PROPOSAL
to
REDUCE PHYSICAL, CHEMICAL, AND BIOLOGICAL IMPACTS
CREATED BY DIRECT DELTA WATER PROJECT EXPORTS

By
James F. Arthur
U.S. Bureau of Reclamation
Mid-Pacific Region

Problems to be Resolved

Water managers realize that there are major long-term impacts associated with the current method of exporting water through existing Delta channels. These impacts include the location of the fish facilities, aquatic weeds, predation, hydrodynamics, reduced residence times, salt load recycling to the San Joaquin Valley, trihalomethane precursor loading from Delta Islands, and biological losses.

These impacts were discussed recently in a paper entitled, "Summary of Federal and State Water Project Environmental Impacts in the San Francisco-Delta Estuary" (Arthur, et.al., 1995). The paper was prepared for the upcoming American Association for the Academy of Sciences (AAAS) book (currently in press) about the San Francisco Bay. The information presented in the paper has been well documented during the last 30 years in State Water Resources Control Board hearings, in numerous reports by the Interagency Ecological Program, and in other sources.

In addition to the long-term problems mentioned above, there are two significant problems which require remedial, short-term action within the next few years. The first problem is the major deterioration of the existing Tracy Fish Facility (TFF) infrastructure: there is a need to make major repairs to keep the present fish facility operating. Major rebuilding and upgrading or new construction is needed within the next several years. Unless changed, a new fish facility would most likely be located in the vicinity of the present TFF. Considering the cost and problems associated with the existing facility, relocating the facility to a new location could potentially achieve better results.

Another significant problem that requires remedial action during the next several years is fish predation at both the TFF and the Skinner Fish Facilities (SFF). Studies during the last several years have documented fish predation as a major problem in effectively salvaging fish at both facilities. Although short-term actions are under way to reduce the problem, long-term, major predator control may not be practical at the existing sites. Again, alternate sites for screening and salvaging fish may prove effective.

Proposal Description

The basic concept of the proposal is simple and represents one stage of the long-term proposal previously provided to CALFED (Arthur, 1993). The proposal is to enlarge (deepen) and isolate lower Old River from the diversion point on the lower San Joaquin River to the two export facilities (Figure 1) from the rest of the south Delta. Although this proposal utilizes lower Old River as the conveyance channel, the same purpose could be achieved by using other existing channels, constructing a new channel, or even using a large pipe.

Features

As envisioned, flow control gates and a relatively small fish screen would be constructed at the intake located at the confluence of lower Old River and the San Joaquin River. Old River would be isolated between the lower San Joaquin River and the export facilities with permanent blocks and/or screens at all the diversions, including those in Old River adjacent to the export facilities. As proposed in the long-term plan, islands adjacent to Old River and on both sides of the channel could be deepened to serve as storage and wildlife habitat during periods of high runoff or as an intermediate source of water when pulses of fish initiate closure of the control gate.

A key to the plan is implementing a real-time monitoring program in the San Joaquin River near the diversion point. The Interagency Ecological Program (IEP) has both a long history of monitoring and an existing program that can be used to indicate when key fish species will be in the Delta and thus in the vicinity of the intake. Last year, at the request of CALFED, the IEP developed and implemented the capability to conduct real-time field fisheries monitoring.

In addition, there continue to be major improvements in hydroacoustic hardware and software for measuring fish passage. For example, it is now possible to continuously operate hydroacoustic arrays across a channel, automatically processing the data and telemetering the data to the Joint Project Operations office in Sacramento.

Also, Reclamation's Denver staff is currently working with the Navy on spectral scanning equipment. This equipment was developed by the Navy and can digitally identify major fish species. Staff feels this technology is very promising and hopes to field test it in 1996.

In addition to monitoring larger fish, fish eggs and larvae near the intake and closure of the control gate could be monitored to greatly reduce the losses which occur with the present operation. Reclamation has developed an automatic, continuous egg and larval sampler that can run unattended for fairly long periods during the day.

Construction of a fish screen at the head of Old River would greatly reduce the amount of screen required and would simplify fish screen operations. The fish screen would be used primarily to help keep larger resident fish from being diverted to the export pumps during normal pumping. During periods when there are large numbers of migrating fish (or eggs and larvae) in the vicinity of the diversion, the gates would be closed until the fish pass the diversion point.

