Value Planning Study

Final Report

California Department of Water Resources

Through Delta Facility

Sacramento, California

June 2007

CH2MHILL

Strategic Value Solutions, Inc.

Final

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for

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In addition, we would like to thank the members of the DWR Division of Planning team for sharing their knowledge about the project and for their responsiveness to our questions and requests throughout this Value Planning study. We would especially like to thank Don Kurosaka and Ajay Goyal.

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SECTION 1

EXECUTIVE SUMMARY

SECTION 1
EXECUTIVE SUMMARY

This report presents the results of a Value Study conducted by Strategic Value Solutions, Inc. (SVS) on the design of the Through Delta Facility for the California Department of Water Resources (DWR). The project was reviewed at the beginning of the planning phase.

The project plan being reviewed was developed by the Department of Water Resources (DWR).

The Value Study included a five-day (40-hour) value methodology workshop that was conducted with a multidisciplinary team in Sacramento, California, on March 26-30, 2007.

PROJECT DESCRIPTION SUMMARY

This project focuses on an alternative to the Peripheral Canal, which was conceived as a solution to bypass the Sacramento and San Joaquin River's Delta to deliver Sacramento River water more directly to the Southern Delta. Instead of bypassing the Delta, this project proposes a new canal through the northern portion of the Delta. This new canal will discharge into the Central Delta. The objective is to increase the net outflow in the Delta to reduce salinity at the export locations in the Southern Delta by reducing seawater intrusion. As the Delta flows are reduced due to withdrawals during dry and critically dry periods the seawater encroaches further into the Delta during high tide cycles. This high salinity water is drawn to the export pump stations and transfers the salinity to downstream users. This is driving up treatment costs.

The project team presented the following concept to the Value Team:

1. A new intake structure at Hood, CA to draw 4,000 cfs from the Sacramento River.
2. The new intake would have a trash rack structure and "V-shaped" or saw tooth shaped fish screen and fish bypass feature. The design approach velocity would be 0.2 fps.
3. A pump station would be constructed as part of the intake structure to withdraw the required 4,000 cfs.
4. The water would be conveyed from Hood, CA to the South Fork of the Mokelumne River near the confluence with Snodgrass Slough by a new canal.
5. At the downstream end of the canal would be a gated structure outlet structure to discourage fish from swimming upstream to the pumping station.

SCOPE OF THE VALUE STUDY

This study is the only Value Study currently planned for this project. The scope of this Value Study was to validate the concept of a new canal that would convey 4,000 cfs from Hood, CA to the Central Delta. As part of the study, the team was tasked with optimizing this concept and considering alternative alignments that would allow water to be taken from the Sacramento River somewhere between Hood and the Walnut Grove, CA. The discharge location is unconstrained. The objectives of this study were to:

- Determine the technical feasibility of the proposed plan including fisheries impacts
- Recommend a preferred alignment
- Provide any relevant criteria for design and construction
- Provide any relevant criteria for operations

VALUE STUDY TEAM

The team members that comprised this multidisciplinary Value Study Team are listed on the introductory pages of this report. All other participants of the study are provided in Appendix A.

In general, the Value Study Team members were independent of the project development team. This ensured maximum objectivity towards identifying alternative solutions.

VALUE METHODOLOGY

This Value Study used the international standard Value Methodology established by SAVE International, the Value Society. The Value Methodology (VM) uses a six-phase process executed in a workshop format with a multidisciplinary team. Value is expressed as the relationship between functions and resources where function is measured by the performance requirements of the customer and resources are measured in materials, labor, price, time, etc. required to accomplish that function. VM focuses on improving Value by identifying the most resource efficient way to reliably accomplish a function that meets the performance expectations of the customer.

With this process, the Value Team identifies the essential project functions and alternative ways to achieve those functions, and then selects the best alternatives to develop into workable solutions for value improvements.

Additional information about the Value Study processes used in the generation of the results presented is provided in Section 3 of this report.

Value Study Constraints

Often constraints or limits are imposed on the Value Study to define the boundaries between project aspects that the project stakeholders will consider changing and those that cannot be changed. These constraints may result from a variety of political, technical, schedule, or environmental causes. For this Value Study, no such constraints were placed on the team's ability to identify and pursue creative solutions for value improvements.

PROJECT COST ANALYSIS

The Value Team was provided a summary level, nine-item construction cost estimate as part of the project Draft Memorandum Report dated March 2007. In addition, a more recent detailed estimate prepared by DWR was provided in support of these numbers. A document entitled "Isolated Facility Incised Canal Bay-Delta System, Estimate of Construction Costs," dated August 2006 was also provided. These two documents were compared with other cost information provided with various team members. Overall "building block" type costs were developed for Intake structure/fish screens, pumping station, various bridges, various siphons, canal cost per mile, and outlet.

As a part of this workshop, the team developed individual conceptual layout of facilities for eight different alternative configurations. The above construction building block costs were applied according to each alternative configuration. These conceptual estimates can be used in the future by DWR to access other alternatives.

The estimated cost of construction is $443,900,000 based on second quarter 2007 prices. To arrive at this cost, some unit prices and quantities have been adjusted from the DWR estimate provided to the Value Team. In addition, a 30 percent design contingency was added to account for the remaining uncertainties in the design and cost estimate.

WORKSHOP RESULTS

The purpose of the workshop is to identify and develop alternative concepts that will improve the overall value of the project. In order to be successful at identifying alternatives, it is essential that the Value Team first understand the project objectives and the problems that must be solved. For this reason, the workshop began with presentations by DWR's project management to define the project objectives and to provide background information on the project. This was followed by a more detailed presentation of the project plan by the project development team on how the plan will accomplish the project's objectives. To give the Value Team a better perspective on the project the team participated in a site visit following the presentations.

This Information Phase of the workshop was followed by an in-depth analysis of the functional requirements of the project. A complete understanding of the basic functions that must be accomplished in order to achieve the mission of the project is essential for the team to identify feasible alternatives to the current concept.

Using function analysis and Function Analysis System Technique (FAST) diagramming, the team concluded that the mission of this project is to meet the Record of Decision (ROD) given to DWR by CALFED. The basic functions that must be accomplished in order to meet the ROD are *Improve Water Quality* and *Protect Fish.* Key secondary functions that supported the basic functions included *Reduce Salinity, Reduce Predation, Avoid Migration Delay, and Prevent Injury*. Analysis of the functions to be performed by the project helped the team focus on the mission of the project and, consequently, how to identify alternative concepts that would meet the mission, as well as explore opportunities for value enhancement.

Analyzing the functions of this project gave the team the following key insights:

- Protecting the fish is a significant consideration in the design and operation of the new diversion. This also has significant cost implications.

- Water quality will be improved by introducing more Sacramento River water into the Delta, which will have the affect of increasing the net outflow of water from the Delta and thus reduce the amount of saltwater intrusion from the bay.

With an understanding of the functional requirements, the Value Team transitioned to the Creative Phase of the workshop and brainstormed on all of the possible ways to accomplish each of those functions. The team generated 73 ideas for potential changes to the current plan.

Based on the team members' professional judgment and input from DWR, 11 of these ideas were selected for developing into Value Alternatives.

Value Alternatives

Table 1-1, at the end of this section, includes a complete list of all the Value Alternatives developed. This table shows the number and title of each alternative as well as a summary of the construction cost.

It should be noted that Value Studies are working sessions for the purpose of developing and recommending alternative approaches to the current plan. As such, the results presented are of a conceptual nature and are not intended as a final design. Detailed feasibility assessment and final design development of any of the alternatives or suggestions presented herein, should they be accepted, remain the responsibility of DWR.

Some alternatives presented in this report are variations of a common concept and others are alternatives to a specific aspect of the plan. Thus, not necessarily all alternatives in this report can be implemented as selection of some may preclude or limit the use of others.

These potential savings do not reflect any costs for redesign, which must be considered. Moreover, the full benefit and impact of many of the alternatives goes beyond the cost savings

Design Suggestions

In addition to the Value Alternatives, the team also identified four design suggestions. These are suggestions for changes or clarifications to the project documents that did not have an identifiable or quantifiable cost impact that could be determined within the scope of the workshop. The design suggestions from this study are included in Section 5 of this report.

Additional Benefits

A Value Study typically results in benefits beyond cost savings. These benefits are generated as a part of an alternative, design suggestion, or from an observation made by the team or one of the other participants during the workshop. Below are some of the benefits realized from this study, in addition to the cost savings discussed above.

- The Value Team developed a strategy for addressing environmental issues in the project as the project development advances.
- The Value Team also developed a discussion on the fish concerns related to a new diversion on the Sacramento River that will provide valuable information to the project development team as they begin design.
- Also related to fish, the Value Team provided a discussion on fish screens that may help the project team in their analysis and decision on a screening mechanism.
- The analysis of fish concerns also led to a discussion on handling upstream migrating fish

RESOLUTION OF ALTERNATIVES

DWR has reviewed the various alternatives presented in this report and has decided to further evaluate Alternatives CF-04, CF-10 (a,b,c), CF-15, CF-19, and CF-38 with additional modeling to assess the hydraulic affects and the affect on salinity reduction. The results of this modeling will be analyzed in a pre-feasibility study. The objective of this study will be to further reduce the number of alternatives that will be evaluated in more detail in a full feasibility study for the Through Delta Facility.

CONCLUSIONS

At the conclusion of the study, the Value Team offered the following recommendations:

1. While the proposed alignment for the Through Delta Facility appears to be a viable solution, it is not the preferred alignment. This alignment requires the construction of a new canal that is very expensive. There are several other locations where the Sacramento River water could be diverted that would substantially reduce the cost.

2. Further evaluation should be performed on diverting more water at the Delta Cross Channel which we believe will have the same net affect on salinity reduction at a much reduced cost.

3. The Value Team evaluated both in canal fish screens and in-river fish screens and concluded that the in-river has some definite advantages for fish but the cost is extremely high. For that reason, we recommend in-canal "V-shaped" screens.

4. We recommend that if there is a new canal that a fish barrier be provided to prevent/reduce upstream migration.

Table 1-1
Summary of Value Alternatives

Alt. No.	Description	Capital Cost
CF-04	Divert at Hood and open channel to Snodgrass Slough at McCormick Williamson Tract (Lost Slough)	$358,936,000
CF-10a	Intake structure north of Walnut Grove/Locke (pipe to Mokelumne River, 2 siphon, 3 bridges)	$389,861,000
CF-10b	Intake structure north of Walnut Grove/Locke (4,000' canal to Mokelumne River, no siphon, 3 bridges)	$232,566,000
CF-10c	Intake structure north of Walnut Grove/Locke (pipe 3 ea 9,000', transition to 2.5 mile canal to S. Fork Mokelumne River, 3 siphon, 5 bridges)	$450,431,000
CF-15	Divert at Georgiana Slough and cut channel across Staten Island to South Fork	$316,554,000
CF-19	Divert at multiple locations; Snodgrass Slough, Meadows Slough, Open up DCC and Georgiana Slough, Hood to Stone Lake	
	First Cost – Site 1	$60,653,000
	First Cost – Site 1a	$49,450,000
	First Cost – Site 2	$57,633,000
	First Cost – Site 3	$57,105,000
	First Cost – Site 4	$54,513,000
	First Cost – Site 5	$52,490,000
	First Cost – Site 6	$55,655,000
CF-38	Expand capacity at DCC and screen the flow – 12,000 cfs	$369,383,000
	Expand capacity at DCC and screen the flow – 4,000 cfs	$140,583,000
DF-01	Vertical plate screen on the river	No Costs Developed
DF-27	Provide trash racks and culverts under levee to connect to head gates followed by canal filled by screen followed by pump station	No Costs Developed

SECTION 2

PROJECT DESCRIPTION

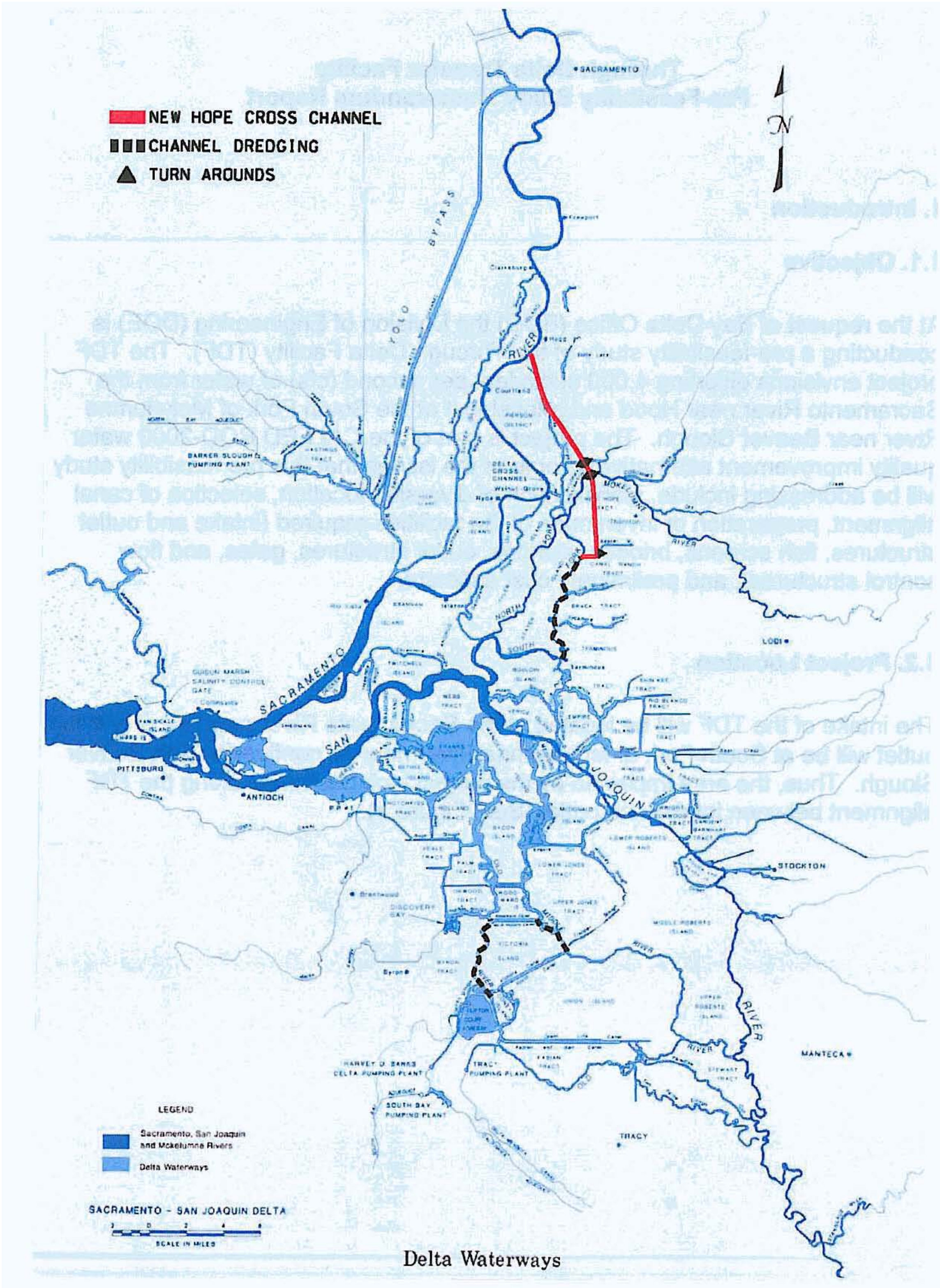
SECTION 2
PROJECT DESCRIPTION

The following description was taken from the Through Delta Facility Prefeasibility Study, Draft Memorandum Report, dated march 2007.

At the request of Bay Delta Office (BDO) the Division of Engineering (DOE) is conducting a pre-feasibility study of the Through Delta Facility (TDF). The TDF project envisions diverting 4,000 cubic feet per second (cfs) of water from the Sacramento River near Hood and releasing it at the South Fork of Mokelumne River near Beaver Slough. The project is part of the CALFED ROD-2000 water quality improvement alternative. Some of the issues that this pre-feasibility study will be addressing include, identification of diversion location, selection of canal alignment, preparation of inventories of the facilities required (intake and outlet structures, fish screens, bridges, siphons, outlet structures, gates, and flow control structures), and preliminary cost estimate.

The intake of the TDF will be located at the Sacramento River near Hood and the outlet will be at South Fork of Mokelumne River near its confluence with Beaver Slough. Thus, the area impacted by the project includes areas along the TDF alignment between intake and outlet (See, Figure 3-1).

