supplies from the SWP groundwater program.

Assumptions

To analyze the economic, social and environmental impacts that would occur in the service areas as a result of expanding the DPP, the following assumptions were made:

1. SWP service areas that would be affected by the DPP expansion include the North Bay, South Bay, San Joaquin, Central Coastal and Southern California service areas. Because the Feather River service area is an area of origin, it will receive its entitlement with or without the DPP expansion. Voters in the Central Coastal service area have opted not to receive SWP supplies (at least in the forseeable future). However, a contractual obligation between DWR and the water agencies in that service area still exists; thus this report estimates the DPP expansion impact of fulfilling that obligation.2/

2. The yield of these alternatives has been allocated to the affected SWP service areas in proportion to the service areas' overall entitlement in 2020.3/ For the Southern California, North Bay, South Bay and Central Coastal service areas, all of the DPP allocation is assumed to be used for M&I purposes. In the San Joaquin service area, it is assumed that

---

2/ The Central Coastal service area's annual entitlement has recently been reduced from 82,700 AF to 70,500 AF.

3/ These proportions are based upon a SWP yield of 4,190,200 AF (instead of 4,230,000 AF) reflecting the exclusion of the Feather River service area.

90 percent of the DPP allocation will be used for agricultural purposes, with the remainder M&I. Table D-2 summarizes the service area DPP firm yield allocations, as well as the increased intermittent ground water allocations, by service areas and by agricultural and M&I uses.

3. This analysis assumes that economic motives (employment and income) are the primary determinants in population location. Thus, if water shortages do develop in an area, it is assumed that there will be minimal population relocation if employment opportunities remain. However, if employment becomes affected by water shortages (for example, industry leaves the area), then there could also be impacts upon the population. Accordingly, this analysis examines the maximum effect of the DPP expansion upon M&I income and employment, then translates these effects into population and other environmental impacts.

4. DWR has established a goal of 600,000 acre-feet of M&I conservation and waste water reclamation to be achieved in the SWP service areas by 2000. This analysis assumes that this conservation is implemented by that date, and it incorporates the least expensive and most easily implemental measures, including improved water use efficiencies and changed technologies (substituting other inputs, such as capital and labor, for water in the production process). This conservation is incorporated into Table D-3 (page D-12), which shows net water use and supply (1990-2000) for the service areas. This table indicates water shortages in the service areas, which in turn cause the economic and social impacts described in this report.

5. The impacts represent average annual impacts resulting from the increased firm yield of the DPP. The additional pumping capacity should be

C—105726

C-105726

Table D-2: Delta Pumping Plant Firm and Ground Water Yield Allocations by Service Area and Use

(thousands of acre-feet)

Firm Yield Allocations

Service Area	Allocation 1/	Uses 2/ M&I	Uses 2/ Agricultural
Southern California	34.0	34.0	0
	38.1	38.1	0
	106.1	106.1	0
	112.0	112.0	0
San Joaquin	18.3	1.8	16.5
	20.7	2.1	18.6
	57.5	5.7	51.8
	60.7	6.1	54.6
Central Coastal	1.1	1.1	0
	1.2	1.2	0
	3.4	3.4	0
	3.6	3.6	0
South Bay	2.6	2.6	0
	2.9	2.9	0
	8.0	8.0	0
	8.5	8.5	0
North Bay	1.0	1.0	0
	1.1	1.1	0
	3.0	3.0	0
	3.2	3.2	0
TOTAL	57.0	40.5	16.5
	64.0	45.4	18.6
	178.0	126.2	51.8
	188.0	133.4	54.6

Ground Water Yield Allocations

Service Area	Allocation 3/	Uses 2/ M&I	Uses 2/ Agricultural
Southern California	6.3	6.3	0
	30.1	30.1	0
San Joaquin	2.7	0.3	2.4
	12.9	1.3	11.6
TOTAL	9.0	6.6	2.4
	43.0	31.4	11.6

1/ Service area firm yield allocation proportions: Southern California, .596; San Joaquin, .323; Central Coastal, .019; South Bay, .045 and North Bay, .017.
2/ Use proportions: San Joaquin - .9 agricultural, .1 M&I. All others 1.00 M&I.
3/ Service area ground water yield allocation proportions: Southern California, .7; San Joaquin, .3.

C-105727

C-105727

installed by 1990, thus the annual impacts presented in this report begin in that year.

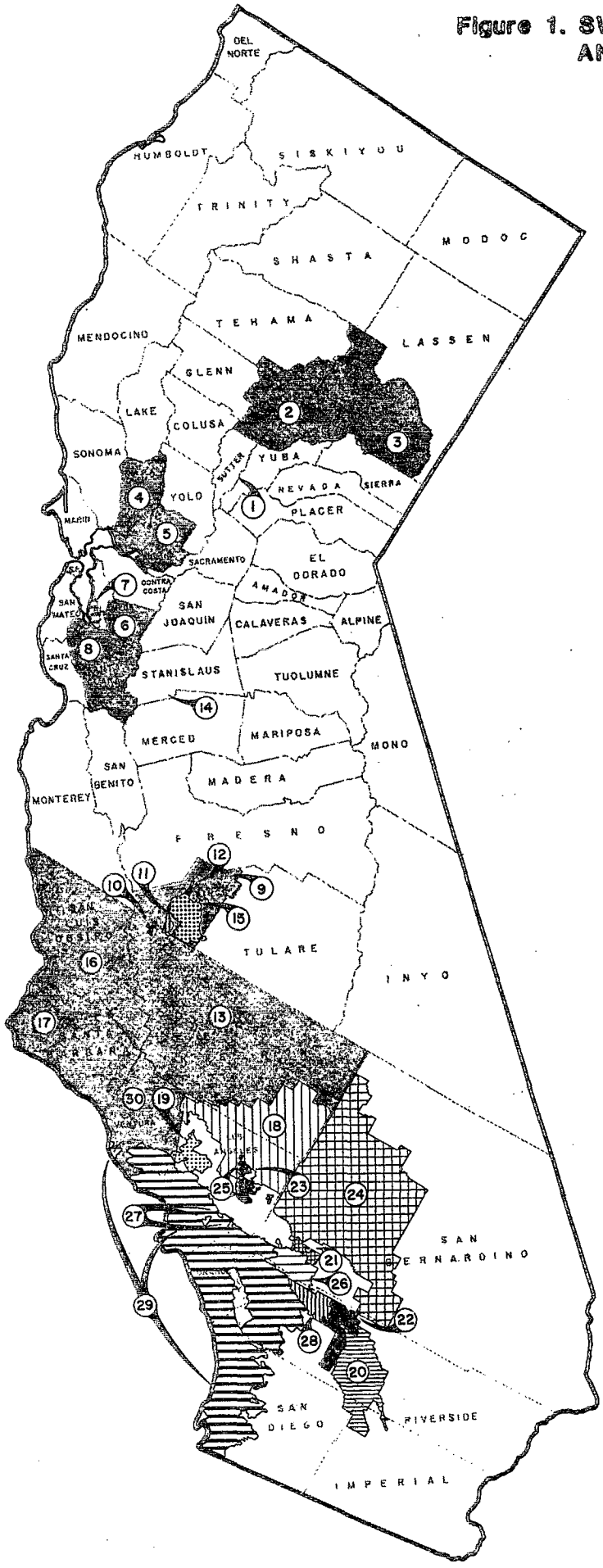
6. Finally, most of the information presented in this report is disaggregated by SWP service areas, shown in Figure 1. However, sometimes information was only available by hydrologic basins, which are shown in Figure 2, or by air basins, which are shown in Figure 3.

Summary

This study estimates the State Water Project (SWP) service area economic, social and environmental impacts resulting from the expansion of the Delta Pumping Plant (DPP). The first step is to allocate the increased yield to the affected service areas; in this case, the Southern California, San Joaquin, South Bay, North Bay and Central Coastal service areas. These service areas will receive approximately 60, 32, 4, 2 and 2 percent of the DPP firm yield, respectively. Once the allocations have been made to the service areas, it is necessary to make a further allocation by the type of use: M&I or agricultural. For the San Joaquin service area, it is assumed that 90 percent of the supplies would be used for agricultural purposes, and 10 percent for M&I. In the Southern California, South Bay, North Bay and Central Coastal service areas, 100 percent of the supplies is assumed to be used for M&I purposes.

Table D-3 summarizes projected net water use and supplies for hydrologic study areas containing the SWP service areas. The South Coastal study area includes the South Coastal SWP Service Area; the Central Coastal study area incorporates the Central Coastal SWP Service Area; the San Francisco Bay study area incorporates the North and South Bay SWP Service Areas; and the Tulare Lake study area includes the San Joaquin SWP Service Area. Figures 1 and 2 show the geographic boundaries of these regions; generally, the study

Figure 1. SWP SERVICE AREAS AND CONTRACTING AGENCIES



Location No.	Contracting Agency	Maximum Annual Entitlement (acre-feet) (a)
	(1)	(3)
	UPPER FEATHER AREA	
1	City of Yuba City	9,600
2	County of Butte	27,500
3	Plumas County Flood Control and Water Conservation District	2,700
	Subtotal	39,800
	NORTH BAY AREA	
4	Napa County Flood Control and Water Conservation District	25,000
5	Solano County Flood Control and Water Conservation District	42,000
	Subtotal	67,000
	SOUTH BAY AREA	
6	Alameda County Flood Control and Water Conservation Dist., Zone 7	46,000
7	Alameda County Water District	42,000
8	Santa Clara Valley Water District	100,000
	Subtotal	188,000
	SAN JOAQUIN VALLEY AREA	
9	County of Kings	4,000
10	Devil's Den Water District	12,700
11	Dudley Ridge Water District	57,700
12	Empire West Side Irrigation District	3,000
13	Kern County Water Agency	1,153,400
14	Oak Flat Water District	5,700
15	Tulare Lake Basin Water Storage District (e	118,500
	Subtotal	1,355,000
	CENTRAL COASTAL AREA	
16	San Luis Obispo County Flood Control and Water Conservation District	25,000
17	Santa Barbara County Flood Control and Water Conservation District	57,700
	Subtotal	82,700
	SOUTHERN CALIFORNIA AREA	
18	Antelope Valley-East Kern Water Agency	138,400
19	Castaic Lake Water Agency	41,500
20	Coachella Valley Water District	23,100
21	Crestline-Lake Arrowhead Water Agency	5,800
22	Desert Water Agency	38,100
23	Littlerock Creek Irrigation District	2,300
24	Mojave Water Agency	50,800
25	Palmdale Water District	17,300
26	San Bernardino Valley Municipal Water District	102,600
27	San Gabriel Valley Municipal Water District	28,800
28	San Gorgonio Pass Water Agency	17,300
29	The Metropolitan Water District of Southern California	2,011,500
30	Ventura County Flood Control District	20,000
	Subtotal	2,497,500
	TOTAL STATE WATER PROJECT	4,230,000