Also, the lower San Joaquin River at the proposed diversion point is large in cross section and has tidal flows on the order of 100,000 cfs. Large tidal

flows perpendicular to the screens would provide large sweeping flows across the face of the screen. This is in contrast to the location of the present fish facility which provides a dead-end channel with no other place for either the fish or the food-web organisms to go. Fish entrainment might also be reduced because of the relatively large channel size at this location on the San Joaquin River.

Before this proposal is implemented, additional information will be needed to determine the distribution of fish and food web organisms in the lower San Joaquin River and in lower Old River under different flow and tidal conditions. For example, Reclamation's Tracy studies have shown there are peaks of fish entering the TFF on flood tides, at night, and when the Clifton Court gates are open. Similar studies near the proposed intake facility would provide valuable insight for the development of a new fish facility.

Finally, with this proposal there would be less need for fish handling and transporting, as the system would be shut down when large numbers of fish are present. Any fish retained at this point would not have to be hauled to some other location, but would be released during strong ebbing tides and periods of shutdown.

Disadvantages and Advantages

As with any proposal, there are disadvantages and advantages. In this proposal, it appears that the advantages outweigh the disadvantages. Advantages, disadvantages, and impacts should be identified and fully analyzed during the CALFED process.

Disadvantages

One disadvantage is the loss of habitat and boater use in any isolated transfer channel. However, much of the habitat currently lost would be regained by restoring it to areas of slow-moving flow (in the downstream direction). If an existing south Delta channel were selected, boat locks could be included for access to the interior islands.

A significant problem could be the loss of fresh water supplies for agriculture in the south Delta during certain periods. However, in the past Reclamation has made releases from the Delta-Mendota Canal into the San Joaquin River to improve water quality; this might be an option.

Advantages

The aquatic plant problem would be greatly reduced. The source of water hyacinth at the facilities will largely be eliminated because the proposed facilities are isolated from upper Old River. Instead of the need to treat the entire south Delta during shutdown periods, treatment for *Egeria densa* could be isolated to the conveyance channel.

The use of real-time monitoring at an optimum intake location, combined with fish screens and gate closures during peak fishery occurrences, could reduce both the requirements and costs of fish screening.

Predation, while still not being eliminated, would be greatly reduced by closing the intake control gates when large numbers of fish are present near the intake.

Much of the South Delta aquatic habitat lost under the present system would be restored for the food web and the fisheries.

Water quality would be improved, and the salt load and THM problems would be reduced.

Fish could be directly released to the estuary, thereby minimizing fish handling and trucking.