Figure 3-1



Delta Waterways

TDF COMPONENTS

Canal Alignment

The proposed TDF alignment starts from Sacramento River near Hood and ends at South Fork of Mokelumne River, near Beaver Slough (See Figure 1). The total length of the canal is about 12 miles. Initially the TDF canal follows parallel with the abandoned Southern Pacific Rail Road track. Thus, the existing railway track could be used as one side of the embankment fill. At about 3.5 miles downstream of the intake, the TDF crosses the railroad track and Stone Lake Drain and enters Tract and

Major Components of the TDF

Intake Facility	Trash rack, fish screen, fish-bypass channel, low-head pumping plant, and flood gates
Outlet Structure	Energy dissipation device
Canal	Unlined canal (approximately 12 miles long)
Siphons	Stone Lake Drain, Lost Slough, and Mokelumne River
Bridges	Highway 160, Lambert Road, Southern Pacific Rail, Twin Cities Road, Lauffer Road, and Walnut Grove Thornton Road
Turn-Out Facility	None
Delta Slough Enlargement	Beaver Slough, South Fork Mokelumne River between Beaver Slough and Terminous Island

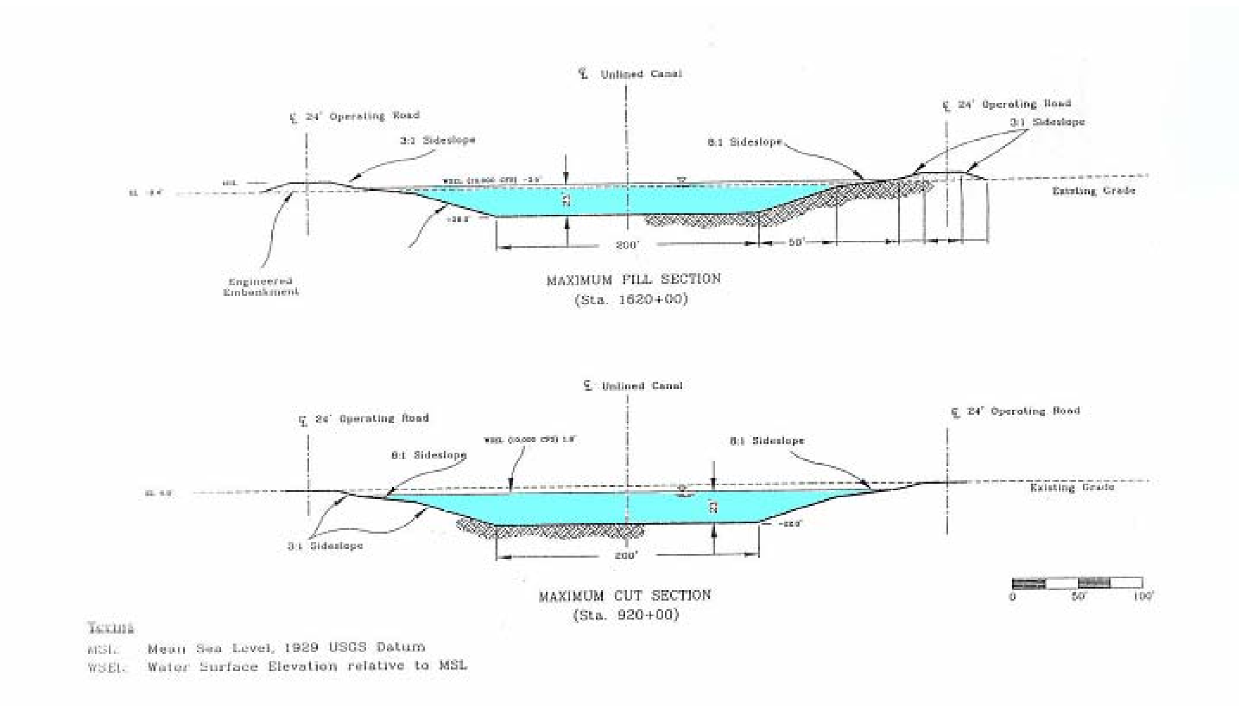
The TDF canal alignment was selected based on geological and foundation conditions for the construction of embankment, ease of alteration and relocation of existing facilities such as roads, and required location of the intake and outlet structures. Consideration was given to avoid developed areas, communication towers, sharp bends, wetlands, and places of historical importance along the TDF alignment. The shortest canal was preferred considering the anticipated canal construction cost and land acquisition cost. The alignment was selected to pass through or close to the properties owned by DWR. This will allow the DWR properties to be used as borrow pits. However, the right of way issues were not addressed at this stage.

The TDF alignment deviates from the earlier studied Peripheral Canal alignment. The Peripheral Canal followed an easterly alignment to allow excess borrow from the excavation to be used for the construction of the 1-5 freeway. Construction of 1-5 is already completed. Some of the borrow pits, excavated during the construction of 1-5, are still on properties owned by the DWR. However, these borrow pits have since filled with water and would probably be designated wetlands habitat making them more difficult to use for the TDF canal.

Canal Geometry

The TDF canal was designed to carry discharge of 4,000 cfs. The canal will be unlined and will have a trapezoidal section. To avoid the erosion of the embankment and canal bed maximum permissible velocity was limited to 2.5 ft/s. The inside of the canal will be sloped to 3H:1V. This slope will be maintained from the canal bottom to the embankment top. The entire slope of the back of the embankment will be sloped to 2H:1V. The longitudinal slope of the canal was set to 1 foot per 1,000 feet (0.0001) and Manning's n was set to 0.025. Under these conditions, the width of the canal at the base was about 110 feet. This shape will be provided throughout the TDF alignment except at bridges and siphons. At these locations a rectangular canal will be provided. The embankments on both sides of the canal will have 16-foot wide access roads with 3-foot shoulders. As a result the top width of the embankment will be 22 feet wide.

Throughout the alignment, the top of the embankment will be at least 4 feet above the maximum water surface elevation. This will provide freeboard against wind surges, embankment consolidation, subsidence, and erosion.



Outlet Sill Elevation

The Sacramento River near Hood and Mokelumne River near Beaver Slough channel cross sections were taken from the DSM2 model input data. The minimum elevation of channel bed for Sacramento River near Hood and Mokelumne River near Beaver Slough are -21 feet -13 feet, respectively (See, Figure 3-2). The primary objectives in the determination of the intake sill elevation were to minimize the entry of sediment into the canal, and also to minimize the width of the intake facility. The invert for the upstream intake at Hood was set to -12 feet elevation. This provides a clearance of about 9 feet between the average bed level of the river and the level of intake sill. This clearance was thought to be sufficient to exclude most of the sediments from entering the TDF canal. The invert of the outlet canal will be set at -10 feet elevation.

Sacramento and Mokelumne River Cross Sections

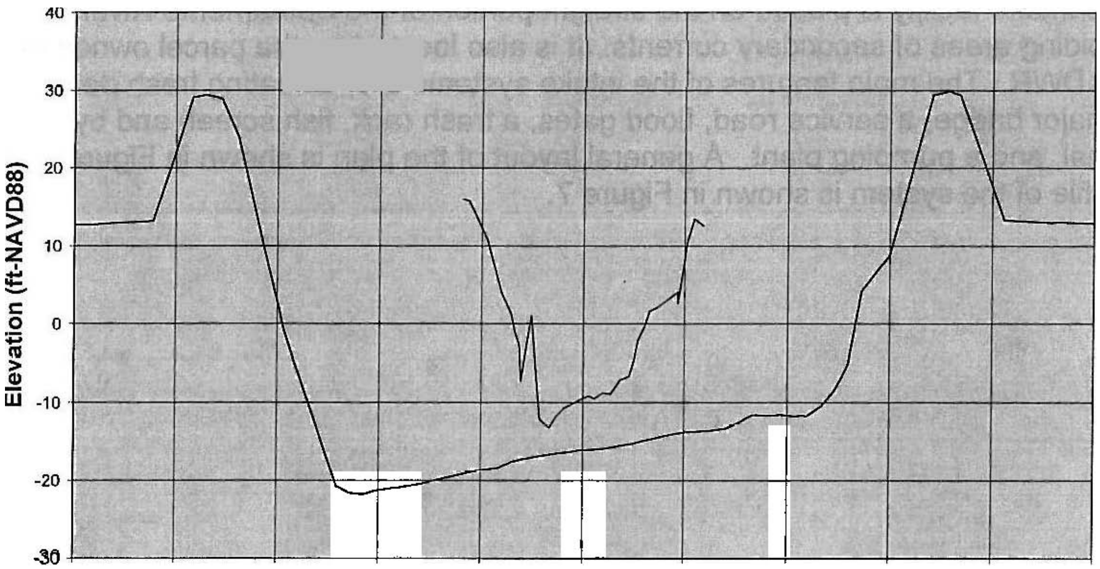


Figure 3-2: River Cross Section at Intake and Outlet

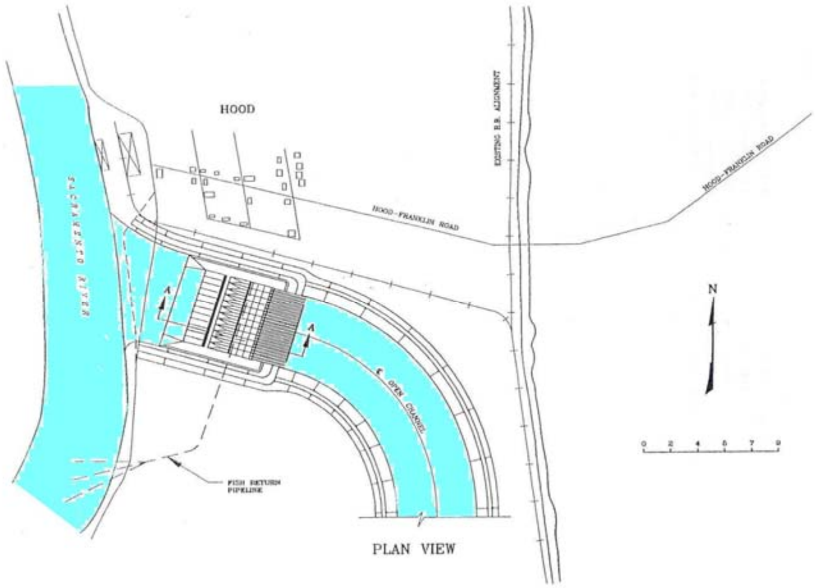
Embankment Top

The Sacramento River near Hood is approximately 700 feet wide and the tops of the levees are at about 30 feet elevation. The River levee top near Beaver Slough is at about 16 feet elevation (See, Figure 3-2). The top of the TDF canal levee will be at 30 feet elevation, and the intake and outlet sites will be at 10 feet elevation. This design prevents flood waters from entering the TDF canal and flooding the neighboring islands. On the interior side the engineered embankments will have 3H:1V side slopes. On the outer side the embankments will have a 2H:1V slope. Riprap slope protection will be placed on all embankments to avoid erosion from wind-wave action that could lead to embankment failure.

At other locations along the alignment, the top of the embankment will be at least 4 feet above the maximum water surface elevation. This will provide freeboard protection against wind surges, embankment consolidation, subsidence, and erosion. Where required, the height of the embankment will be increased to allow for additional subsidence and to provide sufficient freeboard for flood protection.

Intake Facility

The intake facility is placed on the straight portion of the Sacramento River, avoiding areas of secondary currents. It is also located on the parcel owned by the DWR. The main features of the intake systems are; a floating trash deflector, a major bridge, a service road, flood gates, a trash rack, fish screen and bypass canal, and a pumping plant.



Trash Deflector

Floating trash deflector will be used to stop the large debris coming into the Intake Facility. The floating deflectors will be supported by Dolphin piles upstream of Highway 160 bridge.

Floodgates and Bridge

Radial flood gates will be provided to isolate the intake from the Sacramento River during repair times. The gate structure will consist of 3 bays each having a clear spacing of 20 feet. The flood gates will not be used to regulate flow into the TDF. The regulation of flow will be done using the pumps. Along with the radial gates, a service bridge will be provided. The service bridge will provide support for motors and hoists. The bridge will support a trash rack on the downstream end.

Trashrack with Cleaning System

A trashrack with cleaning system will be provided to protect the fish screens and pumps against the incoming debris. The trash rack panes should be made of anti-fouling steel with a maximum clear opening of about *6* inch. The cleaning of the trashrack will be carried out by automated trash rack cleaning system. The trashrack cleaning machine may be fixed type, serving only one clearance or of movable type cleaning multiple racks along the intake. To reduce the operating costs, the operation of the cleaning machine may be automated.

Sediment Ponds

Sedimentation basin may not be provided for the TDF intake facility. It was expected that the sedimentation issue will be managed by the selection of intake sill and the permissible velocity in the canal. As explained earlier, the intake sill will be placed at -12 feet elevation whereas the average River bed elevation near intake site is -21 feet. The permissible in the canal was set to 2.5 ft/s.

This velocity was selected to maintain the canal regime. In addition, the intake area could be periodically dewatered and cleaned by closing the radial gates.

Fish Screen with Cleaning System

The fish screen facility is located immediately downstream of trash rack. The objective of the fish screen facility is to pass the design diversion flow, over a range of water levels, while protecting juvenile fish from entrainment, impingement, and migration delay.

The proposed screens will meet applicable design criteria set forth by the California Department of Fish and Game (DFG) and the National Marine and Fisheries Service (NMFS). Some of the pertinent criteria used to size the fish screen facility are shown below.

Approach velocity (Va):	0.33 ft/s
Sweeping velocity (6Va):	2 ft/s
Angle of inclination:	11 degrees
Canal velocity in front of fish screen system:	2.2 ft/s
Maximum fish exposure time in front of screen:	60 sec
Bar opening:	0.0689 inch

The fish screen design criteria are designed to protect the juvenile Salmon. The design criteria will be different if the screens are intended species are different. For example Delta Smelt. The proposed fish screens will be vertical profile bar type made of antifouling material. The screen will be equipped with automatic cleaning device to continuously clean and to prevent excessive debris buildup. To minimize the span of the fish screen facility, the screens will have V shaped configuration. The components of each fish screen facility will include a fish screen, cleaning device, adjustable baffles, debris collection and removal system, reinforced concrete box culvert structural section, and an access road.

Fish Bypass Channel

At the end of each fish screen, bypass will be provided to take the fish back to Sacramento River. The bypass channel will be 2 feet wide. The flushing velocity will be kept to about 5 ft/s so that the fish do not come back to the screen area. To maintain the desired velocity each bypass channel will have its own pumping unit. The pumps are also required because of the location of the project in a tidally influenced area. The capacity of pumps will be about 60 cfs. The outlet of the bypass channel will be taken to areas so that the migrating fish are not consumed by predator species. To minimize flow through bypass channel, secondary fish screen could also be provided.

Fish Ladder

At this stage of design, there is no fish ladder in the intake site. A fish ladder could be provided to help the migrating fish to pass around the pump. It is expected that the TDF will not be operated during the Salmon migrating season, similar to that of Delta Cross channel. This will preclude the need of providing fish screens.

Pumping Plant

Both the intake and outlet facilities are located in tidally influenced areas. As a result, to deliver the design flow of 4,000 cfs flow over constantly changing head, pumps are required. Pumping plants are located on the downstream of fish screen. The pumps were designed for an average delivery head of 8 feet, which falls in the low head range. The pumping plant consists of five pumping units, with a capacity of 833 cfs each, totaling a maximum pumping capacity of 4,165 cfs. This combination of pump sizes will allow flexibility in operations when needed. Axial pumps, which are suitable for low head and high discharge, will be suitable for these conditions. The pump delivery head keeps changing constantly, so the pumps should be selected such that its efficiency remains near constant for a wide range of delivery head.

The pumping plant is a reinforced concrete sub-structure, steel superstructure equipped with a gantry crane. A formed suction intake (FSI) will be mounted to each pump below the impeller to eliminate vortex formation in front of the pump. The size of the pumping units could be changed in the later stage considering operational flexibility and submergence requirement. Usually, smaller pumps have lower submergence requirements than the larger pumps. The pump type will be self-priming type with no vacuum system required. This will make easier for remote operation of the pumps. Stop gates will be provided in front of each pumping plant intake. This will allow individual pumping units to be shut down and while the rest of the units continue operating.

Other Structures

Siphons

Three siphons (Stone Lake Drain, Lost Slough, and Mokelumne River) will be provided to isolate the TDF canal flow from the natural drainages. The discharge from the Stone Lake will be siphoned underneath the TDF canal. The Lost Slough and Mokelumne River siphons will pass the TDF canal water underneath these channels. The TDF canal embankment will be strengthened to prevent exchange of water between TDF canal and major drainage channels, particularly during high flows. All siphons will be sized to keep the sediment from depositing. They will have a minimum velocity of 5 ft/s. Both upstream and downstream ends of the siphons will have trash boom, transition structures, and protection.

Bridges

A total of six bridges will be provided along the TDF alignment, Highway 160, Lambert Road, Southern Pacific Railway, Twin Cities Road, Lauffer Road, and Walnut Grove-Thornton Road. The bridge on Highway 160 is a major bridge whereas the remaining are county road bridges. Locations of bridges and siphons along the alignment are given below.

Major Bridges and Siphons along the TDF alignment

Structure	Approximate Location	Remark
Highway 160 Bridge	0	Major highway, 4-lane bridge
Lambert Bridge	3.3	County Road, 2 lane bridge

Structure	Approximate Location	Remark
Southern Pacific RR Bridge	3.4	One track railway crossing
Stone Lake Drain Siphon	3.6	Siphon, approximately 500 ft long to divert Stone Lake Drain
Twin Cities Bridge	6.4	Major County Road, 2 or 4 lane bridge
Lost Slough Siphon	7.0	Siphon to drain Mokelumne River
Mokelumne Siphon	8.3	Siphon to drain Mokelumne River
Lauffer Bridge	9.6	County road, 2 lane bridge
Walnut Grove Road Bridge	10.3	Major county road, 2 or 4 lane bridge
Outlet Structure	11.8	

Outlet Structure

The TDF outlet is located at the South Fork of Mokelumne River, near its confluence with Beaver Slough. The location of outlet structure was decided by the project need. The Outlet structure was designed to release the 4,000 cfs of flow. The main feature of the outlet will be a floor to prevent scouring. Since the pumps upstream control the inflow into the canal, no flow gates are provided at outlet.

Passages to the migrating and local Delta fish species is critical with any projects located in Delta. If it is thought that the migrating fish are confused by the operation of the TDF, then fish control gates would be needed at the outlet facility. If the gates are provided at the outlet facility then fish collection and handling facility might also be required.

Canal Seepage

The ground water elevation of the area is close to the existing ground level, so there will be some exchange of mass between field and canal. The seepage from the canal is expected to diminish with time because of the settlement of sediments in the canal.

Utilities Relocation

There is no major relocation of existing utilities along the TDF alignments. At this point there is no detailed information for the underground cables or gas pipelines requiring relocation.

Delta Channels

To transfer the water to the state and federal pumping plants, this plan uses new canal as well as the existing Delta Sloughs. However, the existing Delta Sloughs will be subjected to high flows for a sustained period. This could impact on channel erosion, sedimentation, and levee stability. In order to handle the increase flow in the Delta channels, the plan may possibly require enlargement of Beaver Slough, and South Fork Mokelumne River between Beaver Slough and Terminous. The plan will also require strengthening of several Delta Levees. Since the Delta levees are built on soft peat soil, they are vulnerable to failure and the overall reliability and integrity of the water transfer system is poor.

Operation and Maintenance Issues

The main operation and maintenance issues include embankment maintenance, pumps, trash racks and fish screens maintenance, seepage system monitoring, weed control, fisheries monitoring, Delta Levee maintenance, and bridge and siphons monitoring.

PROJECT COST

The preliminary estimated cost of the TDF project is 360 million dollars. This cost estimate excludes cost for cultural resources preservation associated with mitigation and recovery. The estimate also excludes estimates for relocations, land and right of ways, engineering design, supervision and administration, and project indirect cost (such as, project staff, job site facilities, utilities, and equipment). The construction cost estimate for each component is summarized below.

Itemized Construction Cost for TDF

Item	Cost ($1000)
General (mobilization and demobilization)	8,736
Inlet Structure	43,948
Pump Station	58,814
TDF Canal	87,420
Siphons	13,790
Bridges	33,751
Outlet and Misc. Structures	3,941
Subtotal	250,400
Contingency	100,160
Total	350,560
Rounded Total	360,000

CONCLUSIONS AND RECOMMENDATIONS

The TDF project envisions diverting 4,000 cfs of Sacramento River water to South Fork of Mokelumne River. The project components include an intake facility, approximately 12 mile long unlined canal, three siphons, six bridges, and an outlet structure. The pertinent facilities in the intake include a trash boom, floodgate, trash rack, fish screen, bypass channel, and a pumping plant.