C—105729

C-105729

Figure 2. HYDROLOGIC BASINS OF CALIFORNIA

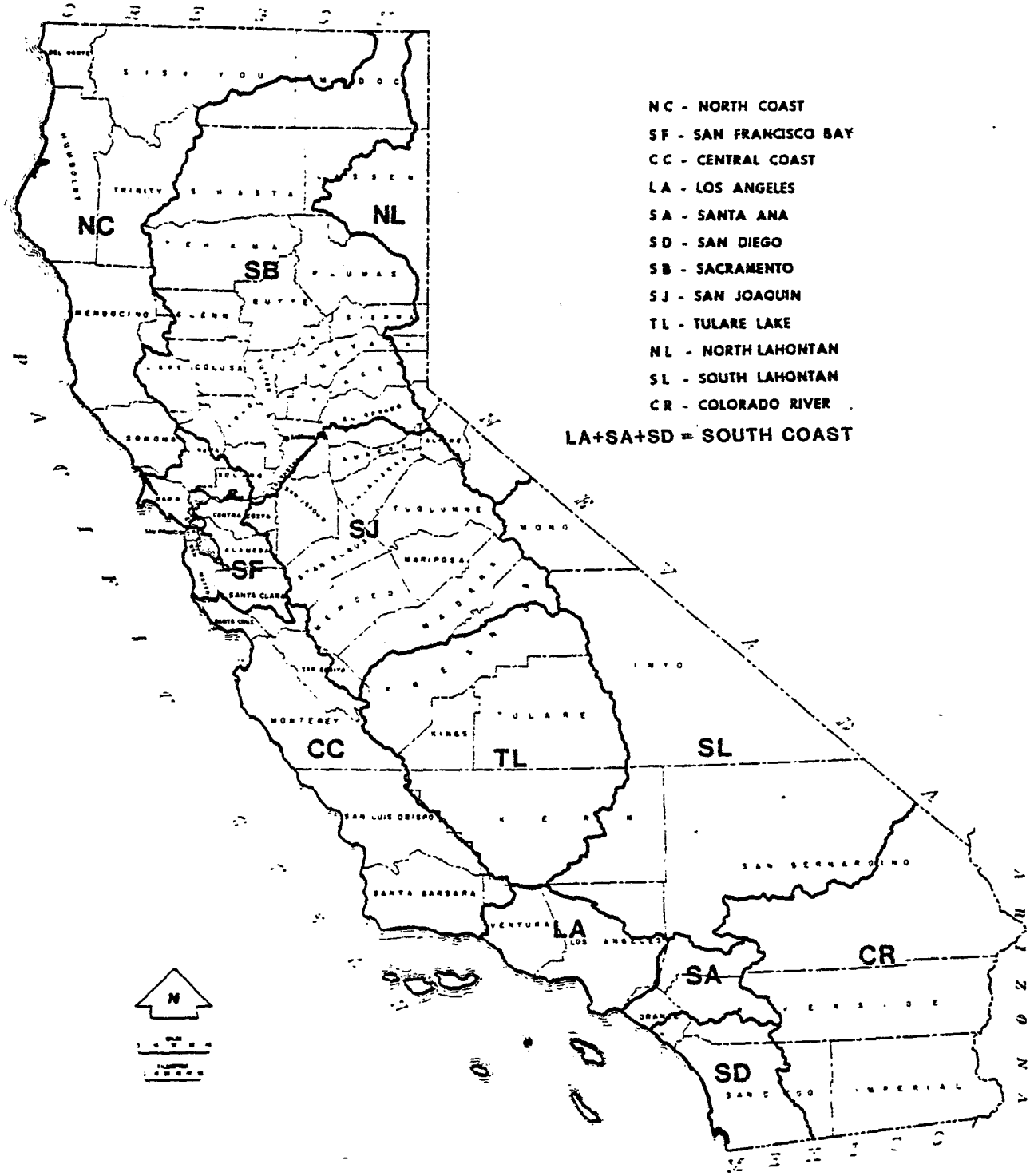


Figure 3. CALIFORNIA AIR BASINS

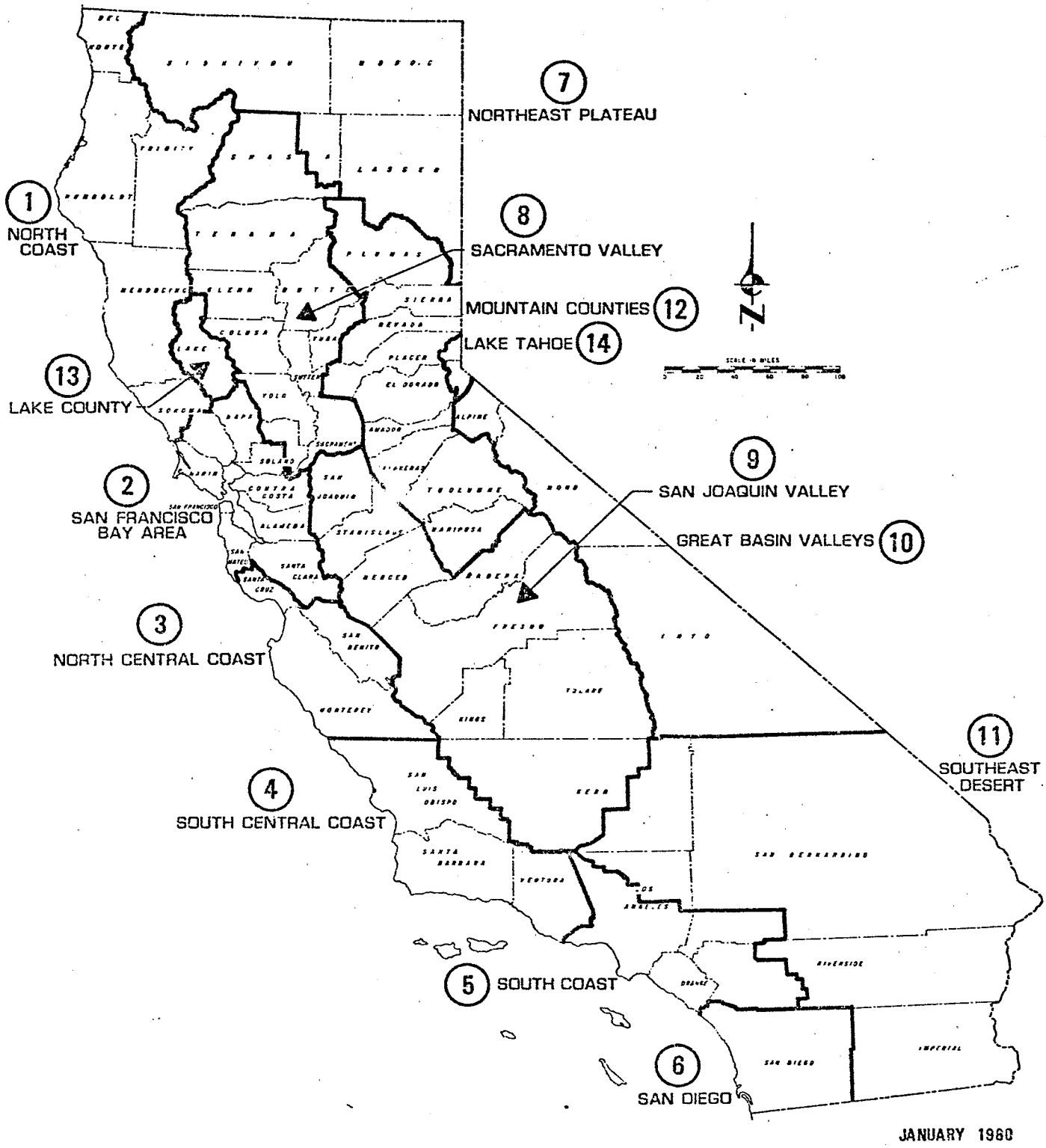


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Table D-3
Net Water Use And Supply[1/]
1990 - 2000
(thousands acre-feet)

Hydrologic Study Area	Net Water Use 1990 M&I[2/]	Net Water Use 1990 Total[3/]	Net Water Use 2000 M&I[2/]	Net Water Use 2000 Total[3/]	Water Supply 1990 Dependable	Water Supply 1990 Overdraft	Water Supply 1990 Total	Water Supply 2000 Dependable	Water Supply 2000 Overdraft	Water Supply 2000 Total	Water Shortage 1990	Water Shortage 2000
South Study Area[4/]	2,820	3,760	3,060	3,920	3,530	0	3,530	3,580	0	3,580	230	340
Tulare Lake	280	8,425	310	8,700	6,580	1,190	7,770	6,590	1,450	8,040	655	660
Central Coast	210	1,175	230	1,195	985	180	1,165	1,005	180	1,185	10	10
San Francisco Bay	1,050	1,275	1,090	1,325	1,225	20	1,245	1,260	0	1,260	30	65

1/ Source: Department of Water Resources, Bulletin 160-82 (Draft).
2/ Includes allowances for conservation.
3/ Includes irrigation, municipal and industrial, wildlife and recreation, energy production and conveyance losses.
4/Includes Los Angeles, Santa Ana, and San Diego hydrologic study areas.

C-105732
C-105732

areas encompass larger geographic regions than the SWP service areas. The net water use estimates have been adjusted to account for conservation; the water supply figures include supplies delivered from the additional Delta pumps, Cottonwood Creek, and from ground water storage.

As can be seen in this table, the Central Coastal and Tulare Lake study areas were projected to remain in a groundwater overdraft condition into the future. Beginning in 1990 (when the additional pumps are to be operational), all the study areas are projected to have water shortages.

Economic Impacts. Economic impacts are the economic consequences resulting from a project or other action, and can be classified as either direct, indirect or induced. Direct economic impacts are those effects that occur as immediate consequence from the use of the project's output. For this report, direct economic impacts include the differences in income and employment in the SWP service areas with and without full SWP deliveries. These direct economic impacts will have repurcussionary effects upon the local and state economies. Included in these effects is the increase (or decrease) in the value of goods and services which indirectly result from the project's output (indirect effects). Also included are the wages and other income that are reinjected into the economy in the form of personal consumption expenditures (induced impacts). In this report, these indirect and induced impacts are measured over the entire State. Thus, the total economic impact includes the sum of the service area direct impacts, as well as the statewide indirect and induced impacts.

M&I. The water supply available from the additional pumps is divided into M&I and agricultural uses. Of the total M&I supplies, that portion to be used for industrial purposes (based upon historical industrial water use) in each service area is determined. For this analysis, it is assumed that only deliveries

to the industrial sector (and not the residential, commercial or governmental sectors) directly create income and employment because the water is used in the production process for processing and cooling. It is further assumed that water supply is the only constraint to further production.

Based upon these assumptions, differing amounts of water deliveries may cause a change in the level and/or composition of a region's industrial production. Included in this production is that portion used for final demand and that used for intermediate production. Final demand is that portion of gross output that is used for final consumption, as in personal consumption, capital formation, government purchases and exports. Because of doublecounting problems, that output which is used as input by other firms (intermediate production) in the region is excluded.

For every dollar of industrial output delivered to final demand, some portion of that dollar is returned to each of the productive inputs as income in the form of economic profit to the firm owners, employee compensation, net interest, indirect business taxes and capital consumption allowances. Changes in final demand will also result in employment impacts. These income and employment impacts are called direct impacts because they are an immediate consequence of a change in water supplies.

The direct income and employment impacts will have indirect and induced effects upon the local and state economies. Thus, the total impact of a direct stimulus to the economy is the sum of the service area direct impact and the statewide indirect and induced impacts. The Department's input/output (I/O) model is used to estimate the indirect and induced income and employment impacts.

Agricultural. Agricultural direct income impacts were determined for the San Joaquin Valley using the Department's linear programming model (L/P).

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Included in these direct income impacts are economic profit accruing to the land owners, returns to management and returns to labor (wages). The income values obtained in the L/P model assume that no other SWP facilities are built. Direct agricultural employment impacts are estimated from the number of acres irrigated and crop labor requirements (per acre). As in the M&I analysis, indirect and induced income and employment impacts are estimated for the agricultural sector.

Social Impacts. Population impacts are derived from the direct and local indirect and induced employment impacts (permanent employment for the agricultural sector). This assumes that economic motives (employment and income) are the primary determinants in population location.

Population also affects land use. One aspect of land use is housing; in the DPP impact analysis, the impact of population upon housing types (single family and multiple family) is estimated. Land use impacts are closely associated with environmental impacts, which are discussed below.

Finally, the socioeconomic impacts in the Southern California service area will need to be adjusted to account for the loss of Colorado River supplies; an adjustment in the San Joaquin service area will also be needed to account for the replacement of SWP surplus agricultural supplies.

In the Southern California service area, Colorado River entitlements to MWD will be reduced from 1,200,000 AF to 550,000 AF in the late 1980s, as a result of a 1964 Supreme Court decision diverting this entitlement to the Central Arizona Project. In addition, the Supreme Court awarded the lower Colorado River Indian tribes certain water rights that could potentially lower MWD's entitlement to 450,000 AF (and possibly only 400,000 AF) beginning in the late 1980s. If it is assumed that all of the SWP facilities (existing and planned) serve all the service areas collectively, then it could also be

assumed that all of the individual SWP facilities contribute equally to reducing deficits in other water supplies in the service areas. For Southern California, an average of 33 percent of SWP deliveries between 1990 and 2035 will be needed to replace water diverted annually (about 650,000 AF) to the Central Arizona Project; hence, it will be assumed that 33 percent of the DPP impacts in this service area can be regarded as a continuation of current conditions. This replacement affects SWP M&I and agricultural deliveries.

From 1973 to 1980 there have been substantial deliveries of agricultural surplus water to the San Joaquin service area (about 407,700 AF per year, excluding 1977, the drought year). Future SWP agricultural entitlement deliveries (totalling about 1,244,400 AF per year) will replace these historical surplus deliveries, which are about 33 percent of projected future entitlement.[4/] M&I deliveries to this service area will not be affected by this surplus replacement.

The DPP annual economic (income and employment) and social (population and housing) impacts are summarized in Tables D-4 through D-7 for the firm yield allocations (57,000, 64,000, 178,000 and 188,000 AF). Included in these tables are the direct and total of direct, indirect and induced impacts, as well as the replacement impacts (for the Southern California and San Joaquin service areas). Total impacts for all service areas are presented with and without replacement; however, the "with" replacement impacts represent the "bottom line" in this impact assessment.

4/ These future SWP entitlement deliveries are dependent upon the construction of the SB 200 facilities. With the defeat of Proposition 9, it is uncertain that these water deliveries could be made, at least up to the year 2000.

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C-105736

Table D-4: Summary - Average Annual Direct, Indirect and Induced Income Impacts: Firm Yield Allocations (millions 1982 $)

Service Area	Firm Yield (TAF)	Income Impacts Direct	Direct Indirect and Induced
Southern California Total Impacts	34.0	$266.7	$ 907.5
	38.1	298.9	1,016.9
	106.1	832.3	2,831.9
	112.0	878.6	2,989.3
Replacement Impacts 1/	11.2	87.9	298.9
	12.6	98.8	336.3
	35.0	274.6	934.2
	37.0	290.2	987.5
Net Impacts	22.8	178.8	608.6
	25.5	200.1	680.6
	71.1	557.7	1,897.7
	75.0	588.4	2,001.8
San Joaquin Total Impacts	18.3	4.2	14.7
	20.7	4.7	16.7
	57.5	13.1	46.0
	60.7	14.0	49.1
Replacement Impacts 2/	5.4	0.7	2.0
	6.1	0.8	2.3
	17.1	2.2	6.3
	18.0	2.3	6.6
Net Impacts	12.9	3.5	12.7
	14.6	3.9	14.4
	40.4	10.9	39.7
	42.7	11.7	42.5
Central Coastal	1.1	4.8	19.3
	1.2	5.2	21.1
	3.4	14.8	60.0
	3.6	15.6	63.2
South Bay	2.6	29.4	98.5
	2.9	32.8	109.9
	8.0	90.5	303.0
	8.5	96.1	322.0
North Bay	1.0	6.4	25.0
	1.1	7.1	27.5
	3.0	19.3	74.9
	3.2	20.5	79.9
Total (w/o replacement)	57.0	311.5	1,065.0
	64.0	348.7	1,192.1
	178.0	970.0	3,315.8
	188.0	1,024.8	3,503.5
Total (with replacement)	40.4	222.9	764.1
	45.3	249.1	853.5
	125.9	693.2	2,375.3
	133.0	732.3	2,509.4

1/ Assumes 33 percent of SWP supplies replace lost Colorado River supplies.
2/ Assumes 33 percent of SWP agricultural entitlement supplies replace past SWP surplus deliveries.

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Table D-5: Summary - Average Annual Direct, Indirect and Induced Employment Impacts: Firm Yield Allocations (thousands of person-years)

Service Area	Firm Yield (TAF)	Employment Impacts Direct	Direct Indirect and Induced
Southern California Total Impacts	34.0 38.1 106.1 112.0	7.2 8.1 22.5 23.7	43.1 48.3 134.4 141.9
Replacement Impacts 1/	11.2 12.6 35.0 37.0	2.4 2.7 7.4 7.8	14.2 16.0 44.3 46.9
Net Impacts	22.8 25.5 71.1 75.0	4.8 5.4 15.1 15.9	28.9 32.3 90.1 95.0
San Joaquin Total Impacts	18.3 20.7 57.5 60.7	0.4 0.5 1.3 1.5	2.3 2.9 7.4 8.1
Replacement Impacts 2/	5.4 6.1 17.1 18.0	0.1 0.1 0.2 0.3	0.4 0.4 0.9 1.3
Net Impacts	12.9 14.6 40.4 42.7	0.3 0.4 1.1 1.2	1.9 2.5 6.5 6.8
Central Coastal	1.1 1.2 3.4 3.6	0.2 0.2 0.6 0.7	1.3 1.4 4.1 4.3
South Bay	2.6 2.9 8.0 8.5	0.8 0.9 2.5 2.6	3.2 3.5 9.8 10.4
North Bay	1.0 1.1 3.0 3.2	0.1 0.1 0.4 0.4	1.0 1.1 3.1 3.3
Total (w/o replacement)	57.0 64.0 178.0 188.0	8.7 9.8 27.3 28.9	50.9 57.2 158.8 168.0
Total (with replacement)	40.4 45.3 125.9 133.0	6.2 7.0 19.7 20.8	36.3 40.8 113.6 119.8

1/ Assumes 33 percent of SWP supplies replace lost Colorado River supplies
2/ Assumes 33 percent of SWP agricultural entitlement supplies replace past SWP surplus deliveries.