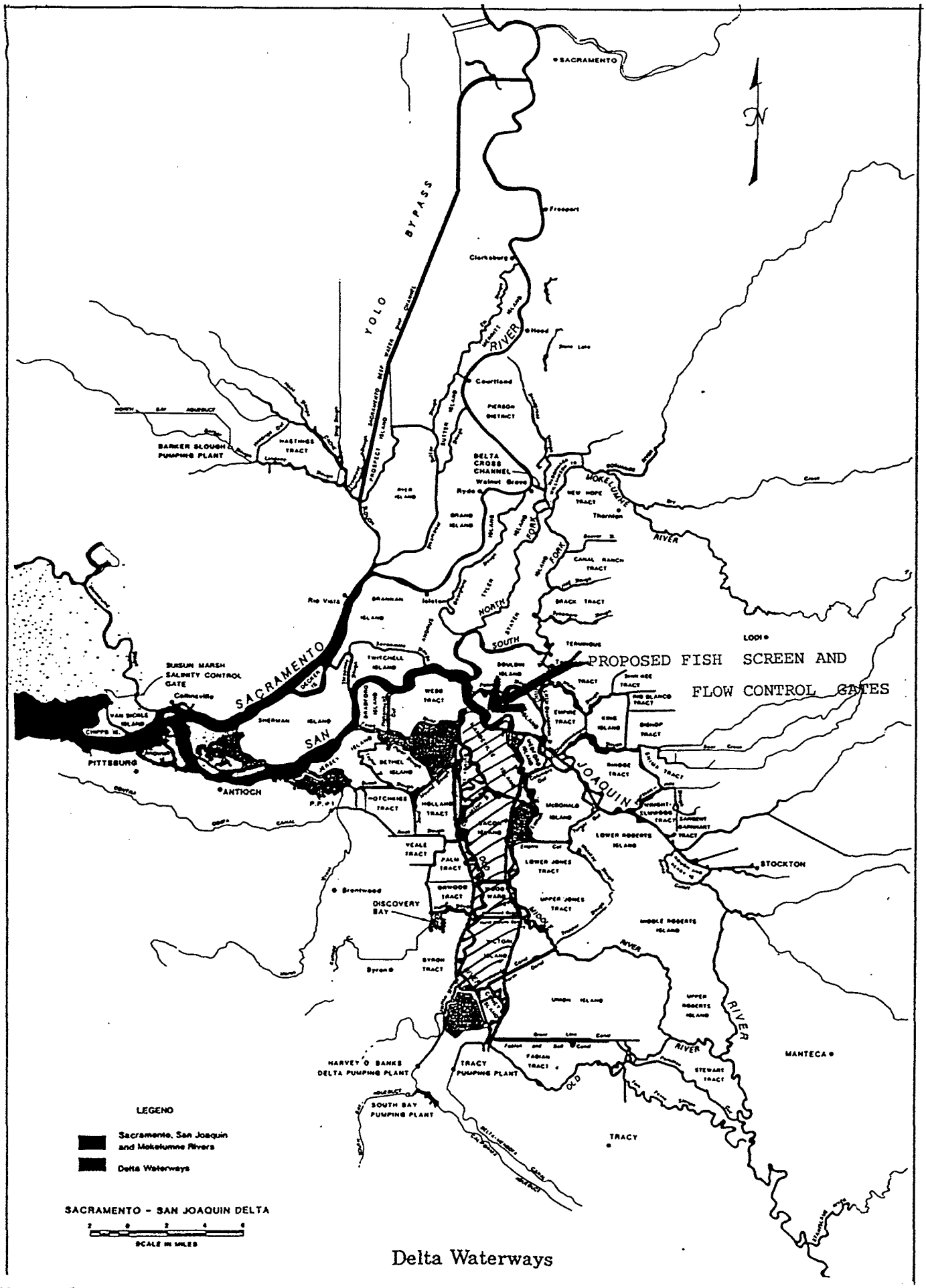

Figure 1. Proposed path for an isolated water transfer facility. *Department of Water Resources*

Details

The previously-mentioned problems that could be remedied by the proposed relocation of the fish facilities are discussed here in greater detail.

Tracy Fish Facility (TFF)

Deterioration of the Facility - The TFF was constructed nearly 50 years ago using the best fish screening (behavioral louvers) technology available at that time. Now, however, the current fish louvering system is outdated and ineffective, and the entire facility is in such a deteriorated state that either an entirely new facility or a substantial modification is required within the next several years to repair the existing facility. Dr. Charles Liston of the Denver Technical Center will be preparing a white paper for Reclamation management in early 1996 on the status of the TFF, including recommendations for either a new or highly modified facility.

CVPIA Funds - Many of the recommendations listed above will be considered for implementation under the CVPIA 3406(6)(4). The question is whether the current location will achieve the best results for the fisheries. This is the time to evaluate alternatives and to coordinate the activities with needed repairs to keep the present fish facility operating, while making the best use of available funds.

Fish Predation

The John F. Skinner Fish Facility (SFF) is much newer than the TFF and has a more efficient fish recovery system because approach velocities can be better regulated. However, studies have demonstrated that an average of 75 percent of the salvageable salmon and striped bass never reach the fish screening facility because of predation in Clifton Court Forebay. Unfortunately, there appears to be no realistic method to effectively control predation within the existing facility.

The TFF has similar problems but on a smaller scale, as there is no major forebay. Reclamation has been conducting predator studies in the primary and secondary louvers at the TFF during the last several years. A weekly predator removal program is now in place, but the program does not address predation in front of the louvers, in front of the trash racks, in Old River, or between the TFF and the pumping plant.

Studies by Reclamation and DWR demonstrate that predator re-population occurs at a rapid rate, so major predator control in the existing facilities is probably not possible.

Additionally, even if all the larger predators could somehow be removed, both the TFF and SFF are incapable of screening smaller organisms, including larval fish less than 20 mm in length. Available technologies are not capable of screening these smaller organisms with the debris load normally found in Delta waters. Instead of focusing on the existing facilities, it may be more efficient to reduce the predation problem by tackling the problem at the source: the diversion point off the San Joaquin River.