The pre-feasibility level study concludes that based on the present evaluations the TDF project construction is possible with an acceptable engineering risk. The estimated cost of the project is $360 million.

At this pre-feasibility level, the conclusions are based on limited hydrological, topographical, and physical data. Further steps in the design and engineering analyses should include detailed field surveys of the alignment, geological investigations, and right of way investigations.

SECTION 3

VALUE STUDY PROCESS

SECTION 3
VALUE STUDY PROCESS

This section describes the process used to conduct this Value Study and the significant findings of the Value Team. This Value Study used the international standard Value Methodology established by SAVE International, the Value Society. The standard establishes the specific 6-Phase, sequential process, and the objectives of each of those phases, but does not standardize the specific activities in each phase.

Value Methodology (VM) is the general term that describes the structure and process for executing the Value Workshop. This systematic process was used with a multidisciplinary team to improve the value of the project through the analysis of functions and the identification of targets of opportunity for value improvement.

The **VM Job Plan** provides the structure for the activities associated with the Value Study. These activities are further organized into three major stages:

1. Pre-Workshop preparation
2. VM Workshop
3. Post-Workshop documentation and implementation

Figure 3-2 at the end of this section shows a diagram of the VM Job Plan used for this Value Study.

DEFINING VALUE

Within the context of VM, Value is commonly represented by the following relationship:

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

In this expression, functions are measured by the performance requirements of the customer, such as mission objectives, risk reduction, and quality improvements. Resources are measured in materials, labor, price, time, etc. required to accomplish the specific function. VM focuses on improving Value by identifying the most resource efficient way to reliably accomplish a function that meets the performance expectations of the customer.

It can be seen from this relationship that Value is improved or increased by:

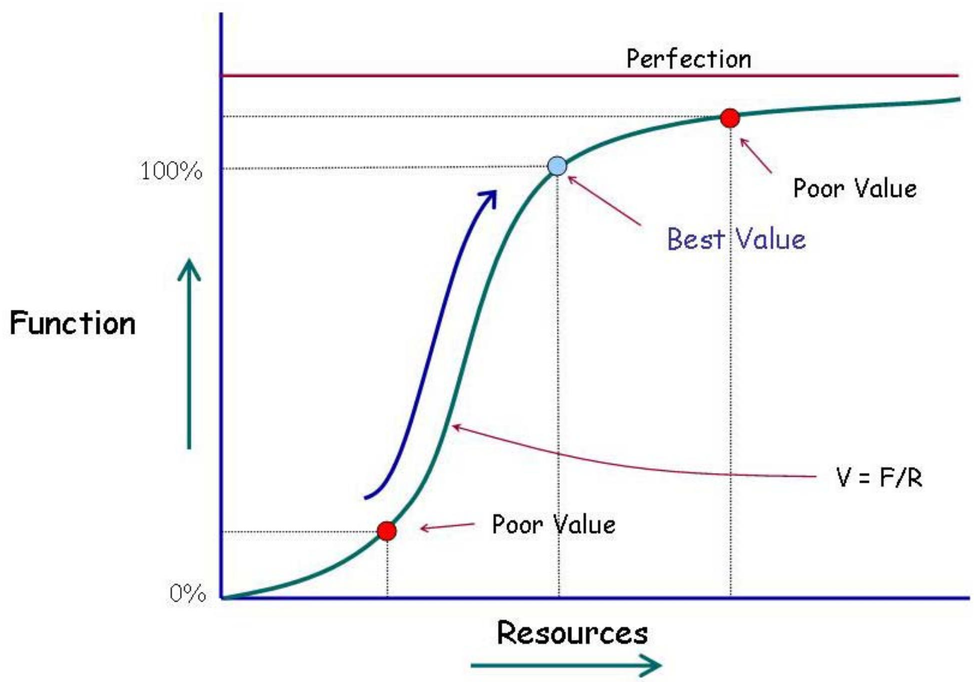
1. Increasing function without increasing resource consumption. Some increase in resources is acceptable as long as there is a greater increase in function performance.
2. Decreasing resources without decreasing function. Again, some decrease in function may be acceptable if the corresponding decrease in resources is significant enough.

Ideally, the Value Team looks for opportunities to increase function and concurrently decrease resource requirements. This will achieve the best value solution.

This Value concept is illustrated in the Figure 3-1, The Value Curve. This figure shows a hypothetical curve from plotting the value expression above. This curve will asymptotically approach perfection. The best value solution for a given project or project element will be found at the knee of the curve. At this point, the required function or functions have been achieved to 100 percent of the required level with a corresponding minimum resource commitment. To attempt to increase the function performance beyond this level will result in a resource consumption that has a higher worth than the marginal increase in function. This results in a poor value solution. Conversely, a poor value solution can also be the result of not achieving the function to 100 percent of the requirement. In this case, an incremental increase in resources delivers significant increase in function performance. The Value Methodology is used to identify the poor value decisions in a project and then develop alternative solutions to better align the project along this curve to achieve a best value solution.

Figure 3-1

The Value Curve



The understanding of how Value is affected by changes in function or resources provides the foundation for all SVS Value Studies. The following paragraphs describe the process we used to understand the functional requirements and how we identified value improvement alternatives.

PRE-WORKSHOP

Prior to the start of the workshop, the team was tasked with reviewing the most current documentation on the project development. This was done to familiarize them with the project plan and to prepare them for asking questions of the project stakeholders during the project presentations at the beginning of the workshop. Much of the background information for this study was generated by DWR in-house staff. Other pre-workshop activities included:

- Coordinating workshop logistics and communicating those to the various participants
- Providing guidance to DWR on presentation content for the project introduction
- scheduling workshop participants and assigning tasks to ensure the team is prepared for the workshop
- gathering necessary background information on the project and making sure project documentation is distributed to the team members

Materials furnished to the team by DWR are listed in the Appendix.

VM WORKSHOP

The VM workshop was an intensive session during which the project plan was analyzed to optimize the balance between functional requirements and resource commitments (primarily capital and O&M costs).

The VM Job Plan used by SVS includes the execution of the following phases during the workshop:

1. Information Phase
2. Function Analysis Phase
3. Creative Phase
4. Evaluation Phase
5. Development Phase
6. Presentation Phase

Information Phase

At the beginning of the workshop, it was important to understand the background of the project from which the plan was developed. This background was provided in an oral overview by DWR. The overview and subsequent project analysis provided information on the following topics:

From these presentations, the Value Team noted the following key information:

- The Hood diversion location was the original diversion location for the Peripheral Canal

- The Peripheral Canal was the preferred alignment to accomplish the function of improving water quality at the export locations but the 23,000 cfs diversion of the Sacramento River was unacceptable to the voters. Therefore, CALFED has reformulated the scope of the project to something more acceptable to the voters.

- The ROD given to DWR by CALFED requires the diversion from the Sacramento River to be located between Hood, CA, and Walnut Grove, CA. The ROD also mandates a maximum diversion of 4,000 CFS.

- The US Bureau of Reclamation is in the planning phase for a renovation/re-operation plan for the Delta Cross Channel

The DWR project management presentation provided the team with an overview of the goals, issues, and expectations for the project. DWR and the Value Team also finalized the Value Study constraints. This was followed by DWR's project development team's presentation that is more detailed on the project plan and an explanation of the rationale behind key plan decisions. Further, this gave the project development team an opportunity to share their issues and concerns about the project from their perspective.

Project Cost Analysis

The Value Team was provided a summary level nine item construction cost estimate as part of the project Draft Memorandum Report dated March 2007. In addition, a recent more detailed estimate prepared by the DWR was provided in support of these numbers. A document entitled "Isolated Facility Incised Canal Bay-Delta System, Estimate of Construction Costs," dated August 2006 was also provided. These two documents were compared with other cost information provided with various team members. Overall "building block" type costs were developed for intake structure/fish screens, pumping station, various bridges, various siphons, canal cost per mile, and outlet

As a part of this workshop, the team developed individual conceptual layout of facilities for eight different alternative configurations. The above construction building block costs were applied according to each alternative configuration. These conceptual estimates can be utilized in the future by DWR to access other alternatives.

The Value Team has developed nine comparative construction cost estimates as part of the project documentation. This estimate indicated an anticipated construction cost ranging from $151 million to $368 million depending on the configuration. All estimates are based on current prices and include a 30 percent contingency.

As a part of this workshop, the team reviewed the following items. The review verified the reasonableness of the:

- ☒ estimated quantities
- ☒ estimated unit costs
- ☒ estimated contingencies
- ☐ overall project cost

This was done to ensure that the value team had reliable data to use as the basis for cost comparisons of alternatives.

Review of the costs included comparison of unit prices to recently received prices for similar projects and to published unit price indices. Unit prices for unique project elements were compared to prices based on applicable crew compositions and production rates. Adjustments were made where appropriate to bring unit prices and quantities into conformance with the current design documents and presentation information provided to the value team.

A complete review of the estimate's supporting backup data was not attempted due to time limitations and availability of information; however, limited reviews were made of some quantities for the larger cost items within the estimate.

Function Analysis Phase

Function Analysis is the heart of the VM process and is the key activity that differentiates the VM process from other problem solving or improvement practices. During the Function Analysis Phase of the VM Job Plan, functions are identified that describe the expected outcomes of the project under study. Function Analysis also defines how those outcomes are expected to be accomplished by the plan. These functions are described using a two-word active verb and measurable noun pairing.

This identification and naming convention of project functions enables a more precise understanding by limiting the description of a function to an *active verb* that operates on a *measurable noun* to communicate what work an item or activity performs. This naming convention also helps multidisciplinary teams to build a shared understanding of the functional requirements of the project.

Function Determination

Defining functional requirements for the project allowed DWR to be sure that the facility, as planned, would fulfill the needed purposes. The entire project was analyzed to determine what functions are being accomplished by the current plan. Required functions were retained. Some functions were not necessary to accomplish the mission of the project and thus became candidates for deletion.

During the Function Analysis Phase, the Value Team used various function analysis techniques to analyze the project. This analysis helped the team confirm its understanding of the overall project objectives and analyzed the functions of key project elements. The Value Team Leader led the team through an in-depth discussion of the possible functions of each key project element to clearly and precisely identify the purposes of each.

FAST Diagram

Function analysis was enhanced by using a graphical mapping tool known as the *Function Analysis System Technique* (FAST), which allows team members to understand how the functions of a project relate to each other. The resulting FAST Diagram allowed quick visualization of the logical relationship between project functions and the project as a whole. The FAST diagram is in the Function Analysis section of the Appendix.

The FAST Diagram is structured such that moving to the right of any function answers the question, "How are we accomplishing this function?" Moving to the left of any function answers the question, "Why are we accomplishing this function?" Elements that are vertically connected occur "When" or as a consequence of the function it is connected to on the horizontal path.

The diagram shows on the far left that the ultimate function or the mission that must be accomplished by this project is to Meet Record of Decision handed down by CALFED. This is accomplished by Improving Water Quality and by Protecting Fish. Water quality must be improved by reducing salinity. This is accomplished by reducing saltwater intrusion into the Delta by increasing the net outflow in the San Joaquin River. To increase the fresh water flow into the Delta, we must divert 4,000 cfs from the Sacramento River.

To protect fish we must reduce predation, reduce delay in the migration process, and to prevent injury to the fish as they migrate both upstream and downstream. Predation is reduced by reducing any potential advantage for the predatory fish. Delay in the migratory path is prevented by reducing confusion for the fish by preserving the migration corridor.

The functions between the two dashed lines, called Scope Lines, represent the functional elements of the project that are within the scope of the Value Study. The first column of functions (basic functions) within the left Scope Line represents the functions that must occur in order for this project to accomplish its mission. The remaining functions (secondary or support functions) represent how the current plan has chosen to accomplish those basic functions.

Function Findings

From the function analysis of this project, the team concluded that:

- Protecting the fish is a significant consideration in the design and operation of the new diversion. This also has significant cost implications.

- Water quality will be improved by introducing more Sacramento River water into the Delta, which will have the effect of increasing the net outflow of water from the Delta and thus reduce the amount of saltwater intrusion from the bay.

- A 4,000 cfs diversion of the Sacramento River will only leave about 8,000 cfs in the river.

DWR has conducted their initial plans and cost estimates based on a 0.33 fps approach velocity on the fish screens but other recent work further upstream on the Sacramento River has been required to use 0.2 fps by the California Fish and Game.

Creative Phase

This step in the VM process involved generating ideas using creativity techniques. The team recorded all ideas regardless of their feasibility. In order to maximize the Value Team's creativity, evaluation of the ideas was not allowed during the creative phase. The team's effort was directed toward a large quantity of ideas. These ideas were later screened in the Evaluation Phase of the workshop.

The creative ideas generated by the team are included in the Appendix. The list also includes ratings for each idea based on the Evaluation Phase of the workshop. These lists should be carefully reviewed, as there may be other good ideas not developed by the team because of time constraints. These should be further evaluated or modified to gain the maximum benefit for the project.

Evaluation Phase

In this phase of the workshop, the team selected the ideas with the most merit for further development.

After an initial vote, the Value Team Leader assessed how many ideas could be developed into Value Alternatives within the remaining duration of the workshop. From this assessment, all ideas with a certain number of votes were selected for development. However, prior to the final selection, all of the ideas were revisited collectively by the Value Team to ensure that those selected by the voting process truly represented the best ideas for development. This gave the team the opportunity to down-rate some ideas and to up-rate other ideas based upon team discussion of the ideas.

The criteria used for selection were:

1. the inherent value, benefit and technical appropriateness of the idea
2. the expected magnitude of the potential cost savings, both capital and life cycle
3. the potential for DWR acceptance of the idea

Ideas were selected for development as Value Alternatives based on all three criteria.

Other ideas were selected for development as design suggestions based primarily on the first and third criteria rather than for cost savings. Some design suggestions may save costs, others may increase costs, and the cost impact of some could not be predicted adequately with information and time available to the team. Not all ideas were developed. This evaluation process is designed to identify those ideas with the greatest potential for value improvement that can be developed into Value Alternatives within the time constraints of the workshop and the production capacity of the team.

The remaining ideas were eliminated from further consideration by the team; however, the ideas not developed should also be reviewed, as there may still be other good ideas not developed by the team because of time constraints or other factors. These could be further evaluated or modified to gain the maximum benefit for the project.

To ensure the Value Team is focused on developing the best ideas, a mid-point review meeting is conducted with the Value Team Leader and DWR representatives. This mid-point review allowed DWR to identify any fatal flaws in the ideas that were not apparent to the Value Team but were apparent to DWR project team because of their greater institutional knowledge of the project. These fatal flaws may be technical, operational, political, etc.

Development Phase

During the Development Phase of the workshop, each idea was expanded into a workable alternative to the original project concept. Development consisted of preparing a description of the value alternative, evaluating advantages and disadvantages, and making cost comparisons.

Each alternative is presented with a brief narrative to compare the original concept and the alternative concept. Sketches and brief calculations were also developed, if needed, to clarify and support the alternative. The value alternatives developed during the workshop are presented in Section 4 – Value Improvement Alternatives.

The Value Team Leader and, to the extent possible, other team members reviewed each alternative to improve completeness and accuracy.

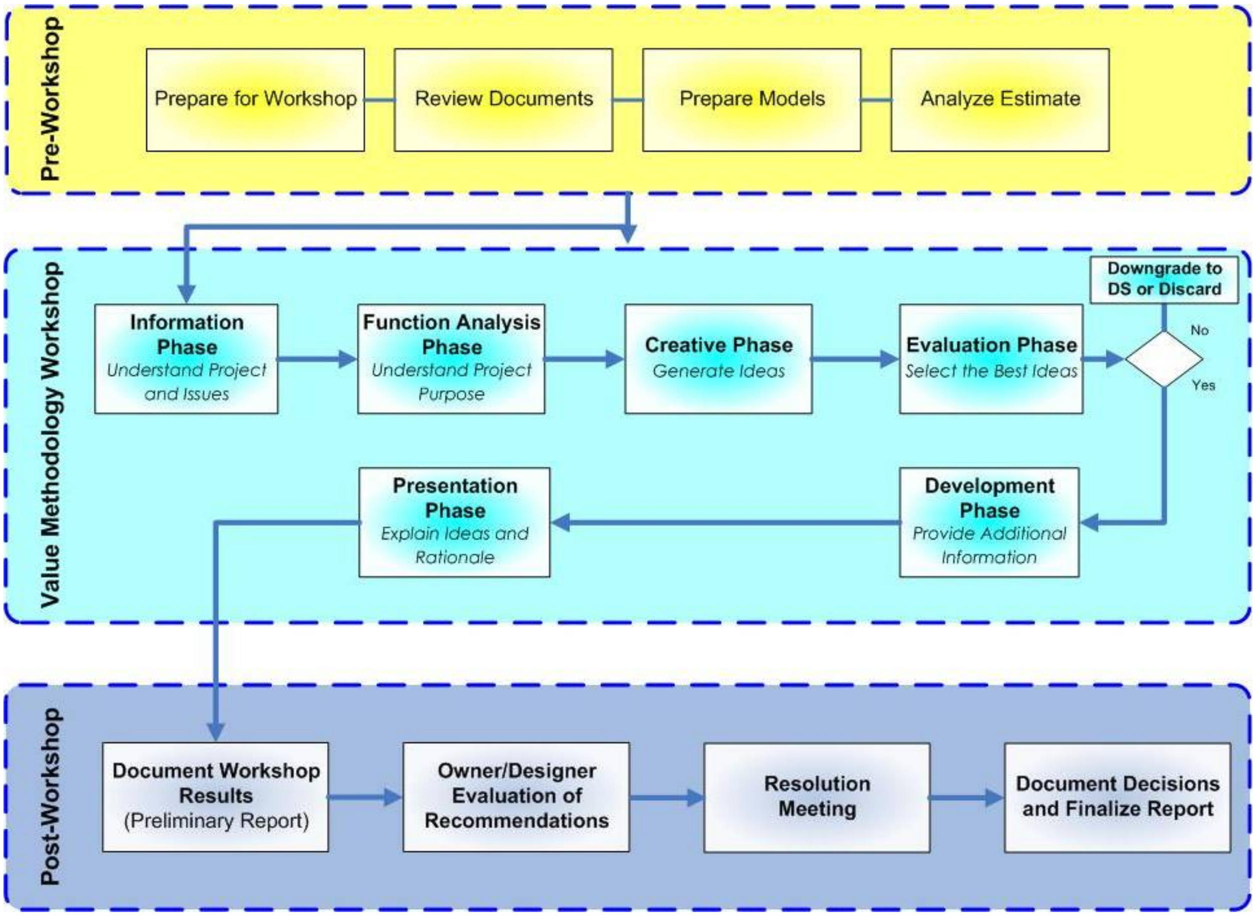
Redesign costs are not included in the cost comparison of alternatives. DWR will be responsible for determining these costs.