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Table D-6: Summary - Average Annual Population Impacts:
Firm Yield Allocations
(thousands of people)

Service Area	Firm Yield (TAF)	Population Impacts
Southern California Total Impacts	34.0 38.1 106.1 112.0	75.8 85.0 236.6 249.8
Replacement Impacts 1/	11.2 12.6 35.0 37.0	25.0 28.1 78.1 82.5
Net Impacts	22.8 25.5 71.1 75.0	50.8 56.9 158.5 167.3
San Joaquin Total Impacts	18.3 20.7 57.5 60.7	0.4 0.4 1.1 1.2
Replacement Impacts 2/	5.4 6.1 17.1 18.0	0 0 0 0
Net Impacts	12.9 14.6 40.4 42.7	0.4 0.4 1.1 1.2
Central Coastal	1.1 1.2 3.4 3.6	0.6 0.7 2.0 2.1
South Bay	2.6 2.9 8.0 8.5	0.3 0.4 1.0 1.1
North Bay	1.0 1.1 3.0 3.2	0.1 0.1 0.4 0.4
Total (w/o replacement)	57.0 64.0 178.0 188.0	77.2 86.6 241.1 254.6
Total (with replacement)	40.4 45.3 125.9 133.0	52.2 58.5 163.0 172.1

1/ Assumes 33 percent of SWP supplies replace lost Colorado River supplies
2/ Assumes 33 percent of SWP agricultural entitlement supplies replace past SWP surplus deliveries.

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C-105739

Table D-7: Summary - Average Annual Housing Unit Impacts:
Firm Yield Allocations
(thousands of units)

Service Area	Firm Yield (TAF)	Housing Unit Impacts		
		Total	Single Family 3/	Multiple Family
Southern California Total Impacts	34.0	30.9	18.0	12.9
	38.1	34.7	20.2	14.5
	106.1	96.6	56.2	40.4
	112.0	101.9	59.4	42.5
Replacement Impacts 1/	11.2	10.2	5.9	4.3
	12.6	11.5	6.7	4.8
	35.0	31.9	18.6	13.3
	37.0	33.7	19.6	14.1
Net Impacts	22.8	20.7	12.1	8.6
	25.5	23.2	13.5	9.7
	71.1	64.7	37.6	27.1
	75.0	68.2	39.8	28.4
San Joaquin Total Impacts	18.3	0.2	0.1	0.1
	20.7	0.2	0.1	0.1
	57.5	0.5	0.4	0.1
	60.7	0.5	0.4	0.1
Replacement Impacts 2/	5.4	0	0	0
	6.1	0	0	0
	17.1	0	0	0
	18.0	0	0	0
Net Impacts	12.9	0.2	0.1	0.1
	14.6	0.2	0.1	0.1
	40.4	0.5	0.4	0.1
	42.7	0.5	0.4	0.1
Central Coastal	1.1	0.3	0.2	0.1
	1.2	0.3	0.2	0.1
	3.4	0.9	0.5	0.4
	3.6	0.9	0.5	0.4
South Bay	2.6	0.2	0.1	0.1
	2.9	0.2	0.1	0.1
	8.0	0.5	0.4	0.1
	8.5	0.5	0.4	0.1
North Bay	1.0	0.1	0.1	0
	1.1	0.1	0.1	0
	3.0	0.2	0.1	0.1
	3.2	0.2	0.1	0.1
Total (w/o Replacement)	57.0	31.7	18.5	13.2
	64.0	35.5	20.7	14.8
	178.0	98.7	57.6	41.1
	188.0	104.0	60.8	43.2
Total (with Replacement)	40.4	21.5	12.6	8.9
	45.3	24.0	14.0	10.0
	125.9	66.8	39.0	27.8
	133.0	70.3	41.2	29.1

1/ Assumes 33 percent of SWP supplies replace lost Colorado River entitlement.
2/ Assumes 33 percent of SWP agricultural entitlement supplies replace past SWP surplus deliveries.
3/ Includes mobile homes.

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For the 188,000 AF firm yield allocation, the direct, indirect and induced income impact, with replacement, totals about $2.5 billion per year, in 1982 $ (Table D-4). For the same allocation, the accompanying direct, indirect and induced employment impacts for all the service areas total about 119,800 jobs per year, with replacement (Table D-5). The total population impact is about 172,100, with a total housing unit impact of about 70,300 (Tables D-6 and D-7, respectively) for the 188,000 AF firm yield allocation. Acreage impacts for the 57.0, 64.0, 178.0 and 188.0 TAF allocations are 5,900, 6,700, 18,600 and 19,700, respectively. With replacement, these impacts are 4,000, 4,500, 12,500 and 13,200, respectively.

For the intermittent groundwater allocations (9,000 and 43,000 AF), the impacts are shown in Tables D-8 and D-9. With the 43,000 AF groundwater allocation (with replacement), Southern California direct, indirect and induced income impacts would be about $539.2 million per year. The San Joaquin impact would be about $9.2 million. Acreage impacts for the 9.0 and 43.0 TAF allocations are 1,000 and 4,200, respectively. With replacement, the acreage impacts are 670 and 2,800 acres, respectively.

Environmental Impacts. Environmental impacts resulting from the 188,000 acre-foot firm yield allocation are summarized below. Environmental impacts would also occur in lesser amounts for the other alternatives.

Air Quality. The projected total emission for each region from 1975 to 1995 are shown in Figure 4 (adopted from California Air Resources Board, State Implementation Plan - Working Document, April 1978). Implicit in these projections is the assumption that there would be adequate levels of resources (including water) to support the projected population levels in these regions. These projections incorporate the sum of all water project impacts; therefore, the air quality impacts resulting from the additional pumps are embodied in these projections.

Table D-8: Summary - Average Annual Direct, Indirect and Induced Income and Employment Impacts: Intermittent Ground Water Yield Allocations

Service Area	Intermittent Ground Water (TAF)	Income (millions 1982$) Direct	Income (millions 1982$) Direct, Indirect & Induced	Employment (thousands) Direct	Employment (thousands) Direct, Indirect & Induced
Southern California Total Impacts	6.3 30.1	$ 49.4 236.1	$ 168.2 803.4	1.3 6.4	8.0 38.1
Replacement Impacts 1/	2.1 9.9	16.5 77.7	56.1 264.2	0.4 2.1	2.7 12.5
Net Impacts	4.2 20.2	32.9 158.4	112.1 539.2	0.9 4.3	5.3 25.6
San Joaquin Total Impacts	2.7 12.9	0.6 3.0	2.3 10.6	0 0.3	0 1.9
Replacement Impacts 2/	0.8 3.8	0.1 0.5	0.3 1.4	0 0.1	0 0.4
Net Impacts	1.9 9.1	0.5 2.5	2.0 9.2	0 0.2	0 1.5
Total (w/o Replacement)	9.0 43.0	50.0 239.1	170.5 814.0	1.3 6.7	8.0 40.0
Total (with Replacement)	6.1 29.3	33.4 160.9	114.1 548.4	0.9 4.5	5.3 27.1

1/ Assumes 33 percent of SWP supplies replace lost Colorado River supplies.
2/ Assumes 33 percent of SWP agricultural entitlement supplies replace past SWP surplus deliveries.

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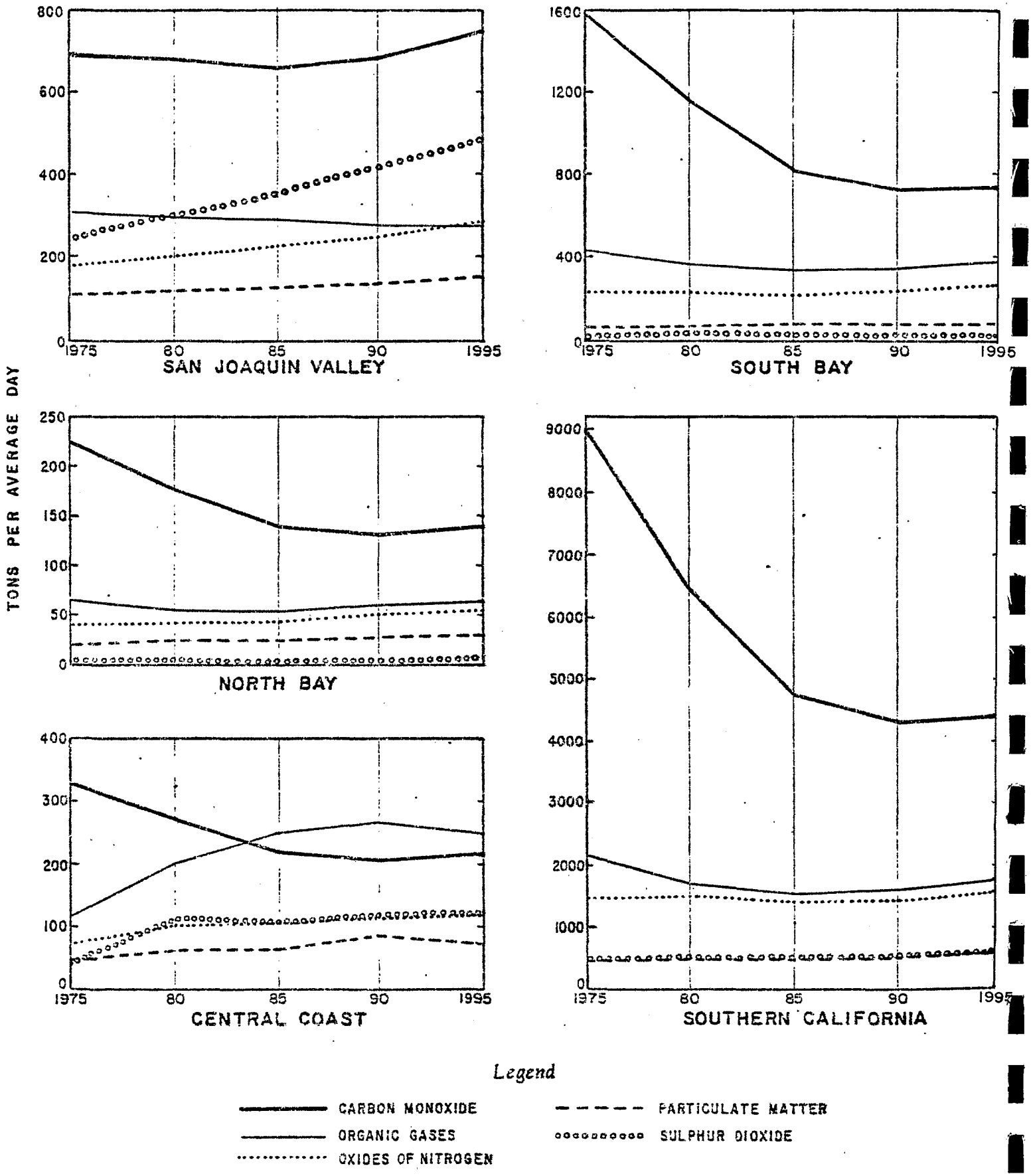
C-105742

Table D-9: Summary: Average Annual Population and Housing Unit Impacts: Intermittent Ground Water Yield Allocations

Service Area	Intermittent Ground Water Yield (TAF)	Population Impact (thousands)	Housing Unit Impacts (thousands)		
			Total	Single Family 3/	Multiple Family
Southern California Total Impacts	6.3 30.1	14.0 67.1	5.7 27.4	3.3 16.0	2.4 11.4
Replacement 1/ Impacts	2.1 9.9	4.7 22.1	0.3 1.2	0.2 0.7	0.1 0.5
Net Impacts	4.2 20.2	9.3 45.0	5.4 26.2	3.1 15.3	2.3 10.9
San Joaquin Total Impacts	2.7 12.9	0.1 0.3	0 0.1	0 0.1	0 0
Replacement 2/ Impacts	0.8 3.8	0 0	0 0	0 0	0 0
Net Impacts	1.9 9.1	0.1 0.3	0 0.1	0 0.1	0 0
Total (w/o replacement)	9.0 43.0	14.1 67.4	5.7 27.5	3.3 16.1	2.4 11.4
Total (with replacement)	6.1 29.3	9.4 45.3	5.4 26.3	3.1 15.4	2.3 10.9

1/ Assumes 33 percent of SWP supplies replace lost Colorado River entitlement.
2/ Assumes 33 percent of SWP agricultural entitlement supplies replace past SWP surplus deliveries.
3/ Includes mobile homes.

Figure 4. SERVICE AREA EMISSIONS TOTALS



Because adverse air quality is an existing, rather than potential problem, any growth within the SWP service areas may be expected to have an effect on the service areas' air quality, either decreasing air quality, or making it more difficult for State and Federal air standards to be met.

Most regions will probably show slight increases of particulates, sulfur dioxide, and oxides of nitrogen. However, more stringent automobile emmission standards will reduce oxidants and carbon monoxide emissions.

1. Southern California Service Area. Oxidant concentrations have begun to decline in the Southern California service area. During 1975, the air quality standard for one-hour concentrations of oxidant was exceeded on 262 days in the South Coast Air Basin, compared with 151 days in 1980.

Carbon monoxide concentrations are declining, primarily as a result of emissions restrictions on motor vehicles. The decline is most noticeable in the South Coast Air Basin, where maximum eight-hour concentrations are ten parts per million less than a decade ago.

Maximum nitrogen dioxide concentrations have dropped in the South Coast Air Basin, although they vary greatly from year to year. In the San Diego Air Basin, the maximum concentrations of this pollutant have remained relatively constant.

2. North and South Bay Service Areas. Maximum oxidant concentrations have declined somewhat in the San Francisco Air Basin. During 1975, the air quality standard for one-hour concentrations of oxidant was exceeded 69 days in the basin, compared with 46 days in 1980.

Carbon monoxide concentrations are showing declines as a result of stricter automobile emissions standards.

In the San Francisco Bay Air Basin, the maximum concentrations of nitrogen dioxide have remained relatively constant, probably because of an increase in the number of stationary combustive sources and because control of

nitric oxide emissions from automobiles has not been as vigorous as the control of other emissions.