Aquatic Weeds

Aquatic weeds, primarily water hyacinth and *Egeria densa*, are major nuisance problems at both facilities. At times, more than 200 dump truck loads of aquatic weeds are removed from the TFF each day.

These aquatic weeds create major problems for effectively louvering fish. The TFF had to be shut down for several hours in 1994 and again in 1995 for aquatic weed removal, thus eliminating fish screening. More typically, however, are long periods when aquatic weed accumulation causes approach velocities to be reduced to the point where louver efficiencies are greatly reduced, resulting in overall losses to effective fish screening.

The primary sources of these aquatic weeds are the San Joaquin River and the southern portion of the Delta east of the facilities. Although there is an active control program for the surface weed water hyacinth, Egeria densa is a submerged aquatic weed and cannot be practically controlled with chemicals because of the large volume of water which requires treatment.

Because of the major problems created by these aquatic weeds, any technique which will reduce the source of weeds and the volume of water needing treatment will enhance fish screening efficiencies.

Hydrodynamic Impacts on Fish

Net Flows - San Joaquin River flows are low in approximately 9 of every 10 years. In the low-flow years, most of the San Joaquin River is diverted toward the export facilities from upper Old River (Figure 1). As a consequence, Sacramento River water is drawn toward Stockton in the San Joaquin River system, creating flow reversals throughout the south-central Delta. This flow reversal creates major problems for fish migration, as the fish follow the flow even if it is in the wrong direction.

As documented in the AAAS paper, US Geological Survey data from instruments placed in Old and Middle Rivers demonstrated that there was not even one day during the 1987-92 period that net flows were downstream (toward the estuary). Instead, at times the net flow toward the pumps was as much as 10,000 cfs. In addition, net flows are generally low in the southern Delta even when there are periods of complete export pumping curtailments. The low net flows seen in the southern Delta result in fish and food web organisms being retained in the south Delta channels until pumping is resumed, with little, if any, net positive benefits to the fisheries.

Also, the current State practice of opening the Clifton Court radial gates during high tides can result in an increase of pulses of flow (and organisms) out of Old River to the export facilities. Spring tides also cause the Delta to "fill" and add to the flow reversal problems created by export pumping.

In addition to affecting planktonic organisms, circulation patterns also have detrimental effects on larger fish. For example, fish recovery data from the TFF and SFF show that young-of-the-year striped bass have major peaks at the facilities in June and July, when they would normally be in the downstream embayments or in the ocean.

Effects of Diversions - Physical and biological information presented in the AAAS paper suggests that many larger fish and most of the smaller fish eggs and larvae, as well as food web organisms, diverted from the main San Joaquin River are essentially removed from the estuary.

During some below-normal flow years, the class strength of some species of a fishery year is largely determined by the survival of eggs and larvae. For example, a data evaluation conducted in 1985 (Arthur, 1986) indicated that approximately 50 percent of the entire striped bass egg and larval production was lost to the export facilities. In a later analysis of the same data base, Don Stevens, the striped bass program manager at the California Department of Fish and Game in Stockton, found that the actual losses may have been closer to 90 percent.

Overall, there will be fewer impacts to the fisheries if there can be a reduction in diversions from the main river.

Loss of Habitat

Residence time is a function of flow rate per unit of time. Residence time affects the standing crop of fish and food web organisms. For example, a decrease in residence time can reduce the standing crop. Generally, organisms such as algae, which are low in the food web, have higher reproductive rates than fish, which are higher in the food web; thus the algae will be affected to a lesser degree by decreases in residence time than fish. The evidence indicates that most of the south-central Delta has been lost as viable habitat for fish and food web organisms in recent years, as residence times have decreased and exposure to San Joaquin diversions have increased.

Salt Recycling and THMs

Sources of trihalomethane (THM) and salts include Delta agricultural discharges and the San Joaquin River. Under current conditions, salt and THM are recycled into the valley via the export facilities. For example, as reported in the AAAS paper, using actual daily salt concentrations and export flows, the actual total salt load returned to the valley since export pumping began was calculated to be approximately 45 million metric tons. Similarly, using actual daily salt concentrations at Greens Landing (near the Hood intake of the proposed Peripheral Canal) and the same export flows, the use of an isolated transfer facility would have resulted in a reduction of approximately 64 percent in salt loads transported to the valley. Diverting export water from the lower San Joaquin river would reduce the concentrations of salts and THMs transported to the valley.