POST-WORKSHOP

The Post-Workshop activities of this Value Study consisted of preparing the Value Study Reports and coordinating with DWR to help them make decisions regarding the acceptance of the value alternatives.

Shortly after the conclusion of the workshop, our Preliminary Report was submitted to DWR for review. Upon receipt of the report, DWR's project team analyzed each Value Alternative.

FIGURE 3-2
VALUE ENGINEERING PROCESS DIAGRAM



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SECTION 4

VALUE IMPROVEMENT ALTERNATIVES

SECTION 4
VALUE IMPROVEMENT ALTERNATIVES

The results of this Value Study represent the value improvement opportunities that can be realized on this project. They are presented as individual alternatives for specific changes to the current plan.

Each alternative includes:

- a summary of the original concept
- a description of the alternative concept
- a brief narrative comparing the original plan and the recommended change
- sketches, where appropriate, to further explain the alternative
- calculations, where appropriate, to support the technical adequacy of the alternative
- a capital cost comparison
- and a life cycle cost analysis, if appropriate

Cost was the primary resource that was compared to the functions being accomplished in the project. To ensure that costs were compatible within the Value Alternatives proposed by the team, the validated cost estimate was used as the basis of cost.

ORGANIZATION OF ALTERNATIVES

The alternatives presented on the following pages are organized by project or functional categories, and then numerically within each of those categories. The divisions used to organize the alternatives are as follows:

CF – Convey Flow

DF – Divert Flow

G – General

These designations have been used throughout the VE process to organize the ideas.

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Convey Flow (CF)

Value Alternative

Project: Through Delta Facility
Location: Sacramento, California

Alternative No:
CF-04

Title:
Divert at Hood, open channel to Lost Slough with reduced footprint

Description of Original Concept:

Divert 4,000 cfs of water from the Sacramento River at Hood and release it at the South Fork of the Mokelumne River at Beaver Slough. Use trapezoidal channel as show in TDF memorandum.

Description of Alternative Concept:

The Alternative Concept reduces the conveyance footprint and shortens the channel. Similar EC reductions are expected at the pumps at substantially less cost. Implement feasible measures to reduce the channel cross section – minimize right-of-way acquisition and environmental, social, and economic costs.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☒ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost: $358,936,000

Advantages/Disadvantages

Alternative No.: CF-04

Advantages of Alternative Concept

- Reduces cost by eliminating 40 percent of channel length, two siphons, and one bridge
- Reduces environmental impact by eliminating the above infrastructure and reducing width
- Eliminates severance of agricultural facilities and operations on New Hope Tract
- Eliminates need to address severe constraints on McCormack-Williamson Tract (towers, flood flows, habitat)
- “Vests” infrastructure improvements along Peripheral Canal corridor

Disadvantages of Alternative Concept

- Reduced water quality benefit – need to verify amount (similarity assumed)
- Delivers flows to area with hydrologic constraints (how constrained?)
- Uses Peripheral Canal alignment for a “different” project
- Will cause backwater at DCC and reduce its capacity to divert Sacramento River flows (may not be significant)

Discussion

Alternative No.: CF-04

This alternative reduces the footprint of the project (both length and width). Five potential discharge points above Beaver Slough were considered:

1. Mokelumne River at the southern edge of McCormack-Williamson Tract – approximately an eight-mile channel

2. Lost Slough north of McCormack-Williamson Tract – approximately a seven-mile channel

3. Snodgrass Slough north of Twin Cities Road – approximately a six-mile channel

4. Stone Lakes outlet – approximately a 3.5-mile channel, and

5. Railroad Slough north of Stone Lake – less than a one-mile channel.

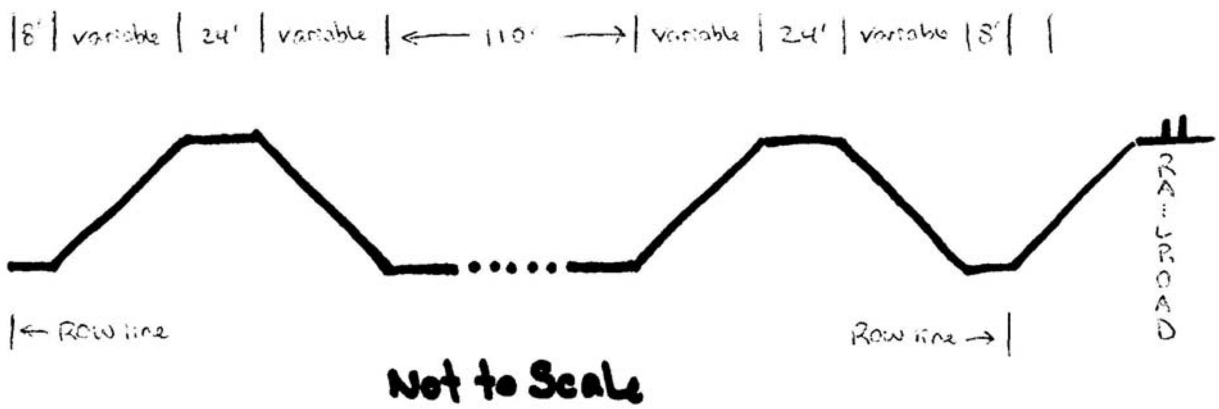
Based on our cursory review, the team selected the Lost Slough discharge location. This would shorten the TDF channel by about 40 percent, and would eliminate the Walnut Grove Road Bridge and the Lost Slough and Mokelumne River siphons. Based on input from DWR, this alternative incorporates the significant assumption that shortening the TDF channel would not compromise the overall project objective to reduce export salinity. This needs to be confirmed. In addition, the hydrodynamic effect on the Delta Cross Channel needs to be studied.

The proposed channel geometry results in a very wide footprint – we propose a smaller channel to minimize the economic and environmental consequences of the original footprint. Based on the typical cross-section described in Section 3.2 of the March 2007 Draft Memorandum, the proposed canal width (right-of-way line to right-of-way line) is over 300 feet and could be up to 500 feet. Various strategies could be used to reduce the channel cross sections, including: (1) using the existing railroad embankment as the channel embankment, and (2) providing two-way vehicle traffic on one embankment only. These modifications would result in a 10-15 percent reduction in overall width. Additional reductions associated with the channel itself, for example, armoring to allow higher velocities and steeper slopes, were deemed cost prohibitive but should be considered during the predesign phase.

Sketch

Alternative No.: CF-04

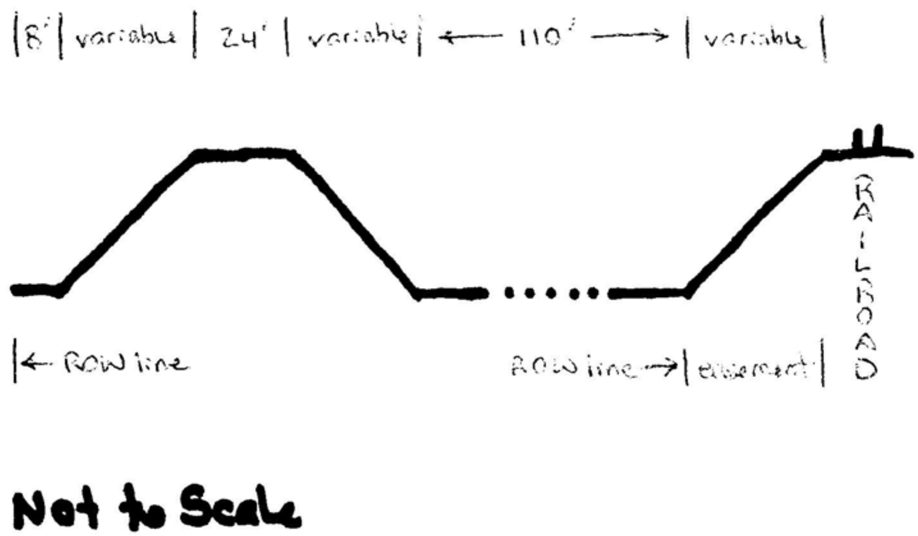
☒ Original ☐ Alternative



Sketch

Alternative No.: CF-04

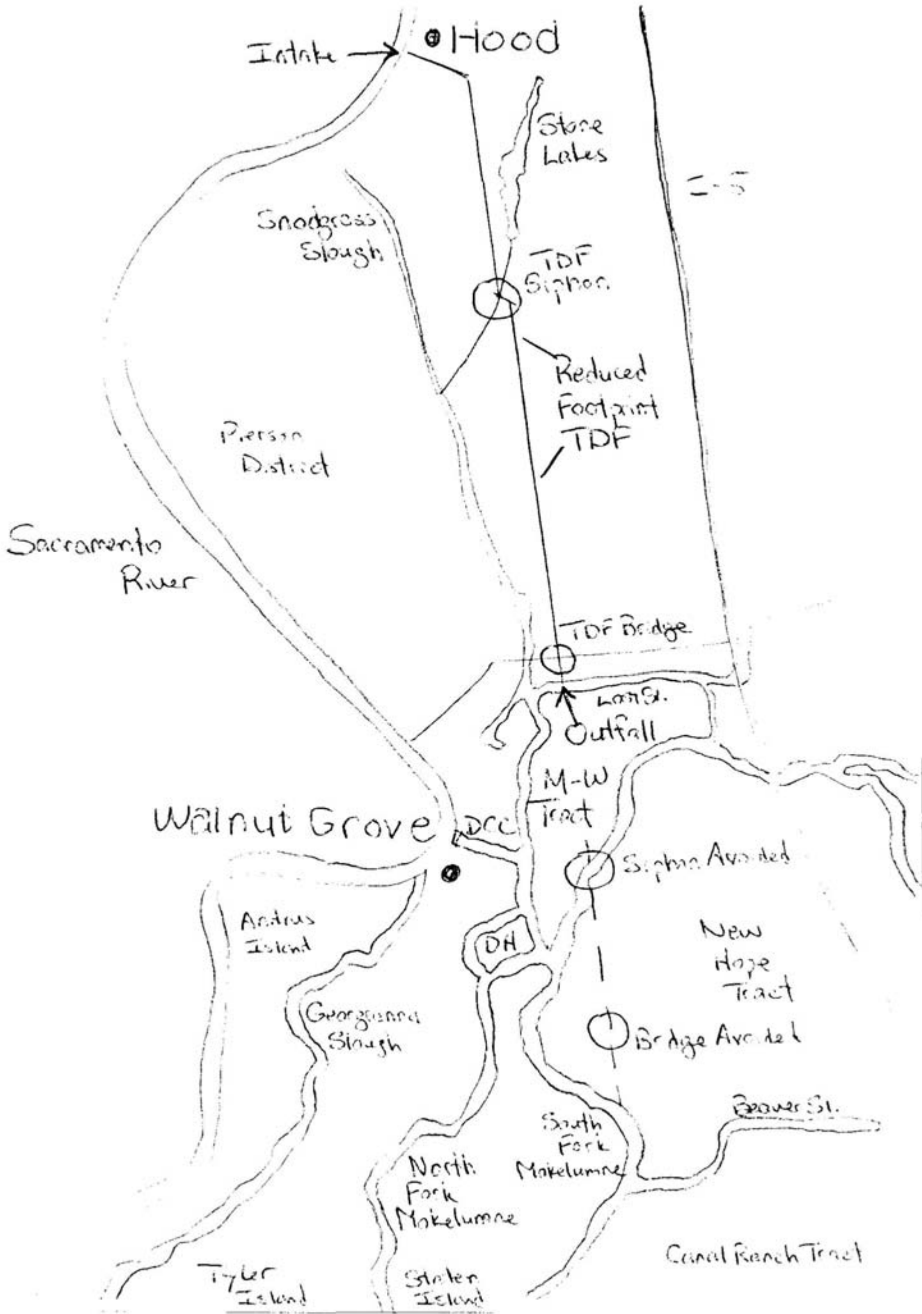
☐ Original ☒ Alternative



Sketch

Alternative No.: CF-04

☐ Original ☒ Alternative



Construction Cost Estimate

Alternative No.: CF-04

Through Delta Transfer Facility				3/28/2007
Alternative CF-4, Divert @ Hood, Open Channel to McCormick & Williamson Tract				
Item	**Quantity**	**Unit**	**Unit Price**	**Total**
Mobilization & General Conditions			12%	29,582,602
Inlet Structure/Screens	1	ls		113,000,000
Pump Station	1	ls		30,000,000
TDF Canal	7.02	miles	8,000,000	56160000
Stone Lake Siphon (Snodgrass)	1	ls		6,000,000
Lost Slough Siphon	0	ls		0
Mokelumne River Siphon	0	ls		
Hwy 160 Bridge	1	ls		8,520,683
Lambert Road Bridge	1	ls		6,800,000
Twin Cities Road Bridge	1	ls		6,100,000
Walnut Grove Road Bridge	0	ls		0
Outlet and Miscellaneous Structures	1	ls		19,941,000
			Subtotal	**276,104,285**
	Contingency		30%	82,831,285
			Total Estimated Cost	**358,935,570**

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Value Alternative

Project: Through Delta Facility
Location: Sacramento, California

Alternative No:
CF-10

Title:
Intake structure north of Walnut Grove/Locke

Description of Original Concept:

The original concept involves a 4,000 cfs intake at the Hood with a discharge to South Fork of the Mokelumne River near Beaver Slough. The project includes the following components:

- Intake facility including trash rack, fish screen, fish bypass channel, low-heat pumping plant, and flood control gates.
- Outlet Structure with energy dissipation device with fish screen/barrier
- Unlined canal approximately 12 miles long
- Reinforced concrete box culvert siphons at Stone Lake Drain, Lost Slough, and Mokelumne River
- Five roadway bridges
- Delta slough enlargement of various waterways

Description of Alternative Concept:

This concept includes a fish screen on the river, reinforced box culvert through the levee section, a forebay, trash rack; low head pump station (except Alternative B), floodgate, multiple pipes to the Mokelumne River, and an outlet structure. The length of the conveyance system will vary depending on the discharge point selected. Three alternative alignments were developed. Alternatives A, B, and C would discharge to Mokelumne River, Snodgrass Slough, and the South Fork Mokelumne River, respectively.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☒ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost – Option A:	$389,861,000
First Cost – Option B:	$232,556,000
First Cost – Option C	$450,431,000

Advantages/Disadvantages

Alternative No.: CF-10

Advantages of Alternative Concept

- Each of the alternatives would result in a project cost reduction
- Reduces required right-of-way and associated environmental and economic impacts
- Concept does not use the site at Hood which may be needed in the future for the Peripheral Canal
- Leaves 4,000 cfs in the Sacramento River from Hood to the Town of Locke

Disadvantages of Alternative Concept

- Possible reduction in benefit to export water quality
- Possible greater public/environmental impacts
- Possible impacts to the hydraulics of the Delta Cross Canal

Discussion

Alternative No.: CF-10

Intake/Fish Screen

For this alternative, either an in-channel fish screen (multiple vee's) or an on-river fixed plate fish screen could be installed. For the purposes of evaluation of this concept, we assumed an on-river fixed plate screen. The fish screen facility would include an approximately 1,200 foot long by 20-feet-deep screen, which would provide a screen approach velocity of 0.2 fps. The screen would be designed to meet design criteria recommended for the TDF presented on page 19 of the Through Delta Transfer Facility Pre-feasibility Study with the exception that the screen facility would not meet the 60-second exposure for fish on the fish screen.

Refer to Figure 2 for a plan view of the fish screen facility and Figure 3 for a cross section of the proposed facility.

The fish screen facility would include 67 bays, each 15-feet wide, and 20-feet deep. Blowout panel(s) would be provided as an emergency hydraulic relief system in the event of high differential head between the river and the forebay. The length of the screen depends on the characteristics of the river (i.e., depth, channel geometry, etc.) and final design flow.

Levee Penetration

Penetration of the levee on the Sacramento River will be governed by the State Reclamation Board and the Corps of Engineers. The issues will be the same for all of the alternatives. These issues could require that flow be pumped over the top of the levee. Pumping over the levee crest would be very expensive and should be avoided to conserve energy. A flow line route for the levee penetration is preferred. In either case there will need to be shut off gates on both sides of the levee.

Pumping Plant

A pumping plant would be required for discharge to the Mokelumne River (Alternative A) or a discharge to the South Fork of the Mokelumne River (Alternative C). The pump station would include a trash rack and five pumping units, with a capacity of 833 cfs each, totaling a maximum pumping capacity of 4,165 cfs. The pumps would be axial flow pumps with the heads varying depending on the alternative selected.

Discussion (cont.)

Alternative No.: CF-10

Conveyance System

Alternative A. The conveyance system would be approximately two miles long would include three 13-foot-diameter pipelines between the intake and Snodgrass Slough, two tunneled waterway crossings, and 2,600 feet of earthen canal. An alternative to the piped section may be a reinforced concrete box culvert or open canal. The water crossings could be constructed using multiple tunnels as we assumed it would not be possible to construct these crossings in the "wet."