3. San Joaquin Valley Service Area. During 1975, the number of days in the San Joaquin Valley Air Basin exceeding the one-hour ambient air quality standard for oxidant was 131, compared to 125 days in 1980. The number of days in 1980 exceeding the one-hour standard in Kern County was 84. Oxidant emissions are projected to decrease slightly.

Particulate emissions, sulfur dioxide, nitrogen oxides, and carbon monoxide are all projected to increase in the future, largely due to an expansion of industrial and agricultural activity.

4. Central Coastal Service Area. Oxidant concentrations have declined somewhat in the Central Coastal Service Area. During 1975, the air quality standard for one-hour concentrations of oxidant was exceeded on 156 days in the South Central Coast Air Basin, compared with 143 days in 1980.

Carbon monoxide concentrations are declining, primarily as a result of emissions restrictions on motor vehicles.

Air quality impacts resulting from this project would be minimal.

Hydrology and Water Quality.

1. Southern California Service Area. Instream deliveries of SWP supplies could support stream and riparian environments in Southern California. Programs of this type would be esthetically pleasing, especially within or near urban areas. However, instream programs using SWP water would be dependent upon the availability of these supplies, and presently not enough supplies are available for this use.

Ground water recharge programs will continue in this service area. Because many of the ground water basins are adjudicated, quality conditions should continue to improve as the proportion of SWP supplies to Colorado River supplies increases.

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C-105746

SWP supplies benefit the overall quality of water in the Southern California service area. Recharging with SWP water improves ground water quality and helps stablize the ground water levels. Blending of SWP supplies with Colorado River water greatly improves the overall water quality. In fact, Colorado River water must be blended with water from a good quality source before it is within standards recommended for drinking water by the State of California.

This quality improvement also has many benefits to the consumer, including improved taste and longer lifetimes for appliances and fixtures.

The water quality control plans adopted for this area, as for all areas of the State, assume deliveries of water from the SWP as contracted. No adverse water quality effects will arise from the use of additional SWP supplies in this area, if the recommendations of the State Water Resources Control Board are implemented.

2. South Bay Service Area. Streamflow in Alameda Creek in the South Bay service area should increase in the future as deliveries from the State Water Project are increased. This will affect riparian vegetation and associated wildlife along Alameda Creek.

Ground water management programs using SWP supplies for recharging will continue. These programs, which are a local responsibility, improve overall ground water quality and prevent subsidence and sea water intrusion.

The southern San Francisco Bay may still have water quality problems in 1990 because of nonpoint source discharges.

3. North Bay Service Area. Streamflow in the North Bay service area should not differ significantly from present conditions. There would be no impacts to the ground water resources of this service area.

By 1990, this service area should not have any significant water quality problems from the use and disposal of municipal and industrial water supplies. Any new industries locating here would have to meet waste discharge requirements issued by the Regional Water Quality Control Board to ensure proper treatment and disposal.

4. San Joaquin Valley Service Area. Streamflow in the San Joaquin Valley service area should not differ significantly from present conditions.

Overdrafting of the ground water basin in this service will continue until sources are imported or land is removed from production. Overdraft could be as great as 1,130,000 acre-feet by 2000 in Kern County alone, assuming full SWP deliveries.

Because the San Joaquin service area lies in a closed basin, most of the salts brought to the irrigated lands (primarily through the application of chemicals and water) tend to accumulate in the soils and subsurface water. Continued applications of SWP water will add to the accumulation of salts.

The accumulation of salts in the basin also contributes to the drainage problem. This occurs in areas where brackish water is within five feet of the ground surface. The use of imported SWP water has contributed to the increase in the drainage problem area in the San Joaquin Valley. Prior to delivery of SWP water, there were approximately 12,000 acres of drainage problem areas in the San Joaquin service area, while the portion of the drainage problem area presently being irrigated with SWP water is estimated at 71,000 acres.

If nothing is done to correct this drainage problem, the salt buildup will continue, leading to agricultural lands being taken out of production and the degradation of underlying water supplies by poor quality "perched" water. A management plan for the collection, reuse, and disposal of drainage water has

been developed by the Department of Water Resources, the U.S. Bureau of Reclamation, and the State Water Resources Control Board.

No significant surface water quality problems are expected to occur in this service area in 1990 or beyond because of M&I water use. However, because of high water use rate in this area, and because of the reduced taxing ability of local governments, financing of municipal waste water treatment plants may become very difficult in the future.

5. Central Coastal Service Area. Streamflows in the Central Coastal service area should not differ from existing conditions.

Although this service area currently has overdrafted ground water basins, importation of SWP supplies will not necessarily reduce this overdraft. Research by the Santa Barbara County Water Agency suggests that farmers would continue pumping from overdrafted basins without litigation to reduce pumpage to the estimated safe yield of the basins.[5/]

Depending upon the ability to finance upgrading of treatment facilities where necessary, no water quality problems should exist from municipal effluent causes in this service area. Service by the SWP to this service area may benefit the overall water quality by blending with existing sources or by use for ground water recharge.

Biological Environment. With the four additional pumps, there would be an increase in the number of acres of native vegetation that would be urbanized or otherwise affected than without the project.

5/ Santa Barbara County Water Agency, Environmental and Water Resources Reconnaissance Study for SWP and Alternatives, January 1979.

Similarly, a small number of wildlife would be disturbed with this project. Additionally, wildlife could be affected by the increase in recreational use associated with growth induced by this project.

The degree of impact on wildlife will vary, but it is anticipated that habitat and wildlife will be lost directly as a result of urban growth. Indirect losses will be the result of diversions of streams for municipal water supplies, increased effluent discharges, and intensified use of remaining open spaces. Some of these losses, such as those resulting from stream diversions, could be lessened if SWP water is used to replenish these streams directly or to replace these diversions, making more water available to wildlife.

1. Southern California Service Area. In the Riverside County portion of the service area, threatened habitats include riparian habitat, lakes, and reservoirs, and upland habitats such as coastal sage scrub and chaparral. Riparian habitats, such as those found along the Santa Ana River, provide cover and water within urban areas and support numerous wildlife species such as herons, Least Bell's Vireos and Yellow-billed Cuckoos. Disturbance of the areas surrounding lakes and reservoirs could impact wintering raptors, including Bald Eagles, and thousands of migrating waterfowl. Other areas that could be impacted by urban expansion include upland habitats. These habitats support numerous wildlife species including deer, quail, foxes, ground squirrels, and numerous raptors. Urban growth in the San Jacinto and Santa Rosa mountains and the Coachella Valley could impact the Southern Rubber Boa and the Coachella Valley Fringe-toed Lizard.

The desert of Southern California has in the past been adversely impacted by the activities of off-road vehicle users. These users have in some areas completely stripped away native vegetation, making it possible for non-desirable species to become established, forcing the decline of small mammal

populations. In some instances, off-road vehicle activities have destroyed the nests of ground-nesting species including the horned lark and Gambel's quail. Destruction of desert habitat and its associated wildlife is a serious concern because of the sensitivity of the resource and its resident wildlife. Impacts to this resource are expected to continue into the future as additional water generates increased economic opportunities, which stimulates more growth in the service area. This impact would be mitigated in part, however, by the implementation of the U. S. Bureau of Land Management's Desert Plan. It is anticipated that this plan will reduce adverse impacts to fragile desert resources by restricting off-road vehicles in sensitive areas and by prohibiting vehicular recreation in wilderness area.

Restricting off-road vehicle use will have some positive effects on sensitive desert species. However, future urban expansion in desert areas, especially in the Coachella and Antelope Valleys, is still expected to threaten these sensitive species. In the Coachella Valley area, for instance, urban growth during the next 20 years is expected to occur in significant amounts in or around the cities of Palm Springs, Palm Desert, Indio, and Coachella. A significant portion of this growth would encroach on habitat of the Coachella Valley Fringe-toed Lizard.

Although the Coachella Valley does not presently receive SWP water, it is anticipated that its future SWP entitlement water will continue to be exchanged with neighboring water agencies for water from the Colorado River. In addition to these exchanges there have also been proposals to construct an aqueduct to allow the area to receive SWP water directly. Subsequently, it is highly probable that SWP future water supplies would accommodate a portion of the economic growth expected in this region.

It is possible that a portion of this new development may occur within the general range of the Coachella Valley Fringe-toed Lizard. The probability of impacting this species may be diminished in the future, however, if Riverside County's plan to establish a lizard habitat preserve and to control the use of wind erosion abatement measures to insure protection of lizard habitat are successfully implemented.

2. South Bay Service Area. Increased urbanization in this service area could lead to a faunal shift from animals that have adopted to the native grass lands community and agricultural development to those species that are more readily adaptable to an urban environment.

Increasing urbanization in the Livermore Valley area (see Land Use) could reduce the available habitat of the rare Alameda Striped Racer (*Masticophis lateralis euryxanthus*). This snake lives in the valleys, foothills, and low mountains of the Coast Range east of San Francisco Bay. Its habitat has been reduced in recent years by suburban development. Growth has also reduced, and is expected to further reduce the habitat of the endangered San Joaquin Kit Fox. Increased recreational use of local lakes and reservoirs could displace the Bald Eagle, an endangered species. Bald Eagle sightings have occurred in the Bay Area, although no known nesting sites exist.

Possibilities for wildlife enhancement include instream deliveries of SWP water to preserve riparian habitats and waterfowl enhancement programs where water is ponded for artificial recharge of ground water basins.

3. North Bay Service Area. As urban growth continues in uncultivated open spaces, the change from natural vegetation species to introduced species will be accelerated.

As in the case of the South Bay service area, the increased recreational use of local lakes and reservoirs could displace the endangered

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Bald Eagle. Bald Eagle sightings have occurred in the Bay Area, although no known nesting sites exist. Growth in this service area will not impact other listed species.

Increased urban growth around Suisun City, Fairfield and Vacaville would substantially increase traffic congestion and elevate ambient noise levels throughout the area. This growth, congestion and increased noise would adversely impact the urban fringe environments and generally diminish the open space and wildlife value of these lands.

Possibilities for wildlife enhancement include instream deliveries of SWP water to preserve riparian habitats. DWR is presently improving habitat in the Suisun Marsh as part of its mitigative measures for the SWP.

4. San Joaquin Valley Service Area. Much of the natural environment in this service area has been altered by agricultural activities. In some of the Kern County Water Agency (KCWA) member units such as Wheeler Ridge-Maricopa, Semitropic, Buena Vista, Tehachapi-Cummings, Empire Westside, Tulare Lake Basin, and County of Kings Water Districts, the increased deliveries will maintain the present land use pattern and would therefore have little impact on wildlife populations.

In the remaining districts, increased deliveries of SWP water supplies could cause new lands to be cultivated and subsequently cause a faunal shift from animals that have adapted to the native subshrub community to those that can more readily adapt to an irrigated cropland environment. Kangaroo rats, whiptail lizards, and San Joaquin Antelope Ground Squirrel populations will be reduced, while populations of species with high reproduction rates or greater adaptability to irrigated cropland, such as the California ground squirrel, deer mouse, and pocket gopher, will also increase. Some bird species such as Brewer's Blackbirds, crows, and sparrows will increase. Populations of

shrikes and raptors, however, can be expected to decline, since these species generally decrease in areas of intensive agriculture.

Rodent populations could increase to the point where control by rodenticides must begin. Some direct wildlife losses can occur from the short-term food chain transfer of some of the less persistent restricted materials. Increased use of rodenticides could impact carnivores further up the food chain.

In the Henry Miller Water District, in Kern County, increased SWP water supplies could have a beneficial effect on wildlife by increasing the size of the Buena Vista Aquatic Recreation Area, a marsh area north of Buena Vista Lake. This increase would be the result of amplified tailwater operations and seepage.

Agricultural expansion in the San Joaquin Valley is chiefly responsible for the decline of the San Joaquin Kit Fox (*Vulpes macrotis mutica*), the San Joaquin Antelope Squirrel (*Amnospermophilus nelsoni*), the Giant Kangaroo Rat (*Dipodomys ingens*), and the Blunt-nosed Leopard Lizard (*Crotaphytus silus*). These species historically occurred on the valley floor, foothills, and the western edge of the San Joaquin Valley but are now threatened by continued habitat loss due to cultivation. Further agricultural expansion in the western San Joaquin Valley will further reduce the habitat available for these species.

Impacts to rare and endangered wildlife would be minimal in the Wheeler Ridge-Maricopa, Semitropic, Empire West Side, Tulare Lake Basin, and County of Kings Water Districts because these districts have already been extensively cultivated.

In the remaining KCWA member units, increasing SWP water supplies could allow existing habitat to be converted to cropland, thus adversely

affecting the rare San Joaquin Kit Fox, the San Joaquin Antelope Squirrel, the endangered Blunt-nosed Leopard Lizard, and the endangered Giant Kangaroo Rat. The endangered Bald Eagle may also be adversely affected because this species is always forced out of areas where intensive agriculture is under way through the elimination of foraging and habitat areas.

Such impacts could be significant in such districts as Belridge, Berrenda Mesa, Lost Hills, Cawelo, and Devil's Den, because these districts have the greatest potential for bringing new lands under cultivation by converting existing areas of natural vegetation. The potential cultivation for the 188,000 acre-foot allocation is about 13,200 acres (after accounting for replacement) for all the SWP contractors in this service area. This represents about five percent of the presently irrigated acreage within the SWP service area.

Predictions concerning the extent and specific location of potential agricultural expansion in these districts cannot be accurately made at this time. Specific decisions on expansion are generally made by the farm operators and the various districts, based mainly on engineering, economic, and financial considerations. Thus, it is difficult to correlate the potential conflicts of such expansion with the recovery plans for the Blunt-nosed Leopard Lizard and San Joaquin Kit Fox. The specific priority habitat areas should be considered in any specific plan for expansion.

5. Central Coastal Service Area. In the past, destruction of coastal and inland marshes by filling and draining has reduced valuable wildlife habitat and unless careful land use planning is used in the future, adverse impacts on these sensitive biological resources will continue to occur.

Importation of SWP water could have a significant beneficial effect on the fisheries in reservoirs along its distribution route. A new fishery

consisting of warm water nonanadomous fish and invertebrates of the Sacramento-San Joaquin Delta would soon become established in terminal reservoirs. This could significantly add to the areas fisheries and result in increased recreation potential.