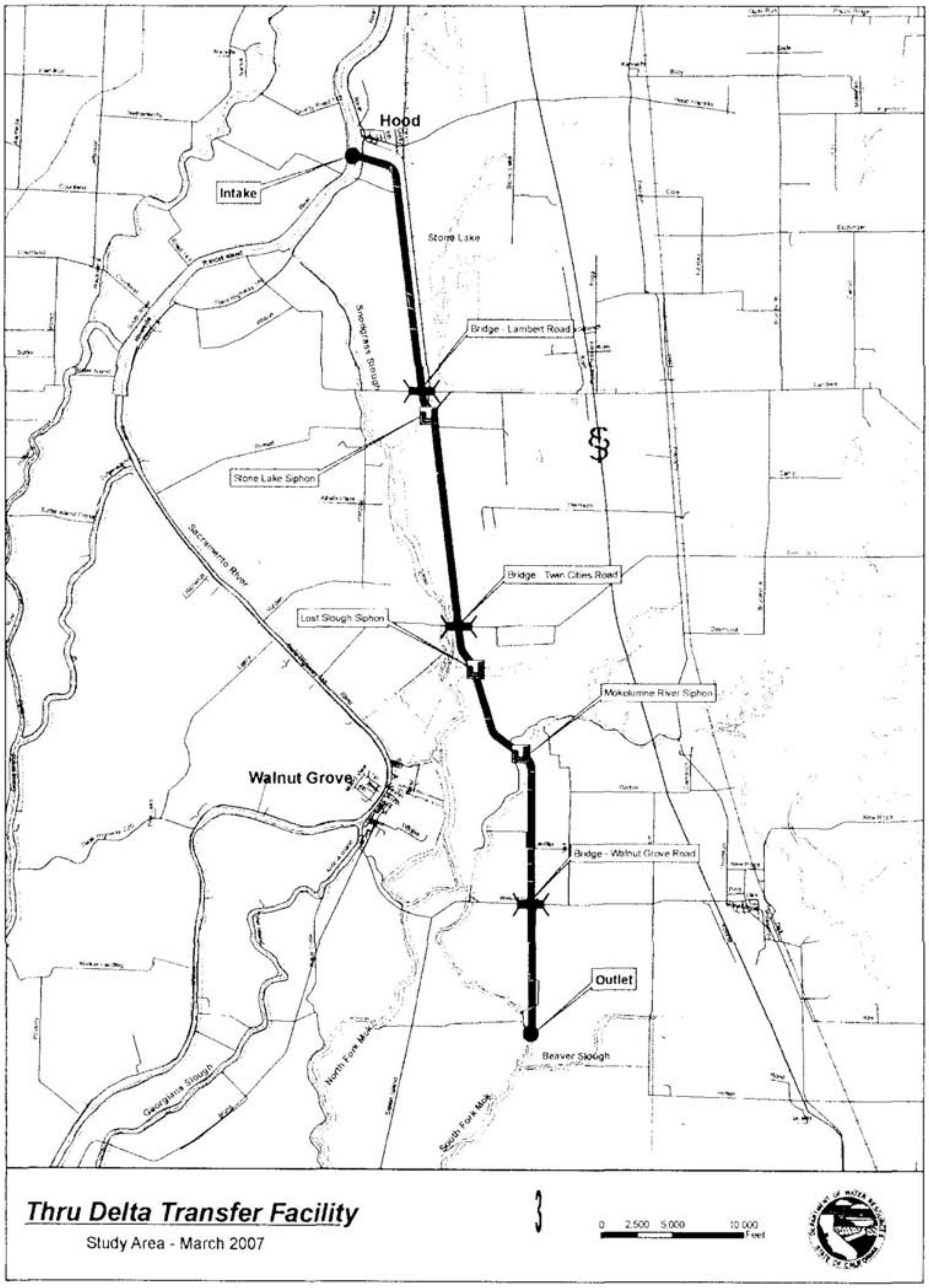
Alternative B, approximately 4,000 feet long, would discharge to Snodgrass Slough upstream of the Delta Cross Canal (DCC). This alternative is the same as Alternative A except that the crossing of Snodgrass Slough is eliminated and a canal would be required from the intake to Snodgrass Slough, eliminating the need for a pumping station.

Should the Department desire to extend the conveyance system to the South Fork of the Mokelumne River, a siphon under the Mokelumne River and an additional 2.5 miles of canal (extension of Alternative A) would be required south Mokelumne River. This alternative, approximately 4.5 miles long, is referred to as Alternative C.

Sketch

Alternative No.: CF-10

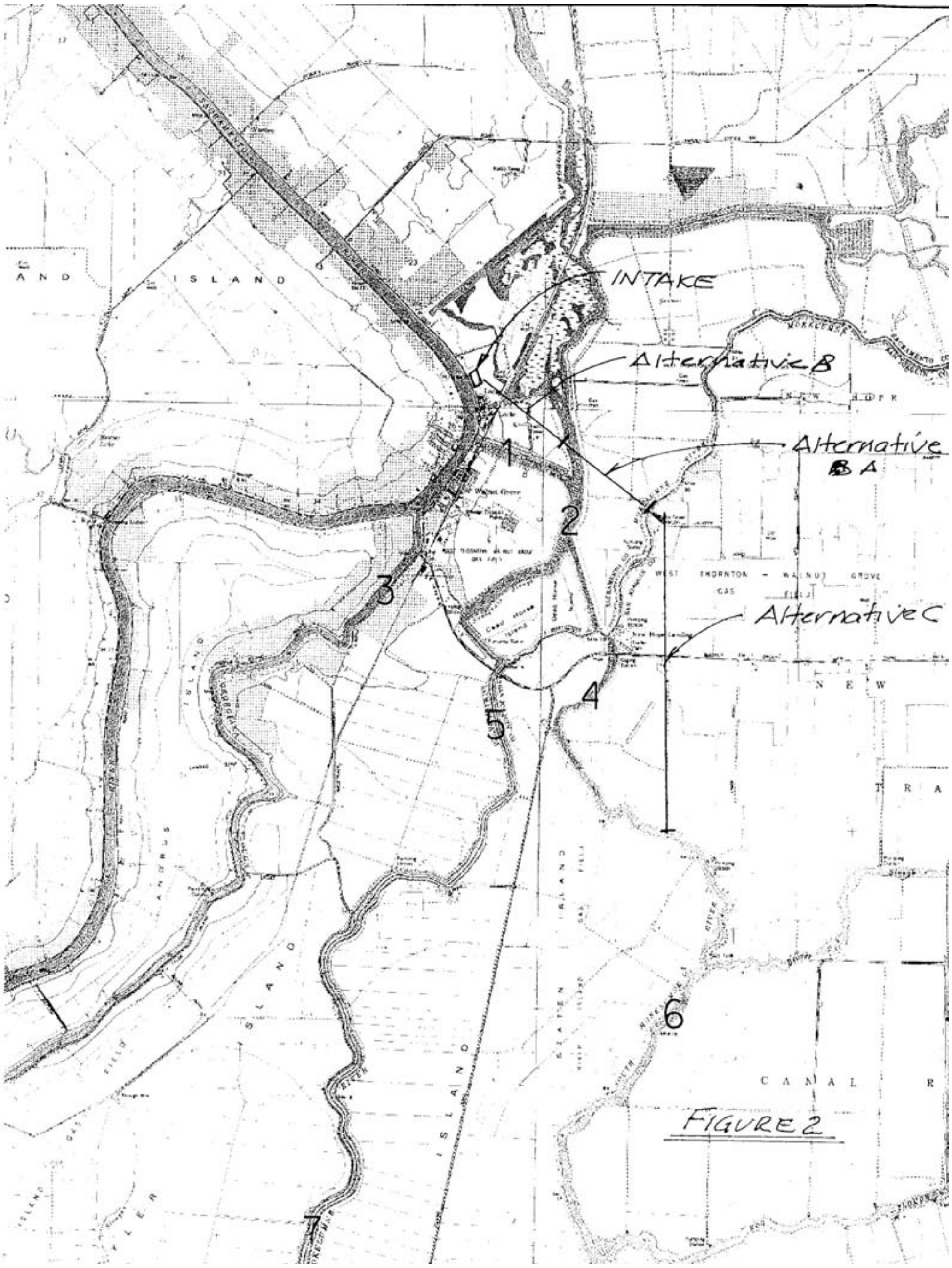
☒ Original ☐ Alternative



Sketch

Alternative No.: CF-10

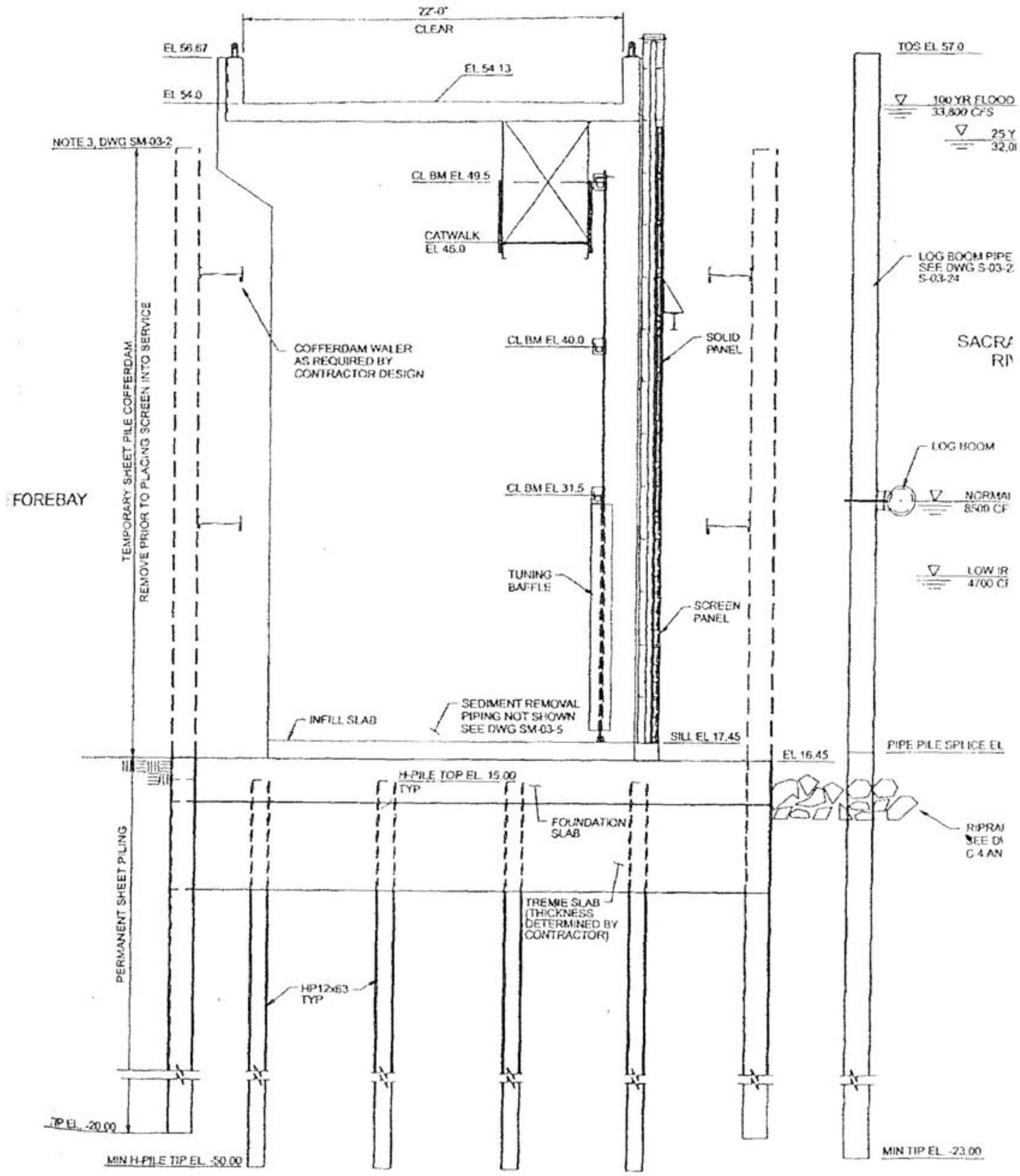
☐ Original ☒ Alternative



Sketch

Alternative No.: CF-10

☐ Original ☒ Alternative



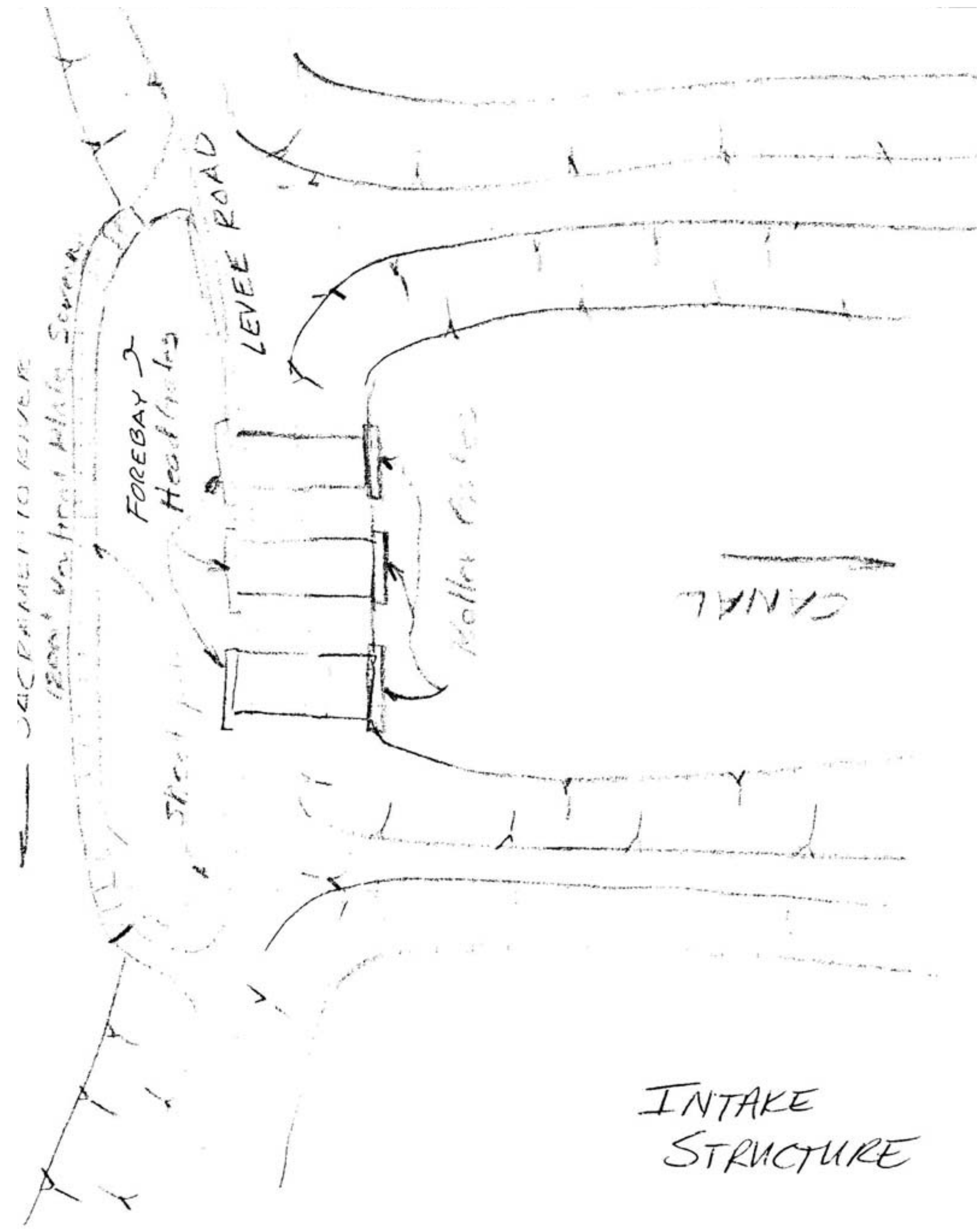
TYPICAL SCREEN BAY SECTION

1/4"=1'-0"

Sketch

Alternative No.: CF-10

☐ Original ☒ Alternative



Construction Cost Estimate

Alternative No.: CF-10

Through Delta Transfer Facility				3/29/2007
Alternative CF-10 A, Divert North of Walnut Grove, Pipe to Mokelumne River, 2 Siphon, 3 Bridges				
Item	**Quantity**	**Unit**	**Unit Price**	**Total**
Mobilization & General Conditions			12%	32,131,402
Inlet Structure/Screens	1	ls		113,000,000
Pump Station	1	ls		30,000,000
Pipeline, 3 ea 13' Steel Conc. Lined	27000	lf	2,700	72,900,000
Stone Lake Siphon (Snodgrass)	1	ls		6,000,000
Unnamed Slough Siphon	1	ls		5,200,000
Hwy 160 Bridge	1	ls		8,520,683
Misc Road Bridge	2	ls	6,100,000	12,200,000
Outlet and Miscellaneous Structures	1	ls		19,941,000
			Subtotal	**299,893,085**
	Contingency		30%	89,967,925
			Total Estimated Cost	**389,861,010**

Construction Cost Estimate

Alternative No.: CF-10

Through Delta Transfer Facility				**3/29/2007**
Alternative CF-10B, Divert North of Walnut Grove, 4000' Canal to Mokelumne River, No Siphon, 3 Bridges				
Item	**Quantity**	**Unit**	**Unit Price**	**Total**
Mobilization & General Conditions			12%	19,166,675
Inlet Structure/Screens	1	ls		113,000,000
Pump Station	0	ls		0
Canal Conveyance	0.76	mi	8,000,000	6,060,606
Unnamed Slough Siphon	0	ls		0
Hwy 160 Bridge	1	ls		8,520,683
Miscellaneous Road Bridge	2	ls	6,100,000	12,200,000
Outlet and Miscellaneous Structures	1	ls		19,941,000
			Subtotal	**178,888,964**
	Contingency		30%	53,666,689
			Total Estimated Cost	**232,555,653**

Construction Cost Estimate

Alternative No.: CF-10

Through Delta Transfer Facility				3/29/2007
Alternative CF-10C, Divert North of Walnut Grove, Pipe 3 ea 9000', Transition to 2.5 mile Canal to S Fork Mokelumne River, 3 Siphon, 5 Bridges				
Item	**Quantity**	**Unit**	**Unit Price**	**Total**
Mobilization & General Conditions			12%	37,123,402
Inlet Structure/Screens	1	ls		113,000,000
Pump Station	1	ls		30,000,000
Pipeline, 3 ea 13' Steel Conc. Lined	27000	lf	2,700	72,900,000
Transition, Pipelines to Canal	1	ls	5,000,000	5,000,000
Canal	2.5	mi	8,000,000	20,000,000
Unnamed Slough Siphon	3	ls	5,200,000	15,600,000
Hwy 160 Bridge	1	ls		8,520,683
Misc Road Bridge	4	ls	6,100,000	24,400,000
Outlet and Miscellaneous Structures	1	ls		19,941,000
			Subtotal	**346,485,085**
	Contingency		30%	103,945,525
			Total Estimated Cost	**450,430,610**

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Value Alternative

Project: Through Delta Facility
Location: Sacramento, California

Alternative No: CF-15

Title:
Divert at Georgiana Slough and cut channel across Staten Island to South Fork

Description of Original Concept:

The original concept involves a 4,000 cfs intake at the Hood with a discharge to South Fork of the Mokelumne River near Beaver Slough. The project includes the following components:

- Intake facility including trash rack, fish screen, fish bypass channel, low-heat pumping plant, and flood control gates.
- Outlet Structure with energy dissipation device with fish screen/barrier
- Unlined canal approximately 12 miles long
- Reinforced concrete box culvert siphons at Stone Lake Drain, Lost Slough, and Mokelumne River
- Five roadway bridges
- Delta slough enlargement of various waterways

Description of Alternative Concept:

The Alternative Concept, Georgiana Slough at Walnut Grove, diverts 4,000 cfs of Sacramento River water for transfer to the South Fork of the Mokelumne River just north of its confluence with Beaver Slough. The size of the diversion is the same as the original concept. Major features include an intake structure with on-river fish screens, radial floodgates, low head pumps, service bridge, south levee road bridge, approximately 20,000 feet of canal, two siphons, and an outlet structure at the river. Required right-of-way is approximately 500 feet wide and 4.2 miles long.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☐ Decreased

Cost Savings Summary

First Cost: $316,554,00

Advantages/Disadvantages

Alternative No.: CF-15

Advantages of Alternative Concept

- 4.2 miles long vs. 12.0 miles
- No fish handling downstream of screens
- Two siphons vs. three
- One public road bridge at intake
- Diverted water stays in stream for additional 12 miles
- Pumps have lower head
- No trash rack is required

Disadvantages of Alternative Concept

- Water quality is reduced slightly
- Right-of-way more costly
- Slightly outside ROD limits
- Siphon construction more difficult
- On-river screen more costly
- Screen construction more difficult

Discussion

Alternative No.: CF-15

This alternative moves 4,000 cfs of Sacramento River water from a diversion point on the river just westerly of Walnut Grove to the south fork of the Mokelumne above its confluence with Beaver Slough. This alternative fulfills the objective of the Original Concept of improving water quality in the eastern Delta and therefore at the export locations in the southern Delta.