In addition to the potential for SWP supplies to create new fisheries, existing fisheries would also benefit, since seasonal fluctuation in reservoirs could be reduced by the addition of the imported water. This increased reservoir stability would be especially beneficial for species such as sunfish and black bass that are dependent upon shallow shoreline areas for spawning, feeding and cover (Jones & Stokes, 1979).

Imported SWP deliveries could have a positive impact on anadromous fish populations should this water be used in lieu of ground water by averting the potentially adverse impacts associated with excessive ground water extractions which lower water tables and reduce instream flow. Additionally, SWP water could be used to supplement existing surface flows, thereby reducing the effects of sedimentation and chemical pollution from both urban and agricultural users on instream fishery resources.

Disturbances and destruction of coastal and inland marshes and riparian areas have in the past impacted a number of sensitive and endangered bird species including the American Peregrine Falcon, Light-footed Clapper Rail, California Least Tern, Belding's Savannah Sparrow, California Brown Pelican, and Least Bell's Vireo and the rare California Black Rail.

The greatest threat to these rare and endangered species is the diminution of coastal wetlands. The peregrine falcon uses wetlands for feeding during the winter, while the other species maintain resident and/or nesting populations in these areas. If these sensitive species are to be protected in the future, it is imperative that these coastal wetlands be preserved.

In the Santa Barbara County portion of the service area two of these bird species, the Belding's Savannah Sparrow and the Light-footed Clapper Rail occur in and around Carpinteria Marsh and Goleta Slough. In the Carpinteria Marsh[6/] area the greatest threat to these endangered and other wildlife species comes from urban expansion while in the Goleta Slough area,[7/] future airport, road and recreation expansion, which has already claimed over sixty percent of the original marsh, continues to threaten the area. Recent surveys by the Department of Fish and Game of peregrine falcon populations have shown that this species is slowly recovering. In an effort to improve its breeding success, the California Fish and Game Commission has established the Morro Rock Ecological Reserve. The Morro Bay area also provides habitat for the endangered California Brown Pelican and Morro Bay Kangaroo Rat, and the rare California Black Rail.

Increasing urbanization in the Baywood Park and Los Osos communities near Morro Bay has reduced the available habitat for the Morro Bay Kangaroo Rat. (Duoidints heermanni morroensis). Expanding urban areas into the Morro Bay Kangaroo Rat's habitat could lead to further declines. Also this species could be affected by any increased recreational use induced by this project.

Construction of the Coastal Branch of the California Aqueduct to serve Santa Barbara and San Luis Obispo Counties could have substantial impacts on vegetation and wildlife. Although a construction route has not been chosen,

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6/ The Carpinteria Marsh supports significant waterfowl populations averaging over 60,000 duck use-days and over 190,000 shore bird use-days annually (Concept Plan for Wintering Waterfowl Habitat Preservation, U.S. F.W.S., 1979).

7/ Goleta Slough is also heavily used by waterfowl averaging over 150,000 annual use-days)Concept Plan for Wintering Waterfowl habitat Preservation, U.S. F.W.S., 1979).

mountainous and foothill terrain having a high wildlife value will be traversed. (See Environmental and Water Resources Reconnassance Study for SWP and Alternatives, prepared by the Santa Barbara County Water Agency, January 1979). Studies concerning alternative routes will require careful consideration of environmental values, and necessary environmental documentation will be prepared and reviewed.

Pesticide Use.

1. San Joaquin Valley Service Area. The majority of SWP water delivered to this area is used for agricultural purposes. As deliveries to this area are increased, the potential for increasing the amount of agricultural land in production and the number of lands that are double-cropped also increases. Subsequently, additional water supplies for agricultural use would increase the risk of conditions that could harm the environment and human health.

In 1977, the drought caused a curtailment of water supplies for agricultural use; however as water supply conditions returned to normal, increased pesticide use occurred. While other variable environmental and economic factors such as, climate, type of crops, etc., play an important role in the use of pesticides, water is the most significant of these factors in determining the use and amounts of pesticides. The number of pounds of pesticides applied in Kings County during the period 1977-80 are shown below:

Pesticides Applied in Kings County
(thousands of pounds)

1980	3,514.0
1979	4,183.5
1978	3,740.2
1977	2,645.9

Source: Dinsdale, Larry. California Department of Food and Agriculture, Sacramento. August 8, 1981. Personal Communication.

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The San Joaquin Valley is the leading user of both restricted and nonrestricted pesticides in the State. Insecticide applications for the control of lepidopterous larvae (primarily cutworms, Heliothia zea, the peach twig borer, cutworms and gray worms, and aphids, mites, and lygus); fumigation to control weed seed and pathogens; and herbicide applications for broadleaf weed control, were the major areas of restricted pesticide use in the region. Dust formulations accounted for 24.6 percent of the total pesticide use and 35.8 percent of the restricted pesticides were applied by air.[8/]

Pesticide contamination associated with agriculture can result from drift or volatilization of materials applied to the fields or other neighboring areas. Movement through the atmosphere is the most common route of transportation of pesticides and is probably the major source of pesticides found in terrestrial wildlife habitat. In aquatic habitats, contamination can occur as a result of pesticide transfer through agricultural return and waste water. Other ways pesticides can enter the environment include spills and other accidents, and in industrial effluent.

It is extremely difficult to assess the impact of pesticides on the ecosystem. Toxic effects of pesticides on wildlife, even large mammals, may go unnoticed. In many cases, although numerous instances in which thousands of fish and other aquatic organisms and hundreds of waterfowl and other birds have been poisoned by pesticides in the water or on treated land have been documented, it is difficult to identify the material responsible.

The most serious effects of pesticide exposure are likely to occur among those persons who work directly with these chemicals. Those most

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8/ Report on Environmental Assessment of Pesticide Regulatory Programs, Draft, Department of Food and Agriculture, 1978.

susceptible to poisoning hazards, include farmworkers, greenhouse and nursery workers, manufacturing and formulation plant workers, and pesticide applicators. Another potential high risk group includes these persons living in the agricultural areas themselves.

Land Use.

1. Southern California Service Area. This service area will continue to grow, and the pressure for urban and suburban land will increase as land becomes more scarce. It is expected that agricultural land will continue to be taken out of production (with or without the four additional pumps) for subdivision, despite greater emphasis given to the preservation of agricultural lands throughout the State. The most intense urban growth is expected in Ventura County, Southern Orange County, the Riverside area, western San Bernardino County and western San Diego County. Projected land use in counties encompassing the service area is shown below:

Southern California Counties Projected Land Use
(1,000 acres)

Land Use	1990	2000
Urban-Suburban	1,525-1,575	1,560-1,640
Irrigated Agriculture	530-580	490-525

Source: Environmental Impact Planning Corporation, Delta Pumping Plant Supplemental Report, October 1978.

Table D-7 indicates that approximately 68,200 housing units (39,800 single family and 28,400 multiple family) would be impacted by the 188,000 acre-foot allocation. The acreages displaced by these housing units include 7,960 acres for single family and 1,425 acres for multiple family, for a total of 9,385 acres.[9/]

9/ Assumes 5 units/acre are required for single family development and 20 units/acre for multi-family.

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As developable land becomes scarce, as it already is in some areas of Orange and Los Angeles Counties, pressure to develop land with wildlife habitat will increase. Local agencies will have to purchase and preserve lands with significant biological resource value.

2, South Bay Service Area. By 2000, twenty percent of the total land will be urbanized (see below). About 910,000 acres will remain in open public lands and other areas where cities have taken action to exclude urban development. It appears that by 2000 almost all land available for development will have been urbanized, and the only vacant lands will be those which are set aside for public use, or for which there are development constraints. In the Livermore Valley area of Alameda County, land use changes from the present to 2000 may be large. Presently, this area appears to have a rural atmosphere and is surrounded by areas of agriculture and open space. By 2000, this area will probably be considerably urbanized.

South Bay Counties Projected Land Use
(thousands of acres)

Land Use	1990	2000
Residential	176.3	183.3
Industrial Commercial	62.6	66.1
Developable Industrial	14.7	12.1
Residential Available	--	0.4
Other	1,062.1	1,053.8
Total Area	1,315.7	1,315.7

Source: Association of Bay Area Governments, Revised Series 3 Projections Base Case I, 1978.

Table D-7 indicates that approximately 500 housing units (400 single family and 100 multiple family) would be impacted by the 188,000 acre-foot allocation. The acreages displaced by these housing units include 80 acres for single family and 5 acres for multiple family, for a total of 85 acres.

In Alameda County, potential exists for suburban growth in and around the Livermore Valley in areas that may have moderate wildlife value. The county general plan calls for recreational use of those lands with the highest wildlife value. The urbanization pressure this area has planned to receive will degrade the wildlife value of the county through residential, industrial, and recreational development. Comparatively little new land will be urbanized in Santa Clara County, and wildlife impacts should be minimal.

3. North Bay Service Area. Growth in Napa County does not appear to be constrained by the availability of land, but rather by increased growth controls. During the spring of 1978, Napa County voters were asked their opinion of the desired population growth and over 70 percent preferred less than 115,000 by 2000.

On November 4, 1980, the voters adopted Measure A, a slow growth iniative. A growth management element adopted by the county Board of Supervisors set the annual allocation of dwelling units within the unincorporated area at 134 units, which would allow an annual increase of approximately one percent.

In Solano County, expansion of cities is leading to the breakdown of existing 5-acre and 2-1/2-acre parcels into 1-acre parcels. Water-related industry with large plants that require access to water has been proposed for the southeastern part of the County, near Rio Vista. This is outside the present delivery area. Urban and residential expansion is expected to increase until after 2000. Estimated land use in the North Bay service area is shown below.

C—105762

C-105762

North Bay Service Area Projected Land Use
(thousands of acres)

Land Use	1990	2000
Residential	31.8	49.3
Industrial-Commercial	11.5	13.6
Agriculture	203.7	191.4
Prime Developable	8.3	3.3
Other	774.6	772.3
Total Area	1,029.9	1,029.9

Sources: Association of Bay Area Governments, Revised Series 3 Projections, Base Case I, 1978. Environmental Impact Planning Corp., Delta Pumping Plant Supplemental Report, 1978.

Table D-7 indicates that approximately 200 housing units would be impacted by the 188,000 acre-foot allocation. The acreages displaced by these housing units total about 25.

Increased urbanization and industrialization will undoubtedly cause development of lands that have some wildlife value. Construction of Phase II of the north Bay Aqueduct will also displace wildlife. This is discussed in a separate Environmental Impact Report.

4. San Joaquin Valley Service Area. Agriculture in Kern and Kings Counties can be expected to continue the trend toward larger, fewer, and more economically efficient farms. About 700,000 acres of irrigated land are projected for 1990 and beyond in the San Joaquin Valley service area.[10/] Kern County has zoned urban areas to minimize intrusion on agricultural land. Expansion of urban areas must be contiguous with existing urban areas.

10/ Gerald Dean and Gordon King, Projection of California Agriculture to 1980 and 2000: Potential Impact of San Joaquin Valley West Side Development, Giannini Foundation Research Report No. 312, September 1970; California Department of Water Resources, "Post Project Economic Evaluation, San Joaquin Valley Service Area, 1975." A memo report used to update service areas.

Table D-7 indicates that approximately 500 housing units (400 single family and 100 multiple family) would be impacted by the 188,000 acre-foot allocation. The acreages displaced by these housing units include 80 acres for single family and 5 acres for multiple family, for a total of 85 acres.

5. Central Coastal Service Area. Although urbanized acreage is expected to increase, agriculture will continue to be the dominant land use. No major conversion of agricultural lands to urban uses is foreseen within Santa Barbara County for the next two decades because of the agricultural preserve program under the Williamson Act and because of city and county land use and growth policies. Land use changes resulting from this project would be minimal. Projected land use in the Central Coast Service Area is shown below.

Central Coast Service Area Projected
Land Use
(thousands of acres)

Land Use	1990	2000
Residential	109.7	128.2
Industrial-Commercial	35.8	42.5
Agriculture	1,357.9	1,360.0
Open Space	1,050.1	1,050.0
Public Use	134.3	139.7
Vacant	1,200.0	1,167.4
Total	3,887.8	3,887.8

Source: Environmental Impact Planning Corp., Delta Pumping Plant Supplemental Report, 1978.

Table D-7 indicates that approximately 900 housing units (500 single family and 400 multiple family) would be impacted by the 188,000 acre-foot allocation. The acreages displaced by these housing units include 100 acres for single family and 20 acres for multiple family, for a total of 120 acres.

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Continued urbanization in this service area will undoubtedly displace some wildlife. The extent of disturbance is unknown at this time, but careful land use planning will be necessary to avoid significant adverse impacts and sensitive biological resources, such as floodplains and sloughs. It is anticipated that most of this expansion will occur in or near already developed areas. Increased recreational use may disturb areas of particular biological significance, such as California condor habitat.

General plans prepared by local government agencies in these service areas identify areas suitable for further development, as well as those to be reserved for open space. It is the responsibility of local planning agencies to evaluate each proposed development on an individual basis to insure compliance with these plans.

Cumulative Socioeconomic Impacts. The State Water Project was authorized in 1960 to serve supplemental water demands in the following service areas: North and South Bay, San Joaquin, Southern California, Feather River and Central Coastal. Although the effects of any one facility (such as the Delta Pumping Plant) may be limited in the service areas, cumulatively the SWP could have a major impact upon the State. This section examines the average annual cumulative impacts of the SWP upon the service areas (excluding Feather River, which has area of origin priorities) in these time periods: 1980-1989, 1990-1999, 2000-2009 and beyond 2020.

The estimation of annual cumulative impacts is based upon projected SWP deliveries presented in Bulletin 132-81. In the 1980s, about 1.9 MAF will be delivered per year to the SWP service areas (excluding Feather River), of which approximately 60 percent is for M&I purposes. Beyond 2020, about 4.2 MAF is projected to be delivered, of which about 71 percent is for M&I purposes.

The cumulative impacts of delivering SWP supplies are presented in Tables D-10 through D-21. These impacts are average annual impacts for the respective time periods (what would occur during an average year); they are not decade totals. The cumulative impacts of income, employment, population, households and housing units were estimated similarly to the Delta Pumping Plant impact procedures. These impacts have been adjusted to account for the replacement of Colorado River supplies in Southern California and the replacement of SWP surplus in the San Joaquin. Tables D-10 through D-12 present the annual 1980-1989 cumulative impacts; Tables D-13 through D-15, 1990- 1999; Tables D-16 through D-18, 2000-2009; and Tables D-19 through D-21, beyond 2020. In the 1980s, average annual direct, indirect and induced income SWP cumulative impacts (with replacement) total about $37.4 billion; this decreases to $31.1 billion in the 1990s because of replacement, but then increases to $38.4 and $60.0 billion in 2000 and 2020, respectively (in 1982 $).