CALFED Bay Delta program Record of Decision of August 28, 2000 identifies diversion points between Hood and Georgiana Slough. This alternative optimizes the lowest diversion point on the river.

The major change in this Alternative to the Original Concept is the on-river fish screen with floating trash barrier, which results in no trash rack being required. It was determined that fish barriers at the outlet structure were preferred over fish ladders at the intake structure. A vertical bar rack with one-inch clear openings and a discharge velocity of 1.0 fps meets these criteria.

Floodgates and closure levees at the intake should be taken to elevation 25. Provisions for sediment removal should also be provided.

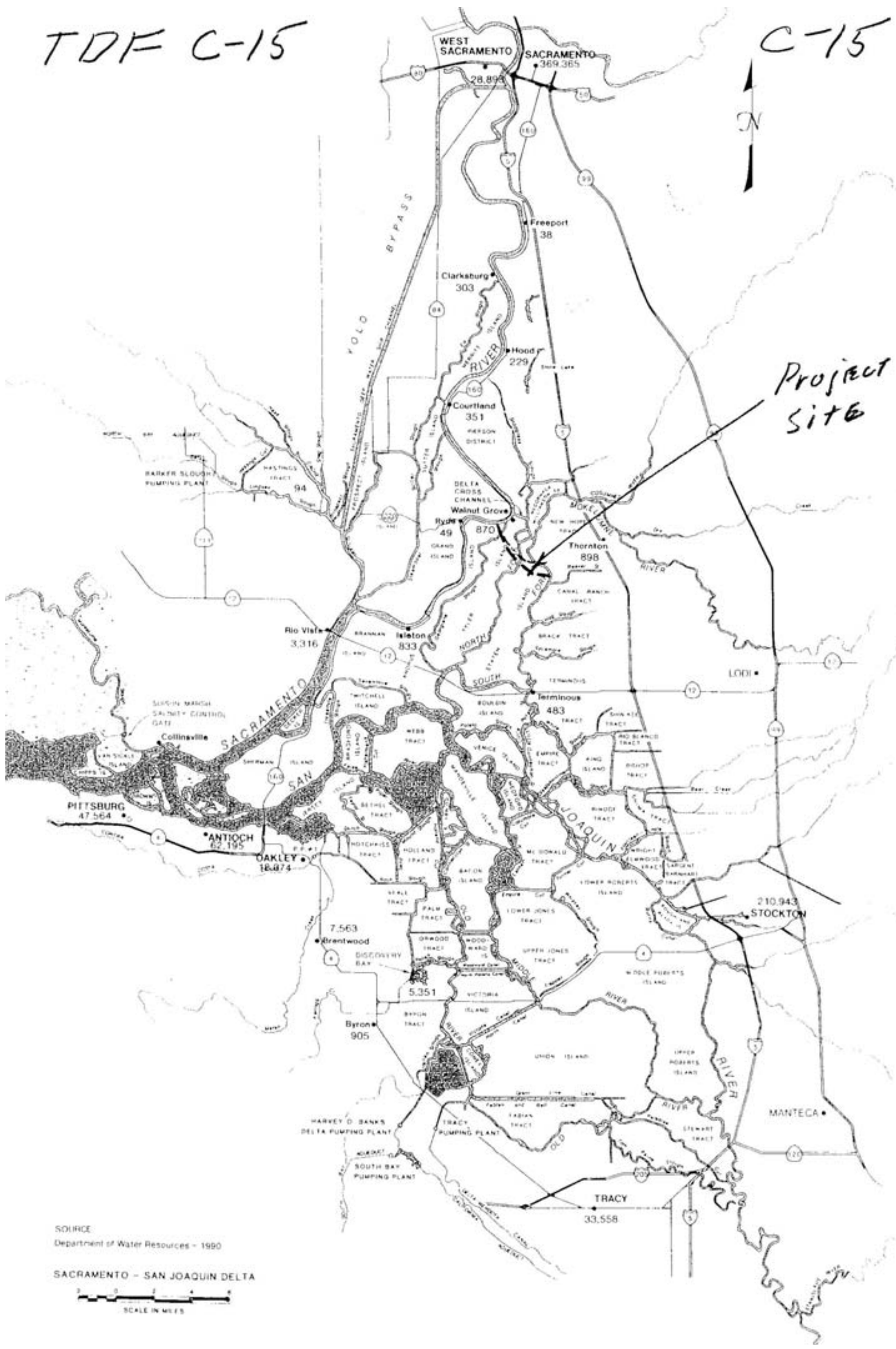
A 20-foot-high screen withdrawal is assumed. Using 0.2 fps approach velocity, a 1,000-foot long screen is required. Wipers should be used for screen cleaning.

A low water elevation of seven was used before operation ceases.

Sketch

Alternative No.: CF-15

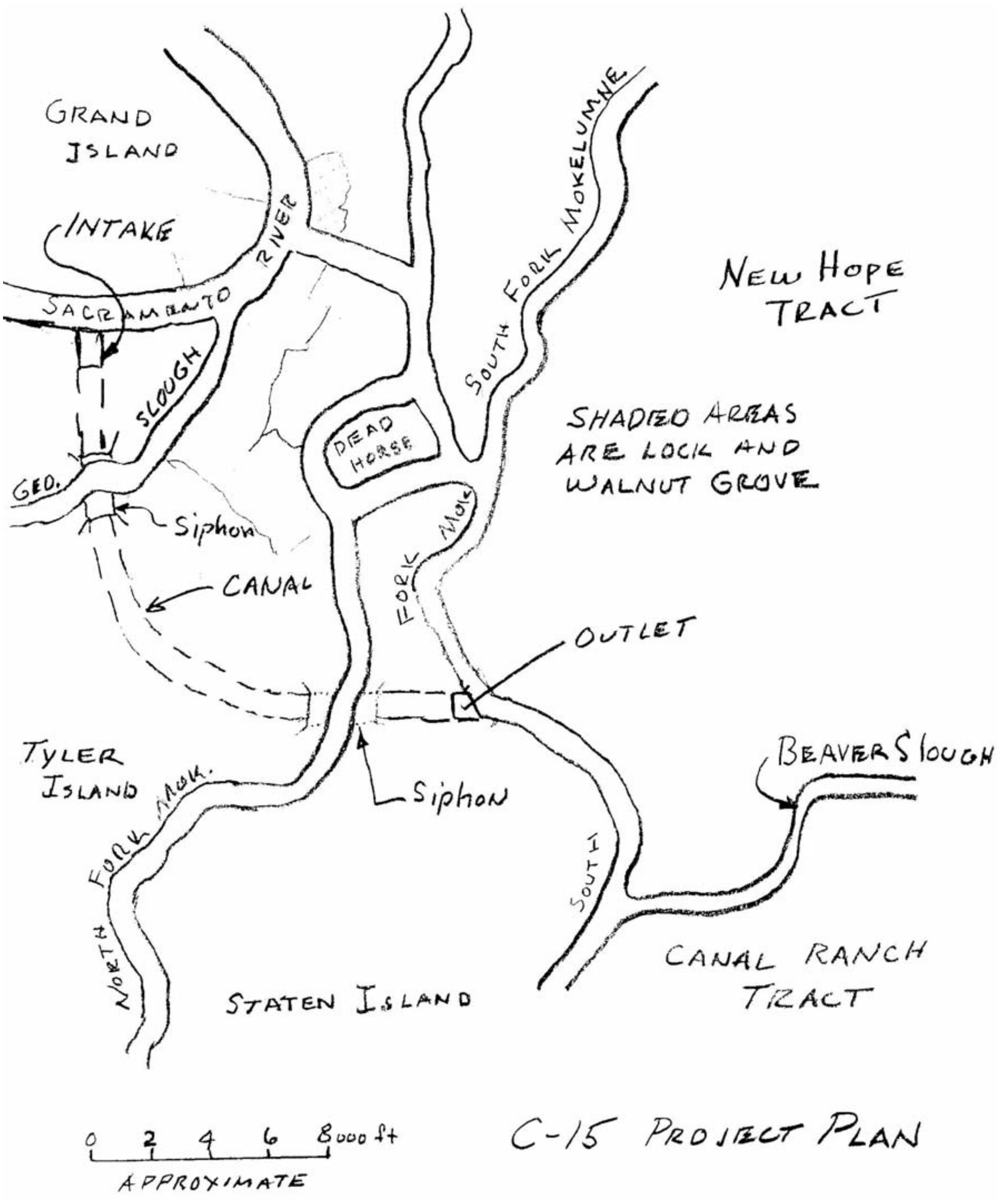
☒ Original ☐ Alternative



Sketch

Alternative No.: CF-15

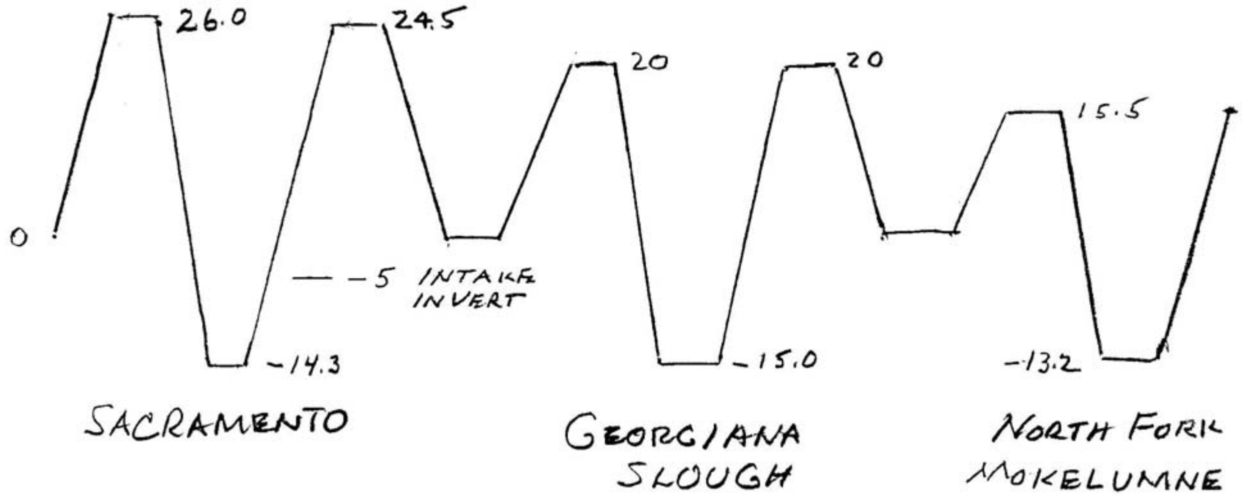
☐ Original ☒ Alternative



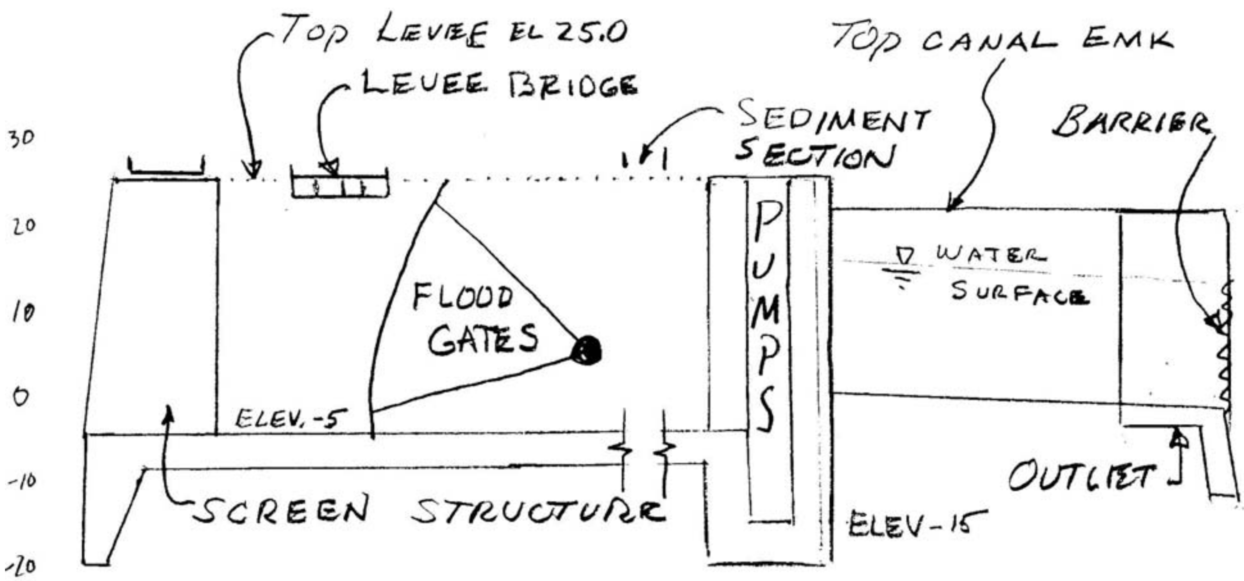
Sketch

Alternative No.: CF-15

☐ Original ☒ Alternative



ELEVATIONS SHOWN ARE TAKEN NEAR DIVERSION ALIGNMENT



INTAKE

Construction Cost Estimate

Alternative No.: CF-15

Through Delta Transfer Facility				**3/28/2007**
Alternative CF-15, Divert @ Georgiana Slough, Open Channel Across Statton Island to South Fork Mokelumne				
Item	**Quantity**	**Unit**	**Unit Price**	**Total**
Mobilization & General Conditions			12%	26,089,646
Inlet Structure/Screens	1	ls		113,000,000
Pump Station	1	ls		30,000,000
TDF Canal	3.8	miles	8,000,000	30,303,030
Georgiana Slough Siphon	1	ls		6,000,000
Mokelumne River Siphon	1	ls		3,500,000
Hwy 160 Bridge	1	ls		8,520,683
Embankment	380000	cy	15	5,700,000
Base	4300	cy	30	129,000
Asphalt Concrete	128000	sf	2.5	320,000
Outlet and Miscellaneous Structures	1	ls		19,941,000
			Subtotal	**243,503,359**
	Contingency		30%	73,051,008
			Total Estimated Cost	**316,554,367**

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Value Alternative

Project: Through Delta Facility
Location: Sacramento, California

Alternative No: CF-19

Title:
Divert at multiple locations and consider capacity of downstream receiving channels in locating and sizing diversion

Description of Original Concept:

The original concept involves a 4,000 cfs intake at the Hood with a discharge to South Fork of the Mokelumne River near Beaver Slough. The project includes the following components:

- Intake facility including trash rack, fish screen, fish bypass channel, low-heat pumping plant, and flood control gates.
- Outlet Structure with energy dissipation device with fish screen/barrier
- Unlined canal approximately 12 miles long
- Reinforced concrete box culvert siphons at Stone Lake Drain, Lost Slough, and Mokelumne River
- Five roadway bridges
- Delta slough enlargement of various waterways

Description of Alternative Concept:

This alternative provides diversions at multiple locations that have a combined diversion capacity of up to 4,000 cfs. The location, size (capacity), and configuration of each diversion would be developed based upon the capacity of the existing downstream receiving channel(s), distance to the receiving channel, environmental constraints, local conditions, and ability to meet the water quality improvement goals.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☒ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost – Site 1:	$60,653,000
First Cost – Site 1a:	$49,450,000
First Cost – Site 2:	$57,633,000
First Cost – Site 3:	$57,105,000
First Cost – Site 4:	$54,513,000
First Cost – Site 5:	$52,490,000
First Cost – Site 6:	$55,655,000

Advantages/Disadvantages

Alternative No.: CF-19

Advantages of Alternative Concept

- Shorter and smaller conveyance channels
- Size for downstream receiving waters
- Reduce or eliminate pumping
- Greater flexibility and reliability in operation (only partial shut downs)
- Allow variations in Delta circulation/flow patterns
- Greater selection of diversion sites
- Standard proven designs
- Probable lower overall cost
- Maintenance of existing landscape (e.g., agricultural use)
- Preserves Hood site for possible future use
- Leaves more flow in upper portions of Sacramento River
- Alternative can be constructed in phases

Disadvantages of Alternative Concept

- Marginally greater O&M costs
- Less "economy of scale"
- Possible enlargement of existing channels
- Possibly less water quality improvement compared to DWR alternative
- Possible more backwater on existing diversions (DCC and Georgiana Slough)

Discussion

Alternative No.: CF-19

A number of potential diversion locations were identified that might be incorporated into this alternative. These potential diversion locations include, but are not limited to:

- a diversion into Snodgrass Slough between Meadows Slough and the community of Locke
- into Meadows Slough north of the DCC channel
- into Snodgrass Slough along north side of Twin Cities Road
- an independent and isolated diversion at DCC
- an independent and isolated diversion at Georgiana Slough
- a diversion into the upper end of Snodgrass Slough.

Locations of these potential diversion sites are shown on the attached sketch.

Facilities needed at each diversion site include:

- One or more fish screens located at each Sacramento River intake.
- Depending upon fish screen type, a trash rack located at Sacramento River intake may or may not be needed.
- Flood Gates located at Sacramento River intake.
- A fish/boat barrier located downstream from the diversion.