Comparison of SWP Cumulative Socioeconomic Impacts with State Projections. Table D-22 presents a comparison of the 1990 income impact (from the Delta Pumping Plant and SWP cumulative) with forecasted State totals. The DPP (188,000 AF firm yield allocation) has a 1990 direct, indirect and induced income impact of about $2.5 billion, which is about 0.4 percent of the State total income. The cumulative impact is about 5.5 percent of the State total.

Also presented in this table are comparative employment and population impacts. The DPP employment impacts are about 0.9 percent of the Statewide total; cumulative SWP employment impacts are about 11.4 percent of the State total. Finally, the DPP population impact is 0.7 percent of the State total; cumulative population impact, 8.0 percent.

Cumulative Environmental Impacts. Delivery of the additional SWP yield could support significant economic activity in the service areas. Increases in

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C-105766

Table D-10: 1980-1989 Average Annual Impacts:
Income
(billions 1982 $)

Service Area	M&I Direct	M&I Direct, Indirect and Induced	Agriculture Direct	Agriculture Direct, Indirect and Induced	Total Direct	Total Direct, Indirect and Induced
Southern California						
Total Impacts	$ 9.1	$ 31.1	$ 0	$ 0	$ 9.1	$ 31.1
Replacement	0	0	0	0	0	0
Net Impacts	9.1	31.1	0	0	9.1	31.1
San Joaquin						
Total Impacts	0.1	0.4	0.1	0.3	0.2	0.7
Replacement	0	0	0	0	0	0
Net Impacts	0.1	0.4	0.1	0.3	0.2	0.7
Central Coastal	0	0	0	0	0	0
South Bay	1.6	5.2	0	0	1.6	5.2
North Bay	0.1	0.4	0	0	0.1	0.4
Total (without replacement)	10.9	37.1	0.1	0.3	11.0	37.4
Total (with replacement)	10.9	37.1	0.1	0.3	11.0	37.4

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C-105767

Table D-11: 1980-1989 Average Annual Impacts:
Employment
(thousands of jobs)

Service Area	M&I Direct	M&I Direct, Indirect and Induced	Agriculture Direct	Agriculture Direct, Indirect and Induced	Total Direct	Total Direct, Indirect and Induced
Southern California						
Total Impacts	248.1	1,482.8	0	0	248.1	1,482.8
Replacement	0	0	0	0	0	0
Net Impacts	248.1	1,482.8	0	0	248.1	1,482.8
San Joaquin						
Total Impacts	10.7	72.3	6.6	28.4	17.3	100.7
Replacement	0	0	2.8	12.1	2.8	12.1
Net Impacts	10.7	72.3	3.8	16.3	14.5	88.6
Central Coastal	0	0	0	0	0	0
South Bay	41.6	163.9	0	0	41.6	163.9
North Bay	1.3	10.7	0	0	1.3	10.7
Total (without replacement)	301.7	1,729.7	6.6	28.4	308.3	1,758.1
Total (with replacement)	301.7	1,729.7	3.8	16.3	305.5	1,746.0

C—105768

C-105768

Table D-12: 1980-1989 Average Annual Impacts:
Population, Households and Housing

Service Area	Population Impact (thousands)	Household Impact (thousands)	Housing Unit Impacts (thousands) Total	Single Family	Multiple Family
Southern California					
Total Impacts	2,668.1	983.0	1,006.4	620.2	386.2
Replacement	0	0	0	0	0
Net Impacts	2,668.1	983.0	1,006.4	620.2	386.2
San Joaquin					
Total Impacts	18.8	6.6	8.5	6.6	1.9
Replacement	0	0	0	0	0
Net Impacts	18.8	6.6	8.5	6.6	1.9
Central Coastal	0	0	0	0	0
South Bay	17.5	6.7	6.7	5.4	1.3
North Bay	1.2	0.5	0.5	0.4	0.1
Total (without replacement)	2,705.6	996.8	1,022.1	632.6	389.5
Total (with replacement)	2,705.6	996.8	1,022.1	632.6	389.5

C—105769

C-105769

Table D-13: 1990-1999 Average Annual Impacts:
Income
(billions 1982 $)

Service Area	M&I Direct	M&I Direct, Indirect and Induced	Agriculture Direct	Agriculture Direct, Indirect and Induced	Total Direct	Total Direct, Indirect and Induced
Southern California						
Total Impacts	$ 12.0	$ 40.7	$ 0	$ 0	$ 12.0	$ 40.7
Replacement	5.1	17.4	0	0	5.1	17.4
Net Impacts	6.9	23.3	0	0	6.9	23.3
San Joaquin						
Total Impacts	0.1	0.4	0.1	0.3	0.2	0.7
Replacement	0	0	0	0	0	0
Net Impacts	0.1	0.4	0.1	0.3	0.2	0.7
Central Coastal	0.1	0.4	0	0	0.1	0.4
South Bay	1.8	5.9	0	0	1.8	5.9
North Bay	0.2	0.8	0	0	0.2	0.8
Total (without replacement)	14.2	48.2	0.1	0.3	14.3	48.5
Total (with replacement)	9.1	30.8	0.1	0.3	9.2	31.1

C—105770

C-105770

Table D-14: 1990-1999 Average Annual Impacts: Employment (thousands of jobs)

Service Area	M&I Direct	M&I Direct, Indirect and Induced	Agriculture Direct	Agriculture Direct, Indirect and Induced	Total Direct	Total Direct, Indirect and Induced
Southern California						
Total Impacts	323.6	1,934.0	0	0	323.6	1,934.0
Replacement	137.8	823.6	0	0	137.8	823.6
Net Impacts	185.8	1,110.4	0	0	185.8	1,110.4
San Joaquin						
Total Impacts	13.9	94.0	8.5	36.6	22.4	130.6
Replacement	0	0	2.8	12.1	2.8	12.1
Net Impacts	13.9	94.0	5.7	24.5	19.6	118.5
Central Coastal	6.3	41.7	0	0	6.3	41.7
South Bay	47.5	187.2	0	0	47.5	187.2
North Bay	3.7	30.4	0	0	3.7	30.4
Total (without replacement)	395.0	2,287.3	8.5	36.6	403.5	2,323.9
Total (with replacement)	257.2	1,463.7	5.7	24.5	262.9	1,488.2

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Table D-15: 1990-1999 Average Annual Impacts:
Population, Households and Housing

Service Area	Population Impact (thousands)	Household Impact (thousands)	Housing Impacts (thousands) Total	Single Family	Multiple Family
Southern California					
Total Impacts	3,572.0	1,373.9	1,465.4	885.4	580.0
Replacement	1,521.0	585.0	624.0	377.0	247.0
Net Impacts	2,051.0	788.9	841.4	508.4	333.0
San Joaquin					
Total Impacts	24.5	8.6	11.0	8.6	2.4
Replacement	0	0	0	0	0
Net Impacts	24.5	8.6	11.0	8.6	2.4
Central Coastal	21.7	9.0	9.3	5.5	3.8
South Bay	19.9	7.7	7.7	6.1	1.6
North Bay	3.5	1.5	1.5	1.2	0.3
Total (without replacement)	3,641.6	1,400.7	1,494.9	906.8	588.1
Total (with replacement)	2,120.6	815.7	870.9	529.8	341.1

C—105772

C-105772

Table D-16: 2000-2009 Average Annual Impacts:
Income
(billions 1982 $)

Service Area	M&I Direct	M&I Direct, Indirect and Induced	Agriculture Direct	Agriculture Direct, Indirect and Induced	Total Direct	Total Direct, Indirect and Induced
Southern California						
Total Impacts	$ 14.0	$ 47.6	$ 0	$ 0	$ 14.0	$ 47.6
Replacement	5.1	17.4	0	0	5.1	17.4
Net Impacts	8.9	30.2	0	0	8.9	30.2
San Joaquin						
Total Impacts	0.1	0.4	0.1	0.3	0.2	0.7
Replacement	0	0	0	0	0	0
Net Impacts	0.1	0.4	0.1	0.3	0.2	0.7
Central Coastal	0.2	0.8	0	0	0.2	0.8
South Bay	1.8	5.9	0	0	1.8	5.9
North Bay	0.2	0.8	0	0	0.2	0.8
Total (without replacement)	16.3	55.5	0.1	0.3	16.4	55.8
Total (with replacement)	11.2	38.1	0.1	0.3	11.3	38.4

C—105773

C-105773

Table D-17: 2000-2009 Average Annual Impacts:
Employment
(thousands of jobs)

Service Area	M&I		Agriculture		Total	
	Direct	Direct, Indirect and Induced	Direct	Direct, Indirect and Induced	Direct	Direct, Indirect and Induced
Southern California						
Total Impacts	380.4	2,273.4	0	0	380.4	2,273.4
Replacement	137.8	823.6	0	0	137.8	823.6
Net Impacts	242.6	1,449.8	0	0	242.6	1,449.8
San Joaquin						
Total Impacts	13.9	94.0	8.5	36.6	22.4	130.6
Replacement	0	0	2.8	12.1	2.8	12.1
Net Impacts	13.9	94.0	5.7	24.5	19.6	118.5
Central Coastal	9.6	63.5	0	0	9.6	63.5
South Bay	49.8	196.2	0	0	49.8	196.2
North Bay	4.6	37.9	0	0	4.6	37.9
Total (without replacement)	458.3	2,665.0	8.5	36.6	466.8	2,701.6
Total (with replacement)	320.5	1,841.4	5.7	24.5	326.2	1,865.9

C—105774

C-105774

Table D-18: 2000-2009 Average Annual Impacts:
Population, Households and Housing

Service Area	Population Impact (thousands)	Household Impact (thousands)	Housing Impacts (thousands) Total	Single Family	Multiple Family
Southern California					
Total Impacts	4,001.1	1,543.0	1,632.7	950.9	681.8
Replacement	1,449.5	559.0	591.5	344.5	247.0
Net Impacts	2,551.6	984.0	1,041.2	606.4	434.8
San Joaquin					
Total Impacts	24.4	8.6	11.0	8.6	2.4
Replacement	0	0	0	0	0
Net Impacts	24.4	8.6	11.0	8.6	2.4
Central Coastal	31.0	13.1	13.7	7.9	5.8
South Bay	20.9	8.0	9.6	8.0	1.6
North Bay	4.4	1.8	1.8	1.5	0.3
Total (without replacement)	4,081.8	1,574.5	1,668.8	976.9	691.9
Total (with replacement)	2,632.3	1,015.5	1,077.3	632.4	444.9

C—105775

C-105775

Table D-19: 2020+ Average Annual Impacts:
Income
(billions 1982 $)

Service Area	M&I Direct	M&I Direct, Indirect and Induced	Agriculture Direct	Agriculture Direct, Indirect and Induced	Total Direct	Total Direct, Indirect and Induced
Southern California						
Total Impacts	$ 19.6	$ 66.6	$ 0	$ 0	$ 19.6	$ 66.6
Replacement	5.1	17.4	0	0	5.1	17.4
Net Impacts	14.5	49.2	0	0	14.5	49.2
San Joaquin						
Total Impacts	0.1	0.4	0.1	0.3	0.2	0.7
Replacement	0	0	0	0	0	0
Net Impacts	0.1	0.4	0.1	0.3	0.2	0.7
Central Coastal	0.3	1.3	0	0	0.3	1.3
South Bay	2.1	7.1	0	0	2.1	7.1
North Bay	0.4	1.7	0	0	0.4	1.7
Total (without replacement)	22.5	77.1	0.1	0.3	22.6	77.4
Total (with replacement)	17.4	59.7	0.1	0.3	17.5	60.0

C—105776

C-105776

Table D-20: 2020+ Average Annual Impacts:
Employment
(thousands of jobs)

Service Area	M&I		Agriculture		Total	
	Direct	Direct, Indirect and Induced	Direct	Direct, Indirect and Induced	Direct	Direct, Indirect and Induced
Southern California						
Total Impacts	529.5	3,164.5	0	0	529.5	3,164.5
Replacement	137.8	823.6	0	0	137.8	823.6
Net Impacts	391.7	2,340.9	0	0	391.7	2,340.9
San Joaquin						
Total Impacts	14.0	94.6	8.6	37.1	22.6	131.7
Replacement	0	0	2.8	12.1	2.8	12.1
Net Impacts	14.0	94.6	5.8	25.0	19.8	119.6
Central Coastal	12.8	84.7	0	0	12.8	84.7
South Bay	58.3	229.7	0	0	58.3	229.7
North Bay	8.5	69.9	0	0	8.5	69.9
Total (without replacement)	623.1	3,643.4	8.6	37.1	631.7	3,680.5
Total (with replacement)	485.3	2,819.8	5.8	25.0	491.1	2,844.8

C—105777

C-105777

Table D-21: 2020+ Average Annual Impacts:
Population, Households and Housing

Service Area	Population Impact (thousands)	Household Impact (thousands)	Housing Impacts (thousands) Total	Single Family	Multiple Family
Southern California					
Total Impacts	5,569.4	2,147.9	2,272.7	1,323.7	949.0
Replacement	1,449.5	559.0	591.5	344.5	247.0
Net Impacts	4,119.9	1,588.9	1,681.2	979.2	702.0
San Joaquin					
Total Impacts	24.6	8.6	11.1	8.6	2.5
Replacement	0	0	0	0	0
Net Impacts	24.6	8.6	11.1	8.6	2.5
Central Coastal	41.6	17.6	18.3	10.6	7.7
South Bay	24.4	9.4	11.3	9.4	1.9
North Bay	8.0	3.4	3.4	2.7	0.7
Total (without replacement)	5,668.0	2,186.9	2,316.8	1,355.0	961.8
Total (with replacement)	4,218.5	1,627.9	1,725.3	1,010.5	714.8

C—105778

C-105778

Table D-22

Comparisons of Delta Pumping Plant
and Cumulative SWP Economic Direct, Indirect and
Induced Impacts with 1990 California Projections[1/][2/]

Direct, Indirect and Induced Income Impacts
(billions 1982 $)

Projected 1990 California Net Income[3/]	Delta Pumping Plant Net Income Impact		Cumulative SWP Impacts Net Income Impact	
	Dollars	% of Calif.	Dollars	% of Calif.
$ 565.8	$2.5	0.4	$31.1	5.5

Direct, Indirect and Induced Employment Impacts
(thousands employees)

Projected 1990 California Employment	Delta Pumping Plant Employment Impact		Cumulative SWP Impacts Employment Impact	
	Persons	% of Calif.	Persons	% of Calif.
13,009.8	119.8	0.9	1,488.2	11.4

Population
(thousands persons)

Projected 1990 California Population	Delta Pumping Plant Population Impact		Cumulative SWP Impacts Population Impact	
	Persons	% of Calif.	Persons	% of Calif.
26,460.0	172.1	0.7	2,120.6	8.0

1/ Projections from the Center for the Continuing Study of the California Economy, California Growth in the 1980s, 1979

2/ Delta Pumping Plant impacts reported are for the 188,000 acre-foot allocation

3/ California projections were for personal income, which has been converted to net income (personal income is about 86% of net income).

socioeconomic activities will undoubtedly cause additional physical impacts (air quality, water quality, hydrology and land use). Where new supplies are needed to substitute for existing supplies, no additional physical impacts should occur.