In addition to the above facilities, construction of diversion channels and road bridges will be needed for each diversion. Table 1 gives the approximate channel lengths and bridge requirements associated with each of the potential diversions identified above. It should be noted that for alternatives 1 and 1a, siphons under Georgiana Slough and North Fork Mokelumne River are not provided – these are surface junctions.

Other diversion sites, not identified above, would most likely require the same types of facilities.

Table 1: Potential Diversion Sites

Site No.	Diversion To	Diversion Location	New Channel Length, feet	Bridges - Levee Roads	Bridges - Public Roads
1	Georgiana S., NF Moke., SF Moke	D/S Georgiana S.	8,600	6	1
1a	Georgiana S., NF Moke.	D/S Georgiana S.	7,100	5	
2	Snodgrass S.	At DCC	3,650		1
3	Snodgrass S.	No. edge Locke	3,100		1
4	Snodgrass S.	At Meadows S.	400		1
5	Snodgrass S.	At Twin Cities Rd.	10,000	2	
6	Snodgrass S.	No. end Snodgrass S.	1,400	1	1

The size of facilities associated with each of the potential diversions will depend upon the diversion capacity most appropriate for the location. Hydrodynamic analyses will be needed to optimize the number, size, and locations of diversions.

The following discussion highlights some of the advantages and disadvantages of the multi-diversion concept.

- All of the diversions identified above can be isolated and provided with fish screens and fish/boat barriers and thereby avoid entrainment of fish and boat bypass facilities.

- Five of the six identified diversion locations are near the existing DCC and the diversion receiving waters and can therefore gravity divert more water using the available hydraulic head differences, thereby avoiding pumping facilities. The diversion at the north end of Snodgrass Slough identified above may require pumping to divert a useful amount of water to the central and south Delta.

- Water can be diverted to Snodgrass Slough, North and South Forks Mokelumne River, and Georgiana Slough by construction of relatively short channels, thereby realizing a substantial cost savings over a 12-mile-long, 4,000 cfs capacity new channel from Hood to South Fork Mokelumne River.

Alternative No.: CF-19

- Multiple diversions from the lower reaches of Sacramento River can be conveyed to different existing channels that have capacity to accept the diverted water without significantly increasing the backwater on all diversions, i.e., the diverted water can be distributed among a number of different receiving waters to optimize hydraulic conditions. Note that diversions for Alternative 1 and 1a will be naturally distributed among Georgiana Slough and the North and South Fork of Mokelumne River based on exiting hydraulic conductivity.
- Water diverted to the upper end of Snodgrass Slough is expected to have slightly better quality than water in the lower reaches of Sacramento River. However, it is believed that this difference will not result in significant differences in the water quality at the Delta export facilities (this should be verified by model studies).
- The multiple-diversion concept allows smaller and more standardized facilities to be used at each diversion site. For example, a 1,000 cfs diversion site may utilize four 250 cfs standard design cylindrical in-river fish screens (such as ISI screens) that have know performance characteristics, may not require trash racks, have self-cleaning capability, and can be easily removed from the river for protection during flood season or repair. Smaller standard design facilities may result in lower unit costs for facilities.
- Smaller diversion facilities may result in more potential diversion sites that can be developed.

Development of the multiple-diversion concept will require hydrodynamic analyses to size and locate facilities. These needed hydrodynamic analyses are not available at this time. The following assumptions were made for purposes of estimating potential costs of each diversion site identified in Table 1:

- Each diversion is assumed to have a diversion capacity of 1,000 cfs.
- 5,000 square feet of fish screen would be needed at each diversion.
- No siphons or trash racks would be needed at any of the diversions.
- No enlargements would be needed for downstream existing channels.
- The new conveyance channels are assumed to have a bed width and bed elevation of 40 feet and -5 feet, respectively; bank slopes of 3H:1V and 2.5H:1V; and a levee crest elevation of 20 feet. Assuming a 10-foot clearance from outside levee toe to the right-of-way limits and a 25-foot-wide levee crest, the needed right-of-way width would be about 380 feet.

Given the assumptions listed above, the estimated order-of-magnitude costs associated with each of the alternatives presented in Table 1 are summarized in Table 2. As shown in Table 2, the cost to divert up to 4,000 cfs (i.e., development of four diversion sites) would be between $190,000,000 and $210,000,000.

Discussion (cont.)

Alternative No.: CF-19

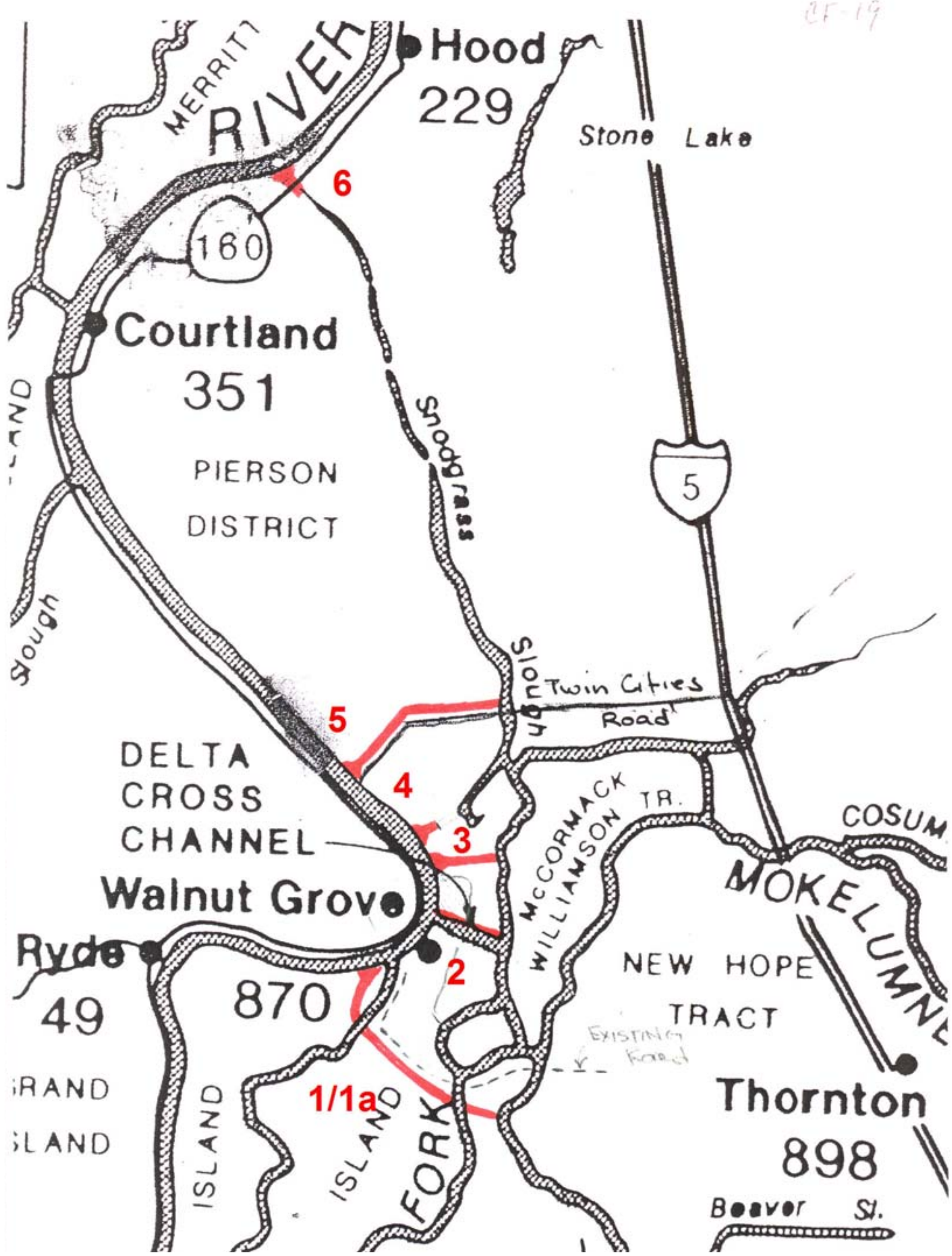
Table 2: Estimated Cost for Potential Diversion Sites

Site No.	Diversion To	Diversion Location	Estimated Cost (1000's)
1	Georgiana S., NF Moke., SF Moke	D/S Georgiana S.	$60,653
1a	Georgiana S., NF Moke.	D/S Georgiana S.	$49,450
2	Snodgrass S.	At DCC	$57,633
3	Snodgrass S.	No. edge Locke	$57,105
4	Snodgrass S.	At Meadows S.	$54,513
5	Snodgrass S.	At Twin Cities Rd.	$52,490
6	Snodgrass S.	No. end Snodgrass S.	$55,655

Sketch

Alternative No.: CF-19

☐ Original ☒ Alternative



Construction Cost Estimate

Alternative No.: CF-19

Through Delta Transfer Facility				**3/29/2007**
Alternative CF19, Divert @ Multiple Locations, Snodgrass/Meadows, Open up DCC @ Georgiana Slough, Hood to Stone Lake				
Item	**Quantity**	**Unit**	**Unit Price**	**Total**
Site 1				
Mobilization & General Conditions			12%	4,570,302
Inlet Structure/Screens	4	ls		24,364,084
1000 cfs Structures (factored by capacity x .6 factor)			14,364,084	
1000 cfs of Fish Screens, In Channel			10,000,000	
Canal	1.6	mi	3,482,202	5,671,769
Riprap Intersection 2 ea	12000	t	80	960,000
Riprap End T	3000	t	80	240,000
Levee Road Bridge	6	ea	125,000	750,000
Secondary Road Bridge	1	ea	6,100,000	6,100,000
Highway Bridge	0	ea	8,520,683	0
Outlet Screen 1000 cfs @ $4000/cfs				4,000,000
			Subtotal	**46,656,155**
	Contingency		30%	13,996,847
	Total Estimated Cost Site 1			**60,653,002**
Site 1A				
Mobilization & General Conditions			12%	3,646,991
Inlet Structure/Screens	4	ls		24,364,084
1000 cfs Structures (factored by capacity x .6 factor)			14,364,084	
1000 cfs of Fish Screens, In Channel			10,000,000	
Canal	1.3	mi	3,482,202	4,682,507
Riprap Intersection	6000	t	80	480,000
Riprap End T	3000	t	80	240,000
Levee Road Bridge	5	ea	125,000	625,000
Secondary Road Bridge	0	ea	6,100,000	0
Highway Bridge	0	ea	8,520,683	0
Outlet Screen 1000 cfs @ $4000/cfs				4,000,000
			Subtotal	**38,038,582**
	Contingency		30%	11,411,575
	Total Estimated Cost Site 1A			**49,450,157**

Construction Cost Estimate

Alternative No.: CF-19

Item	Quantity	Unit	Unit Price	Total
Site 2				
Mobilization & General Conditions			12%	4,321,437
Inlet Structure/Screens	4	ls		24,364,084
1000 cfs Structures (factored by capacity x .6 factor)			14,364,084	
1000 cfs of Fish Screens, In Channel			10,000,000	
Canal	0.7	mi	3,482,202	2,407,204
Riprap Intersection	6000	t	80	480,000
Riprap End T	3000	t	80	240,000
Levee Road Bridge	0	ea	125,000	0
Secondary Road Bridge	0	ea	6,100,000	0
Highway Bridge	1	ea	8,520,683	8,520,683
Outlet Screen 1000 cfs @ $4000/cfs				4,000,000
			Subtotal	**44,333,408**
	Contingency		30%	13,300,022
	Total Estimated Cost Site 2			**57,633,431**
Site 3				
Mobilization & General Conditions			12%	4,277,909
Inlet Structure/Screens	4	ls		24,364,084
1000 cfs Structures (factored by capacity x .6 factor)			14,364,084	
1000 cfs of Fish Screens, In Channel			10,000,000	
Canal	0.6	mi	3,482,202	2,044,475
Riprap Intersection	6000	t	80	480,000
Riprap End T	3000	t	80	240,000
Levee Road Bridge	0	ea	124,000	0
Secondary Road Bridge	0	ea	6,100,000	0
Highway Bridge	1	ea	8,520,683	8,520,683
Outlet Screen 1000 cfs @ $4000/cfs				4,000,000
			Subtotal	**43,927,151**
	Contingency		30%	13,178,145
	Total Estimated Cost Site 3			**57,105,297**

Construction Cost Estimate

Alternative No.: CF-19

Item	Quantity	Unit	Unit Price	Total
Site 4				
Mobilization & General Conditions			12%	4,064,228
Inlet Structure/Screens	4	ls		24,364,084
1000 cfs Structures (factored by capacity x .6 factor)			14,364,084	
1000 cfs of Fish Screens, In Channel			10,000,000	
Canal	0.1	mi	3,482,202	263,803
Riprap Intersection	6000	t	80	480,000
Riprap End T	3000	t	80	240,000
Levee Road Bridge	0	ea	125,000	0
Secondary Road Bridge	0	ea	6,100,000	0
Highway Bridge	1	ea	8,520,683	8,520,683
Outlet Screen 1000 cfs @ $4000/cfs				4,000,000
			Subtotal	**41,932,799**
	Contingency		30%	12,579,840
	Total Estimated Cost Site 4			**54,512,639**
Site 5				
Mobilization & General Conditions			12%	3,897,500
Inlet Structure/Screens	4	ls		24,364,084
1000 cfs Structures (factored by capacity x .6 factor)			14,364,084	
1000 cfs of Fish Screens, In Channel			10,000,000	
Canal	1.9	mi	3,482,202	6,595,080
Riprap Intersection	6000	t	80	480,000
Riprap End T	3000	t	80	240,000
Levee Road Bridge	2	ea	400,000	800,000
Secondary Road Bridge	0	ea	6,100,000	0
Highway Bridge	0	ea	8,520,683	0
Outlet Screen 1000 cfs @ $4000/cfs				4,000,000
			Subtotal	**40,376,664**
	Contingency		30%	12,112,999
	Total Estimated Cost Site 5			**52,489,663**

Construction Cost Estimate

Alternative No.: CF-19

Item	Quantity	Unit	Unit Price	Total
Site 6				
Mobilization & General Conditions			12%	4,158,369
Inlet Structure/Screens	4	ls		24,364,084
1000 cfs Structures (factored by capacity x .6 factor)			14,364,084	
1000 cfs of Fish Screens, In Channel			10,000,000	
Canal	0.3	mi	3,482,202	923,311
Riprap Intersection	6000	t	80	480,000
Riprap End T	3000	t	80	240,000
Levee Road Bridge	1	ea	125,000	125,000
Secondary Road Bridge	0	ea	6,100,000	0
Highway Bridge	1	ea	8,520,683	8,520,683
Outlet Screen 1000 cfs @ $4000/cfs				4,000,000
			Subtotal	**42,811,448**
	Contingency		30%	12,843,434
	Total Estimated Cost Site 6			**55,654,882**

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Value Alternative

Project: Franks Tract Pilot Project
Location: Sacramento-San Joaquin Delta, California

Alternative No:
CF-38

Title:
Increase diversion capacity of the Delta Cross Channel (DCC) and add fish screens

Description of Original Concept:

The existing DCC facility connects Sacramento River with the central and southern Delta via Snodgrass Slough and the Mokelumne River system. The diversion facilities, which are owned and operated by the U.S. Bureau of Reclamation (USBR), are currently capable of diverting up to about 9,000 cubic feet per second (cfs) of water by gravity (no pumping) from the Sacramento River.

The existing DCC radial gates were installed in approximately 1950. It is our understanding that USBR is reluctant to operate the gates on a frequent basis because of their age. Studies that have been completed to date assume that the existing DCC is fully open during the period of late July through early November and closed during the remaining part of the year. These studies indicate that the diverted water results in a significant reduction in salinity at the Delta export facilities located in the southern Delta.

Description of Alternative Concept:

This alternative involves:

1. Refurbishment of the existing DCC gates.
2. Increasing the diversion capacity of the DCC by adding an additional gate on the north side of the existing facility.
3. Widening the existing DCC diversion channel.
4. Provision of vee screens in the widened channel to capture fish passed through the new gates. The fish screens could possibly be expanded to collect fish passing through the existing gates.
5. Provision of a fish collection and pump back system.

It is assumed that additional salinity reductions at the Delta export facilities could be realized by these improvements.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☒ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost (12,000 cfs):	$369,383,000
First Cost (4,000 cfs):	$140,583,000

Advantages/Disadvantages

Alternative No.: CF-38

Advantages of Alternative Concept

- Refurbishment of the existing DCC gates will add reliability of diversions toward the Delta export facilities
- Increasing the diversion capacity of the DCC will add flexibility to the facility operation by allowing one, two, or three diversion gates to be open for control of salinity at the export facilities
- The alternative improvements do not impact boat traffic in the area and, therefore, do not require mitigation
- Potential to stage screening of the entire DCC and realizing significant fish benefits and greater flexibility in operating DCC during periods when it would be closed due to fish concerns
- Keeps a higher flow rate in the Sacramento River for a longer distance

Disadvantages of Alternative Concept

- The extent of downstream channel improvements required to accommodate the increased DCC diversions are not known and may incur additional costs
- This alternative may result in frequent and rapid changes in downstream water surface elevations that may be detrimental to both the downstream channels and water users
- The increased diversions may encourage additional withdrawals by downstream users

Discussion

Alternative No.: CF-38

The existing DCC facility connects the Sacramento River with the central and southern Delta via Snodgrass Slough and the Mokelumne River system. The diversion facilities, which are owned and operated by the U.S. Bureau of Reclamation (USBR), are currently capable of diverting up to about 9,000 cubic feet per second (cfs) of water by gravity (no pumping) from the Sacramento River.

The existing DCC radial gates were installed in approximately 1950. It is our understanding that USBR is reluctant to operate the gates on a frequent basis because of their age. Studies that have been completed to date assume that the existing DCC is fully open during the period of late July through early November and closed during the remaining part of the year. These studies indicate that the diverted water results in a significant reduction in salinity at the Delta export facilities located in the southern Delta.

A diversion capacity increase of up to 4,000 cfs at the DCC may be appropriate, but this increase requires confirmation with additional model studies. Increasing diversions at the DCC would result in some decrease in flows to the south via Georgiana Slough, but it is assumed that a net increase in southward flow could be realized.

Increasing the diversion capacity of the DCC will involve adding one 90-foot-wide by ___-foot-high gate on the north side of the existing structure. This will require extending the existing gatehouse structure or adding a new structure. To allow continued operation of the DCC, a partition wall would be provided to isolate the widened portion of the discharge channel. It might also involve widening the channel between the Sacramento River and the Snodgrass Slough and/or other downstream channels. The assumption is that the existing radial gates can be refurbished and reused. The new gate would be a radial gate, however, alternative types of gates, which may be more efficient, should be considered. Conceptual sketches of an enlarged DCC follow.