Air Quality. Because of their present air quality and/or projected growth rates, some areas of the State have been identified by the Air Resources Board as having the potential to exceed any national ambient air quality standard in the 10-year period 1975-1985.

Ambient air quality for particulate matter, oxidant, carbon monoxide, nitrogen dioxide, and sulfur dioxide was projected through 1985 for all air basins in the State, and it was found that one or more national standards could be expected to be violated between 1977 and 1985 in the SWP service areas. Listed in Table D-23 are the areas that have been identified as having the potential to exceed the air quality standards.

Although carbon monoxide standards will still be exceeded in the South Coast, San Diego, and Kern County service areas, carbon monoxide levels will be substantially reduced in the next 15 years.

Table D-23

Areas with Potential to Exceed Air Quality Standards

Service Area	Air Basin	PM	O_x	CO	SO_2	NO_2
Southern California	South Coast	x	x	x	x	x
	Riverside-San Bernardino	-	x	-	-	-
	San Diego	x	x	x	-	-
North Bay, South Bay	San Francisco Bay Area	x	x	-	x	-
Kern County 1/	San Joaquin Valley	-	x	x	-	-

1/ Excludes the southeast desert portion of Kern County.

C-105780

C-105780

Hydrology. Full SWP deliveries will improve the overall status of the ground water basins in all service areas. In the South Bay, San Joaquin Valley, and Southern California service areas, ground water management programs using SWP supplies to recharge ground water basins are important components of the overall water management.

Instream deliveries of SWP supplies will continue to support stream and riparian environments in Southern California. Programs of this type would be esthetically pleasing and should be encouraged wherever possible, especially within or near urban areas.

Stream flow in Alameda Creek in the South Bay SWP service area will be maintained. This will enhance the riparian vegetation and associated wildlife of Alameda Creek.

Water Quality. The State Water Resources Control Board and the Regional Water Quality Control Boards have the responsibility for issuing waste discharge requirements and for ensuring that the waters of the State are suitable for all beneficial uses. The regional boards must foresee problems based on the anticipated population levels, and they have not suggested that deliveries to the service areas from the SWP would be adverse to water quality conditions. On the contrary, they have indicated that, in some circumstances, the overall water quality would benefit from blending with poor quality sources, such as the Colorado River on poor quality ground water.

SWP deliveries to the San Joaquin Valley service area have contributed to the existing drainage problems. These drainage problems have been increasing in recent years, and failure to remove the saline drainage water could lead to increased soil salinity with a decrease in agricultural productivity.

Disposal of saline agricultural drainage water can also cause adverse environmental impacts at the point of disposal. Solutions to agricultural drainage problems are still under study. By 1990, more than 200,000 acres of agricultural lands in the San Joaquin Valley will require drainage to maintain productivity.

Biological Environment. Urban expansion in the San Francisco Bay area and in Southern California will continue to replace native vegetation and agricultural lands. The full effects will depend on local land use policies.

New agricultural and urban development will also continue to displace more wildlife. As California becomes more developed, less land remains suitable for wild life habitat. Disruption of wildlife populations resulting from increased recreational activity will also be of concern.

Of particular concern is the disruption of habitats utilized by rare and endangered species. Continued urban expansion in the Livermore Valley may adversely affect the Alameda striped racer, while expanding agricultural activities in the San Joaquin Valley will continue to reduce the available habitat of the San Joaquin antelope squirrel, the San Joaquin kit fox, and the blunt-nosed leopard lizard.

Land Use. In areas where SWP supplies will replace existing supplies, there should be no land use changes. In counties where SWP-related growth could occur, actions to restrict new urban development adjacent to or within existing urban areas should minimize the adverse impacts of new development. Impacts will vary with local conditions and land use policies.

C—105782

C-105782

Appendix E.

RECOMMENDED WATER MANAGEMENT PLANS

Appendix E

RECOMMENDED WATER MANAGEMENT PLANS

The Department has prepared draft water management plans for the individual State Water Project service areas. These plans recommend measures to coordinate and maximize use of existing water supplies and to optimize use of existing facilities in the service areas. The objectives of the water management plans are:

- To recommend actions to reduce demand, reclaim waste water, use ground water conjunctively with surface supplies, facilitate water exchanges, and undertake other measures that will reduce or delay the need for new surface water facilities.
- To be feasible and implementable.
- To be flexible and implementable in stages, allowing some actions to be implemented as soon as possible, and other actions, which are subject to institutional, economic, or technologic constraints, to be implemented as the constraints are resolved.

The drafts were sent to the respective State Water Project water service contractors for use in formulating their own water management programs. The completed draft plans have also been provided to the State Water Resources Control Board and are on file with the Department of Water Resources.

For purposes of example, this appendix presents a brief summary of the recommended water management plans for the following two water service contractors:

- Kern County Water Agency -- primarily an agricultural water user with a small urban water use.
- The Metropolitan Water District of Southern California -- primarily an urban water user with a small agricultural water use.

Kern County Water Agency

The draft plan for Kern County Water Agency includes recommendations related to urban water conservation, agricultural water conservation, conjunctive use of ground water and surface supplies, and water exchanges and transfers. The plan specifically relates to the member units within the Agency's boundaries that benefit from State Water Project deliveries. The agricultural water conservation portion of the plan is more specifically directed to those member units that overlie perched water tables and moisture-deficient soils. Other agricultural and urban areas within the Agency's boundaries are not specifically included in the plan, except as they relate to districtwide ground water and exchange programs. In addition to recommended measures, the plan describes the service area and its water supplies and demands, estimates the effects of the plan on the State Water Project, and includes the comments of the Agency and its member units on the plan.

Recommendations included in the plan are:

- Urban Water Conservation -- The urban water conservation programs currently implemented in the Kern County Water Agency service area have generally been managed by the member units. Conservation activities include public speaking, distribution of water conservation educational materials to schools, inclusion of conservation literature in most customer bills, and active water waste reduction programs by several agencies. The water management plan for the Agency service area describes the current conservation measures and additional urban water conservation programs recommended for adoption within the Agency (Table E-1).

- Agricultural Water Conservation -- The plan recommended for agricultural water conservation in the Agency consists of: (1) measures to reduce evapotranspiration; (2) measures to reduce percolation to perched water tables and moisture-deficient soils; and (3) studies and programs to test conservation methods and increase knowledge of factors related to agricultural water conservation.

- Conjunctive Use of Surface Water and Ground Water -- A ground water management program should be specified by local water entities, directed toward eventual management of the ground water overdraft situation. Toward this end, the Agency should take the lead, with cooperation from Federal, State, and local water officials, to establish the mechanisms for ensuring that maximum conjunctive surface-ground water capabilities are utilized.

  The Agency and its member units should continue their recharge programs and expand their efforts according to the findings of their optimization study. The Agency also should explore the possibility that would be mutually advantageous to all water entities with the Department and the U. S. Bureau of Reclamation.

- Waste Water Reclamation -- The plan encourages the reuse of all waste water. Therefore, if the demonstration desalting facility now under construction shows that the production of desalted water is economically feasible, particularly as it relates to energy requirements, consideration should be given to developing a large-scale facility in cooperation with the State for use in Kern County.

- Water Exchanges and Transfers -- The plan encourages maximum use of exchanges to balance water supplies, facilitate distribution, save energy, and increase water supplies, to the degree it is practical to do so. To this end, State, Federal, and Agency water officials should cooperate with local water districts to establish precepts that will ensure full use of all conveyance systems and ground water recharge facilities.

The Metropolitan Water District of Southern California

The draft plan for Metropolitan Water District includes recommendations related to urban water conservation, agricultural water conservation, conjunctive use of ground water and surface supplies, and water exchanges and transfers. In addition to recommended measures, the plan describes the service area and its water supplies and demands, estimates the effects of the plan on the State

C—105785

C-105785

Water Project, and includes the comments of Metropolitan Water District and its member agencies on the plan.

Recommendations included in the plan are:

- Urban Water Conservation -- In September 1981, the Metropolitan Water District Board of Directors approved a water conservation resolution that reemphasized the District's commitment to the efficient use of water in its service area. In the resolution, the District identified several measures that it could develop to encourage water conservation. Those measures include: (1) developing in-school education programs; (2) conducting public information programs; (3) cooperating in water conservation studies; (4) promoting the use of drought-resistant landscaping; (5) encouraging industrial and commercial water conservation; (6) assisting in development of leak detection, repair, and prevention programs; and (7) assisting member agencies in expanding their water conservation activities.

  The many urban water conservation programs implemented by the District and its 27 member agencies include education and public information measures and water management programs. Measures that improve water system efficiency are reported to have been in effect for many years due to the chronic shortage of local water and the area's dependence on imported water. The education and public relations measures generally began in response to the 1976-77 drought, as have most water conservation programs in California. Before the drought, most outreach programs emphasized water awareness, but now water conservation is gaining exposure.

  The plan includes descriptions of the many current conservation programs and recommends additional public education measures, water management measures, and regulations to encourage more efficient use of present water supplies. Recommended water conservation measures are suited to the character and needs of the service area. A summary is provided in Table E-2. The plan is designed as a cooperative effort between Metropolitan Water District and its 27 member agencies, with both responsibilities and funding shared.

- Agricultural Water Conservation -- The plan recommends no change in practices in most areas, and recommends the collection of crop and water use data in certain areas to quantify potential savings.

- Waste Water Reclamation -- The Department recommends that the most promising planned waste water reclamation projects be implemented with participation of Metropolitan Water District through its Local Project Program, and that additional reclamation projects be implemented when technical and funding problems are resolved if the projects will produce water at less cost than newly developed imported water.

- Conjunctive Use of Surface Water and Ground Water -- The local programs for ground water replenishment and conjunctive use should be continued.

  The feasibility study of the storage program in the Chino basin is nearly complete. If the Chino basin program is feasible, it should be implemented, and detailed analyses should be initiated for other promising ground water basins.

C-105786

C-105786

- Water Exchanges, Transfers, and Interties -- Metropolitan Water District should continue cost-effective exchanges, transfers, and interties with other water agencies and among its member agencies to increase the flexibility and yield of its water supply system.

  Metropolitan Water District, the Colorado River Board, and the Department of Water Resources should continue to cooperate in studies related to the Colorado River Banking Plan.

  Metropolitan Water District, in cooperation with the other Colorado River users and the Department of Water Resources, should pursue the possibility of obtaining part of the water conservation potential in Imperial Irrigation District.

Summary of Urban Water Conservation

Table E-3 summarizes urban water conservation for all the State Water Project contractors.

C—105787

C-105787

TABLE E-1

URBAN WATER CONSERVATION MEASURES

o = Evaluate/Revise
X = Recommend Implementation
+ = Recommend Increased Effort
0 = Currently Implemented
* = In Process of Implementing

	WATER AGENCIES						
	Agency	Cal Water	East Niles	North of the River	Oildale	Tehachapi-Cummings	West Kern
I. Education and Public Information							
A. Local Water Conservation Advisory Committee	+	+	+	+	X	+	X
B. Conservation Literature							
1. General Water Conservation Brochure	X	0	0	+	+	+	X
2. Landscape Brochure with Plant List	X	o	X	X	X	+	X
3. Brochures for Specific Water Users	X	X	X	X	X	+	X
C. Previous Year's Use on Water Bills		0	X	X	X	X	X
D. Promotional Measures							
1. Public Relations	+	+	+	+	+	0	+
2. Public Speaking Presentations	+	+	+	0	+	0	+
3. Demonstration Low Water-Using Landscapes	X	X	X	X	X	X	X
4. Promotional Campaign with Nurseries	X	X	X	X	X	X	X
5. Awards for Conservation Developments	X	X	X	X	X	X	X
E. Work with Large Water Users		+	+	+	+	+	+
F. In-School Education	X	+	X	+	+	+	+
G. Information on Federal and State Laws and Programs	X	X	X	X	X	X	X
II. Water Management Programs							
A. Water Loss Reduction Techniques							
1. System-wide Water Audit	o	o	o	o	o	o	o
2. Leak Detection Program							
a. For Agency's System		0	o	*	+	+	o
b. For Customer's Side		0	0	0	0	0	0
3. Meter Calibration and Replacement Program	0	0	o	o	o	0	0
4. Corrosion Control	o	o	o	o	o	o	⊖
5. Valve Exercising Program	0	0	0	0	0	0	+
B. Metering Existing Customers		o	0	o	o	0	0
C. Device Distribution	X	+	X	X	X	X	X
D. Meter Loan Program, Large Water Users		X		X	X	X	X
E. Pricing		o	o	o	o	o	o
III. Regulations							
A. Environmental Impact Reports/Statements	X	X	X	X	X	X	X
B. Water Waste Reduction Program		o	X	o	o	o	o
C. Water Conservation Ordinances							
1. Requirements for Large Water Users		X	X	X	X	X	X
2. Self-Closing Faucets		X	X	X	X	X	X
3. Low Water-Using Landscapes		X	X	X	X	X	X
4. Metering New Customers		+	0	0	+	0	0
IV. Water Emergency Plan	X	X	X	X	X	X	o

TABLE E-2

URBAN WATER CONSERVATION MEASURES

X = Recommended Implementation
+ = Recommend Increased Effort
0 = Currently Implemented
* = In Process of Implementing
o = Evaluate Current Efforts

	WATER AGENCIES							
	Metropolitan	Anaheim	Beverly Hills	Burbank	Calleguas	Central Basin	Chino Basin	Coastal
I. Education and Public Information								
A. Local Water Conservation Advisory Committee	0	X	X	X	+	X	X	X
B. Conservation Literature								
1. General Water Conservation Brochure	0	0	+	0	0	0	0	0
2. Landscape Brochure with Plant List	*	0	+	0	0	0	0	0
3. Brochures for Specific Water Users	+	+	+	+	+	+	+	+
C. Previous Year's Use on Water Bills		X	X	0				
D. Promotional Measures								
1. Public Relations	0	0	0	0	0	0	0	0
2. Public Speaking Presentations	0	0	0	0	0	0	0	0
3. Demonstration Low Water-Using Landscapes	+	X	X	+	X	X	X	X
4. Promotional Campaign with Nurseries	+	X	X	X	X	X	X	X
5. Awards for Conservation Developments	X	X	X	X	X	X	X	X
E. Work with Large Water Users		X	o	X				
F. In-School Education	*	0	X	+	+	+	+	0
G. Information on Federal and State Laws and Programs	0	X	X	X	X	X	X	X
II. Water Management Programs								
A. Water Loss Reduction Techniques								
1. System-wide Water Audit	0	X	*	X	o		o	
2. Leak Detection Program								
a. For Agency's System	0	o	0	o	o		+	
b. For Customer's Side		0	0	0				
3. Meter Calibration and Replacement Program	0	*	+	o	o		o	
4. Corrosion Control	0	o	o	o	o		o	
5. Valve Exercising Program	0	0	0	0	o		o	
B. Metering Existing Customers		o	0	0	0	o	0	0
C. Device Distribution	+	+	+	+	+	+	+	+
D. Meter Loan Program, Large Water Users		X	o	X				
E. Pricing		o	o	o				
III. Regulations								
A. Environmental Impact Reports/Statements	X	X	X	X	X	X	X	X
B. Water Waste Reduction Program		+	X	X				
C. Water Conservation Ordinances								
1. Requirements for Large Water Users		X	X	X				
2. Self-Closing Faucets		X	X	X				
3. Low Water-Using Landscapes		X	X	X				
4. Metering New Customers	0	0	0	0	0	0	0	0
IV. Water Emergency Plan	0	X	X	X	X	X	X	X

TABLE E-2 (con't)

URBAN WATER CONSERVATION MEASURES

X = Recommended Implementation
+ = Recommend Increased Effort
0 = Currently Implemented
* = In Process of Implementing
o = Evaluate Current Efforts

	WATER AGENCIES							
	Torrance	San Gabriel	West Basin	Western				
I. Education and Public Information								
A. Local Water Conservation Advisory Committee	+	+	X	X				
B. Conservation Literature								
1. General Water Conservation Brochure	+	+	+	+				
2. Landscape Brochure with Plant List	+	+	+	+				
3. Brochures for Specific Water Users	+	+	+	+				
C. Previous Year's Use on Water Bills	X			X				
D. Promotional Measures								
1. Public Relations	0	0	0	0				
2. Public Speaking Presentations	0	0	0	0				
3. Demonstration Low Water-Using Landscapes	X	X	X	X				
4. Promotional Campaign with Nurseries	X	X	X	X				
5. Awards for Conservation Developments	X	X	X	X				
E. Work with Large Water Users	+			X				
F. In-School Education	+	+	+	+				
G. Information on Federal and State Laws and Programs	X	X	X	X				
II. Water Management Programs								
A. Water Loss Reduction Techniques								
1. System-wide Water Audit	*	o	o	o				
2. Leak Detection Program								
a. For Agency's System	o	o		0				
b. For Customer's Side	0			+				
3. Meter Calibration and Replacement Program	*	o		o				
4. Corrosion Control	o	o		o				
5. Valve Exercising Program	0	o		o				
B. Metering Existing Customers	0	0	0	0				
C. Device Distribution	+	+	+	+				
D. Meter Loan Program, Large Water Users	X			X				
E. Pricing	o			o				
III. Regulations								
A. Environmental Impact Reports/Statements	X	X	X	X				
B. Water Waste Reduction Program	X			X				
C. Water Conservation Ordinances								
1. Requirements for Large Water Users	X			X				
2. Self-Closing Faucets	X			X				
3. Low Water-Using Landscapes	X			X				
4. Metering New Customers	0	0	0	0				
IV. Water Emergency Plan	X	X	X	0				

TABLE E-2 (con't)

URBAN WATER CONSERVATION MEASURES

X = Recommended Implementation
+ = Recommend Increased Effort
0 = Currently Implemented
* = In Process of Implementing
o = Evaluate Current Efforts

	WATER AGENCIES							
	Compton	Eastern	Foothill	Fullerton	Glendale	Las Virgenes	Long Beach	Los Angeles
I. Education and Public Information								
A. Local Water Conservation Advisory Committee	X	X	X	0	X	+	X	+
B. Conservation Literature								
1. General Water Conservation Brochure	0	+	0	+	0	0	+	0
2. Landscape Brochure with Plant List	0	+	0	+	0	0	+	0
3. Brochures for Specific Water Users	+	+	+	+	+	+	+	0
C. Previous Year's Use on Water Bills	X	*		0	X	0	0	0
D. Promotional Measures								
1. Public Relations	0	0	0	0	0	0	0	0
2. Public Speaking Presentations	0	0	0	0	0	0	0	0
3. Demonstration Low Water-Using Landscapes	X	X	+	X	X	+	X	+
4. Promotional Campaign with Nurseries	X	X	X	X	X	+	X	X
5. Awards for Conservation Developments	X	X	X	X	X	+	X	o
E. Work with Large Water Users	X	o		X	o	o	o	0
F. In-School Education	+	0	0	0	+	0	0	0
G. Information on Federal and State Laws and Programs	X	X	X	X	X	X	X	0
II. Water Management Programs								
A. Water Loss Reduction Techniques								
1. System-wide Water Audit	o	o	o	X	X	o	X	o
2. Leak Detection Program								
a. For Agency's System	+	o	+	0	+	0	+	0
b. For Customer's Side	0	+		0	0	0	0	+
3. Meter Calibration and Replacement Program	o	o	0	o	o	0	0	o
4. Corrosion Control	o	0	0	0	o	0	0	o
5. Valve Exercising Program	0	0	0	o	0	0	0	0
B. Metering Existing Customers	0	*	0	0	0	0	0	0
C. Device Distribution	+	+	+	+	+	+	+	+
D. Meter Loan Program, Large Water Users	X	o		X	o	o	X	+
E. Pricing	o	o		o	o	o	o	o
III. Regulations								
A. Environmental Impact Reports/Statements	X	X	X	X	0	X	X	X
B. Water Waste Reduction Program	X	X		+	X	+	X	X
C. Water Conservation Ordinances								
1. Requirements for Large Water Users	X	X		X	o	X	X	X
2. Self-Closing Faucets	X	X		X	o	X	X	X
3. Low Water-Using Landscapes	X	X		X	o	X	X	X
4. Metering New Customers	0	0	0	0	0	0	0	0
IV. Water Emergency Plan	X	0	X	X	X	X	+	o

TABLE E-2 (con't)

URBAN WATER CONSERVATION MEASURES

X = Recommended Implementation
+ = Recommend Increased Effort
0 = Currently Implemented
* = In Process of Implementing
o = Evaluate Current Efforts

	WATER AGENCIES							
	MWDOC	Pasadena	San Diego	San Fernando	San Marino	Santa Ana	Santa Monica	Three Valleys
I. Education and Public Information								
A. Local Water Conservation Advisory Committee	*	0	+	X	X	X	X	*
B. Conservation Literature								
1. General Water Conservation Brochure	0	+	0	+	0	+	0	0
2. Landscape Brochure with Plant List	0	+	0	+	0	+	0	0
3. Brochures for Specific Water Users	+	+	+	+	+	+	+	+
C. Previous Year's Use on Water Bills		*		X	X	X	0	
D. Promotional Measures								
1. Public Relations	0	0	0	0	0	0	0	0
2. Public Speaking Presentations	0	0	0	0	0	0	0	0
3. Demonstration Low Water-Using Landscapes	+	X	+	X	X	X	X	+
4. Promotional Campaign with Nurseries	X	X	+	X	X	X	X	X
5. Awards for Conservation Developments	X	X	+	X	X	X	X	X
E. Work with Large Water Users		o		o	o	X	X	
F. In-School Education	0	0	+	X	+	0	X	0
G. Information on Federal and State Laws and Programs	X	X	X	X	X	X	X	X
II. Water Management Programs								
A. Water Loss Reduction Techniques								
1. System-wide Water Audit	o	X	X	X	X	X	X	X
2. Leak Detection Program								
a. For Agency's System	0	+	0	+	0	o	+	o
b. For Customer's Side		+		0	0	+	0	
3. Meter Calibration and Replacement Program	0	o	0	o	o	o	+	o
4. Corrosion Control	0	o	o	o	o	o	o	o
5. Valve Exercising Program	0	0	0	X	o	X	o	o
B. Metering Existing Customers	0	0	0	0	0	0	0	0
C. Device Distribution	+	+	+	+	+	+	+	+
D. Meter Loan Program, Large Water Users		o		o	o	X	X	
E. Pricing		o		o	o	o	o	
III. Regulations								
A. Environmental Impact Reports/Statements	0	X	X	X	X	X	0	X
B. Water Waste Reduction Program		X		X	X	+	X	
C. Water Conservation Ordinances								
1. Requirements for Large Water Users		X		X	X	X	o	
2. Self-Closing Faucets	0	X		X	X	X	o	
3. Low Water-Using Landscapes	0	X		X	X	X	o	
4. Metering New Customers	0	0	0	0	0	0	0	0
IV. Water Emergency Plan	X	X	X	+	X	X	+	X

C-105793

Table E-3

DEPARTMENT OF WATER RESOURCES DRAFT WATER MANAGEMENT PLANS
PROJECTED URBAN WATER CONSERVATION
(1,000s acre-feet)

Service Area	1990			2000			2010		
	Potential Gross Savings	Potential Net Savings	Potential Effect on SWP Demand	Potential Gross Savings	Potential Net Savings	Potential Effect on SWP Demand	Potential Gross Savings	Potential Net Savings	Potential Effect on SWP Demand
Alameda County WD	4.1	3.9	0	6.1	5.8	0	6.7	6.4	0
Alameda County FC&WCD, Zone 7	2.2	1.8	1.8	3.9	3.2	3.2	4.8	3.9	3.9
Antelope Valley-East Kern WA	5.1	3.8	3.8	11.4	8.4	8.4	13.9	10.5	10.5
Butte County	0.2	NIL	NIL	0.4	0.1	0.1	0.4	0.1	0.1
Castaic Lake WA	3.4	0.9	0.9	5.5	1.6	1.6	6.1	2.1	2.1
Coachella Valley WD	4.1	3.0	0	11.3	8.7	0	16.4	13.2	0
Crestline-Lake Arrowhead WA	0.2	0	0	0.2	0	0	0.3	0	0
Desert WA	11.8	7.1	0	17.2	10.7	0	20.5	12.8	0
Devil's Den WD 1/	--	--	--	--	--	--	--	--	--
Dudley Ridge WD 1/	--	--	--	--	--	--	--	--	--
Empire West Side ID 1/	--	--	--	--	--	--	--	--	--
Kern County WA	9.3	1.3	0	18.2	3.1	0	23.8	5.4	0
Kings County 3/	--	--	--	--	--	--	--	--	--
Littlerock Creek ID 2/	--	--	--	--	--	--	--	--	--
Mojave WA 4/	5.0	4.0	4.0	12.0	8.0	8.0	15.0	10.0	10.0
Napa County FC&WCD	1.7	1.4 6/	1.4	3.0	2.3 6/	2.3	3.3	2.6 6/	2.6
Oak Flat WD 1/	--	--	--	--	--	--	--	--	--
Palmdale WD	1.1	0.5	0.5	2.4	1.3	1.3	2.8	1.7	1.7
Plumas County FC&WCD	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
San Bernardino Valley MWD	14.7	4.3	4.3	27.1	9.7	9.7	37.5	15.9	0
San Gabriel Valley MWD	3.4	1.1	1.1	5.3	1.8	1.8	5.9	2.1	2.1
San Gorgonio Pass WA	1.8	0.2	0.2	4.3	0.6	0.6	5.4	0.8	0
San Luis Obispo County FC&WCD	4.5	2.7	0	8.0	4.9	0	10.3	6.6	0
Santa Barbara County FC&WCD	6.6	4.8	0	10.5	7.5	0	11.1	8.0	0
Santa Clara Valley WD	32.5	31.6	0	54.2	52.1	0	61.6	59.5	0
Solano County FC&WCD	8.2	7.6 7/	7.6	15.1	13.8 7/	13.8	20.1	18.2 7/	18.2
The MWD of Southern California	312.5	244.8	244.8	530.7	404.4	76.9	626.6	481.1	0
Tulare Lake Basin WSD 1/	--	--	--	--	--	--	--	--	--
Ventura County FCD 5/	2.0	1.0	0	4.0	2.0	0	5.0	3.0	0
Yuba City	0.6	0.3	0.3	1.1	0.6	0.6	1.4	0.8	0.8
TOTALS	435.0	326.1	270.7	751.9	550.6	128.3	898.9	664.7	52.0

1/ Essentially no urban water use.
2/ Urban conservation not estimated because SWP currently used for agriculture only. Savings would be very small.
3/ Recreation water only, no plan prepared.
4/ No plan prepared because no SWP deliveries expected until after 2000. Estimates based on Antelope Valley-East Kern which has similar population and climate.
5/ No plan prepared because contractor has prepared own plan. Estimates based on extrapolation of Calleguas MWD data from MWD plan.
6/ Not adjusted for incidental agricultural reuse (non-SWP) of effluent discharged to the Napa River.
7/ Not adjusted for incidental agricultural reuse (non-SWP) of Vacaville effluent.

C—105793

Appendix F

DOCUMENTS INCORPORATED BY REFERENCE

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U. S. Army Engineer District. 1980. Final Environmental Statement for the Operation of the Delta Pumping Plant.

California State Water Resources Control Board. 1978. Water Right Decision 1485, Sacramento-San Joaquin Delta and Suisun Marsh.

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California Department of Water Resources. 1983. Alternatives for Delta Water Transfer.

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California Department of Fish and Game, California Department of Water Resources, U. S. Fish and Wildlife Service, U. S. Bureau of Reclamation. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Annual Reports.

California Department of Fish and Game/U. S. Fish and Wildlife Service. Sacramento-San Joaquin Delta Wildlife Habitat Protection and Restoration Plan. Prepared by Madrone Associates. December 1980.