This alternative can be constructed in the dry or in the wet. It is assumed that there are existing stop log facilities that can be used to isolate the existing radial gates and a cofferdam can be constructed in the existing channel.

Operation of the expanded DCC under this alternative should be developed based on hydraulic model studies that quantify impacts on salinity levels at the Delta export facilities. Model studies should include assuming the enlarged DCC is fully open during the same late July through early November period that the existing DCC is currently open and assuming the operation period can be extended when or if the fish screening capability is expanded to include the existing DCC diversions.

Alternative operations might also include closure of the DCC during some portion(s) of the tide cycle such that a pulse of water is sent down the Sacramento River and arrives at Three Mile Slough when:

Discussion (cont.)

Alternative No.: CF-38

a. flow in the Three Mile Slough is from the Sacramento River to the San Joaquin River and the pulse of water increases this flow, and/or

b. flow in the Three Mile Slough is from the San Joaquin River to the Sacramento River and the pulse of water increases the Sacramento River water surface elevation and decreases this flow.

These pulses of water would tend to flush saltwater in the lower Sacramento and San Joaquin Rivers downstream toward the San Francisco Bay or reduce upstream flows in the San Joaquin River and reduce upstream movement of saltwater in the lower portion of the river. The pulsing of water down Sacramento River may be particularly beneficial when used in conjunction with Alternative 4 of the Frank's Track Project (Three Mile Slough Barrier).

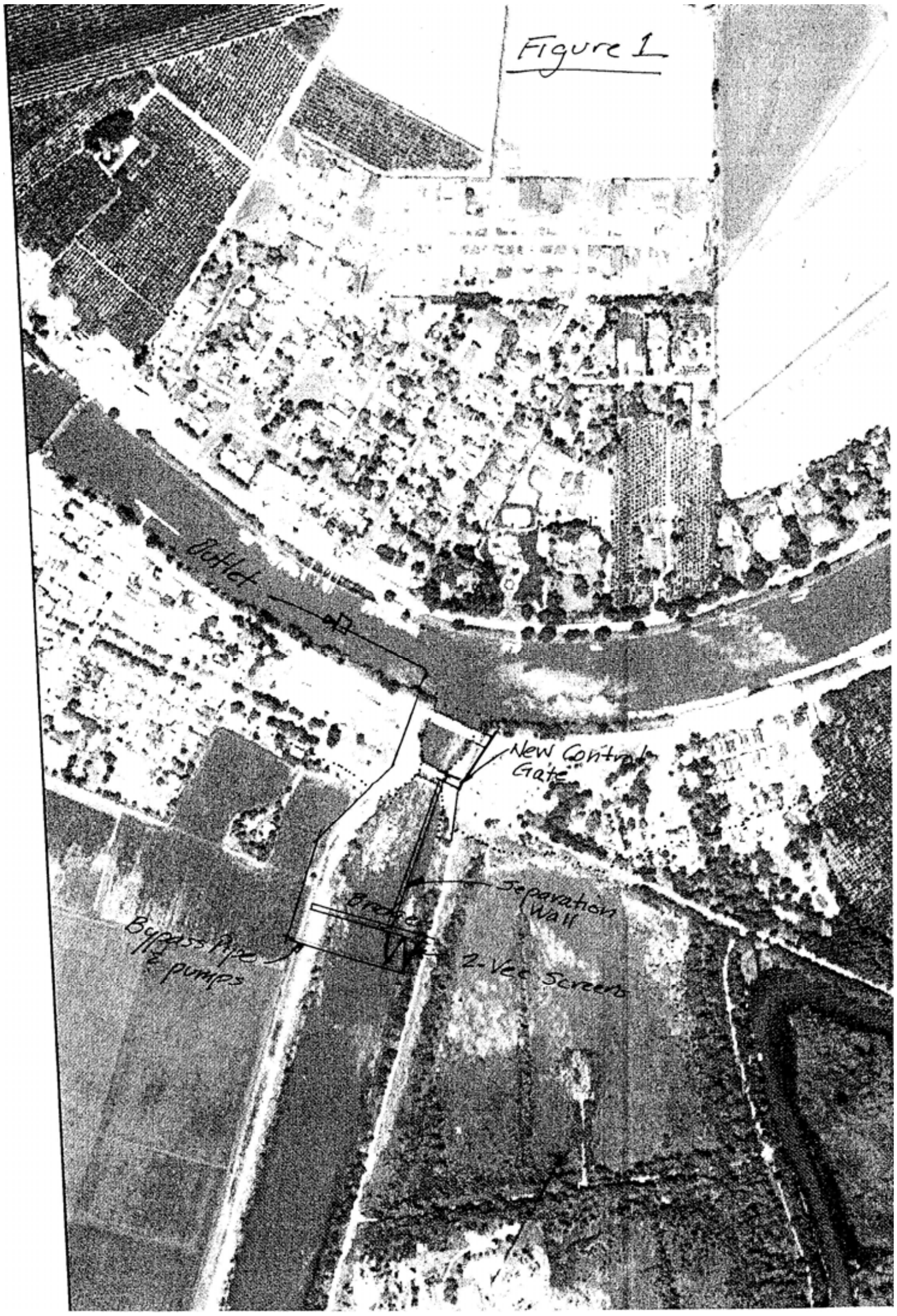
There may be a reasonable likelihood that the costs associated with refurbishment and enlargement of the DCC can be shared with the USBR and other beneficiaries of the project. The USBR recognizes that the existing facilities are nearing the end of their useful life and that refurbishment will be necessary, whether or not a Frank's Track Project is constructed.

On the attached sketches, we have shown 4,000 cfs being screen downstream of the headgates. In the future, the Department and the USBR may elect to expand the fish screens to the full width of the DCC. We assumed the ultimate capacity to be 12,000 cfs. A cost estimate was prepared for the 12,000 cfs fish screening option, as shown on the attached table. This total cost is about $369 million. If only 4,000 cfs is screened, the cost for this alternative would be about $157.5 million.

Sketch

Alternative No.: CF-38

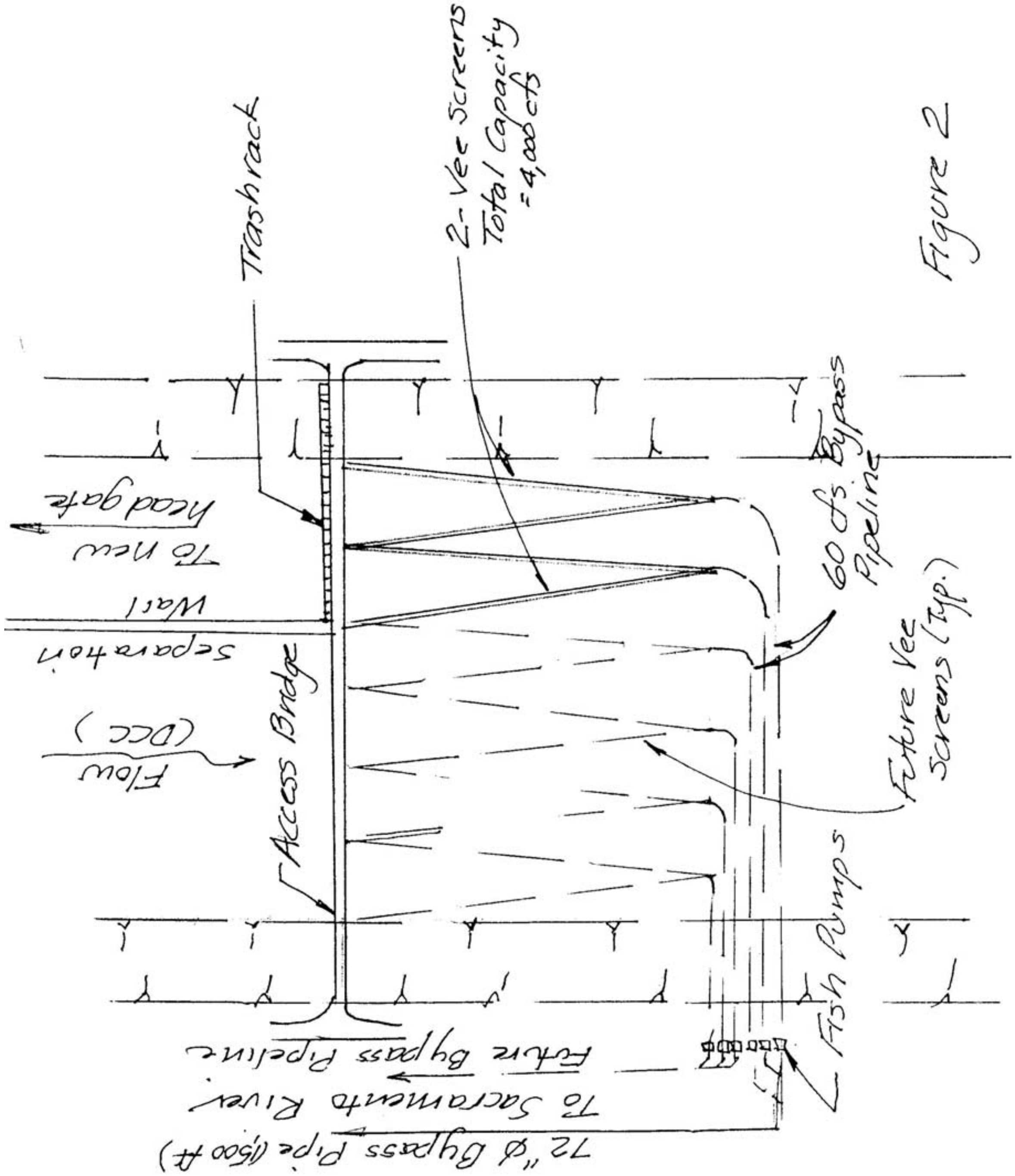
☐ Original ☒ Alternative



Sketch

Alternative No.: CF-38

☐ Original ☒ Alternative



Construction Cost Estimate

Alternative No.: CF-38

12,000 CFS Fish Screen

CF-38 DCC Expansion				**3/29/2007**
Construction Cost	**Quantity**	**Unit**	**Unit Price**	**Total**
Mobilization, General Conditions			10%	25,831,003
River Road Bridge Work				
Allowance For Traffic Staging and Control	1	ls	100,000	100,000
Mob/Demob Pile Rig	1	ls	35,000	35,000
Temporary Support South End River Road B	1	ls	150,000	150,000
Demolish Bridge Abutment	1	ls	42,000	42,000
Temporary Sheet Piling, Pier	8000	sf	40	320,000
Dewater, Pier	1	ls	1,000	1,000
Excavation, Pier	120	cy	30	3,600
H pile. Pier	320	lf	55	17,600
Bridge Pier Concrete	270	cy	1,200	324,000
H pile, Abutment	320	lf	55	17,600
Install New Bridge Abutment Concrete	405	cy	1,300	526,500
Install New Bridge Structure Concrete	550	cy	1,700	935,000
Bridge Rail	280	lf	80	22,400
West End Base/Paving	5,625	sy	25	140,625
Allowance For Traffic Staging and Control	1	ls	10,000	10,000
Allowance For Existing Utility Issues	1	ls	100,000	100,000
Structure And Gate Additions				
Temporary Sheet Piling, Gate Structure	24,000		40	960,000
Dewater	1	ls	15,000	15,000
Demolish Wing Wall	1	ls	42,000	42,000
Excavation, Entire Gate Area	120,000	cy	15	1,800,000
H Pile	2,880	lf	55	158,400
Gate Structure	2,600	cy	1,300	3,380,000
H pile	320	lf	55	17,600
Install New Bridge Abutment	350	cy	1,300	455,000
Install New Bridge Structure	250	cy	1,700	425,000
Bridge Rail	240	lf	80	19,200
West End Paving	500	sy	25	12,500
Allowance For Traffic Staging and Control	1	ls	10,000	10,000
Radial Gate, Incl Mechanism, Controls	2,700	sf	1,000	2,700,000
Temporary Sheet Piling, walls	23,000	sf	40	920,000
Install Downstream Training Wall	600	cy	1,300	780,000
Install Upstream & Downstream Walls	1,100	cy	1,300	1,430,000
Rock Slope Protection, South Bank	17,000	ton	80	1,360,000
Refurbish other 2 gates	1	Allow	1,000,000	1,000,000
Fish Screens & Bypass				
Fish Screens (Ultimate Capavity)	12,000	cfs	20,000	240,000,000
Riprap	1000	t	80	80,000
Subtotal				**284,141,028**
Contingency			30%	85,242,308
Total				**369,383,336**

Construction Cost Estimate

Alternative No.: CF-38

4,000 CFS Fish Screen

CF-38 DCC Expansion				**3/29/2007**
Construction Cost	**Quantity**	**Unit**	**Unit Price**	**Total**
Mobilization, General Conditions			10%	9,831,003
River Road Bridge Work				
Allowance For Traffic Staging and Control	1	ls	100,000	100,000
Mob/Demob Pile Rig	1	ls	35,000	35,000
Temporary Support South End River Road B	1	ls	150,000	150,000
Demolish Bridge Abutment	1	ls	42,000	42,000
Temporary Sheet Piling, Pier	8000	sf	40	320,000
Dewater, Pier	1	ls	1,000	1,000
Excavation, Pier	120	cy	30	3,600
H pile. Pier	320	lf	55	17,600
Bridge Pier Concrete	270	cy	1,200	324,000
H pile, Abutment	320	lf	55	17,600
Install New Bridge Abutment Concrete	405	cy	1,300	526,500
Install New Bridge Structure Concrete	550	cy	1,700	935,000
Bridge Rail	280	lf	80	22,400
West End Base/Paving	5,625	sy	25	140,625
Allowance For Traffic Staging and Control	1	ls	10,000	10,000
Allowance For Existing Utility Issues	1	ls	100,000	100,000
Structure And Gate Additions				
Temporary Sheet Piling, Gate Structure	24,000		40	960,000
Dewater	1	ls	15,000	15,000
Demolish Wing Wall	1	ls	42,000	42,000
Excavation, Entire Gate Area	120,000	cy	15	1,800,000
H Pile	2,880	lf	55	158,400
Gate Structure	2,600	cy	1,300	3,380,000
H pile	320	lf	55	17,600
Install New Bridge Abutment	350	cy	1,300	455,000
Install New Bridge Structure	250	cy	1,700	425,000
Bridge Rail	240	lf	80	19,200
West End Paving	500	sy	25	12,500
Allowance For Traffic Staging and Control	1	ls	10,000	10,000
Radial Gate, Incl Mechanism, Controls	2,700	sf	1,000	2,700,000
Temporary Sheet Piling, walls	23,000	sf	40	920,000
Install Downstream Training Wall	600	cy	1,300	780,000
Install Upstream & Downstream Walls	1,100	cy	1,300	1,430,000
Rock Slope Protection, South Bank	17,000	ton	80	1,360,000
Refurbish other 2 gates	1	Allow	1,000,000	1,000,000
Fish Screens & Bypass				
Fish Screens (Ultimate Capavity)	4,000	cfs	20,000	80,000,000
Riprap	1000	t	80	80,000
Subtotal				**108,141,028**
Contingency			30%	32,442,308
Total				**140,583,336**

Divert Flow (DF)

Value Alternative

Project: Through Delta Facility
Location: Sacramento, California

Alternative No:
DF-01

Title:
Vertical plate screen on the river

Description of Original Concept:

The original concept involves a multiple vee-screen (vertical profile bar type screens) sized for 4,000 cfs and located within the intake channel. The screen will be equipped with an automatic cleaning system, adjustable baffles, debris collection system, reinforced concrete box culvert structural section, and an access road. The juvenile fish will be collected at the end of each vee section and pumped to the bypass channel. The capacity of each bypass pump is 60 cfs. To minimize flow through the bypass channel, a secondary fish screen would be provided. The total length of the wetted screens is approximately 1,200 feet.

Description of Alternative Concept:

The proposed on-river fish screen facility would include approximately 1,200-foot long by 20-foot deep screens to provide an approach velocity of 0.2 fps. The fish screen facility would include 67 bays, each 15 feet wide and 20 feet deep. Blowout panel(s) would be provided as an emergency hydraulic relief system in the event of high differential head between the river and the forebay. The length of the screen depends on the characteristics of the river (i.e., depth, channel geometry, etc.) and final design flow.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☒ Increased	☒ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☐ Decreased

Cost Savings Summary

First Cost Savings:

O&M Savings: No Costs Developed

Life Cycle Cost Savings:

Advantages/Disadvantages

Alternative No.: DF-01

Advantages of Alternative Concept

- The fish are not handled; they remain in the river.
- The debris remains in the river and passes downstream.
- No bypass pumping or bypass channel back to the river are required (See the following discussion on why bypasses are deleted on the on river screen)

Disadvantages of Alternative Concept

- Higher construction cost
- Larger cofferdam is required for construction (the cofferdam for the vee screen option can include both the pump station and fish screen)
- More difficult to maintain uniform approach velocities on the screen face
- Possibly more maintenance
- In-river construction could require long avoidance periods and strict fish and water quality monitoring requirements

Discussion

Alternative No.: DF-01

The proposed fish screen facility would be constructed within a sheet pile cofferdam and would be founded on H-piles. Typically, the sheet piles are cut at the river bottom when the structure is completed. The screen facility would include the same screen material as described for the original concept. Behind the screen would be tuning baffles to assist in regulating the flows through the screen. At the base of the screen facility would be a sediment removal system. The purpose of this sediment removal system is to suspend sediment by water jetting so the sediment can be moved downstream through the screen facility to the forebay where it is easier to remove. An access road would be located the full length of the screen to assist in operation and maintenance. A log boom would be located in front of the screen facility to deflect debris back to the river. Solid panels would be located above the screens to eliminate debris from entering the forebay.

The screen would be designed to meet the criteria recommended for the TDF presented on page 19 of the Through Delta Transfer Facility Pre-feasibility Study with the exception that the screen facility would not meet the 60-second exposure for fish on the fish screen. To accomplish the minimum time exposure would require bypasses in the screen facility. These types of bypasses have proven ineffective on the Glenn-Colusa Irrigation District (GCID) screen facility. The GCID facility is 1,000 feet in length with three internal bypasses and a gravity piped bypass system back to the Sacramento River. Just recently, following exhaustive testing, the bypasses were closed.

This technology is currently being effectively used at the Glenn-Colusa Irrigation District Main Canal intake, two Reclamation District 108 intakes, and Sutter Mutual Water Company intakes. These diversions from the Sacramento River vary from 350 to 2,000 cfs.

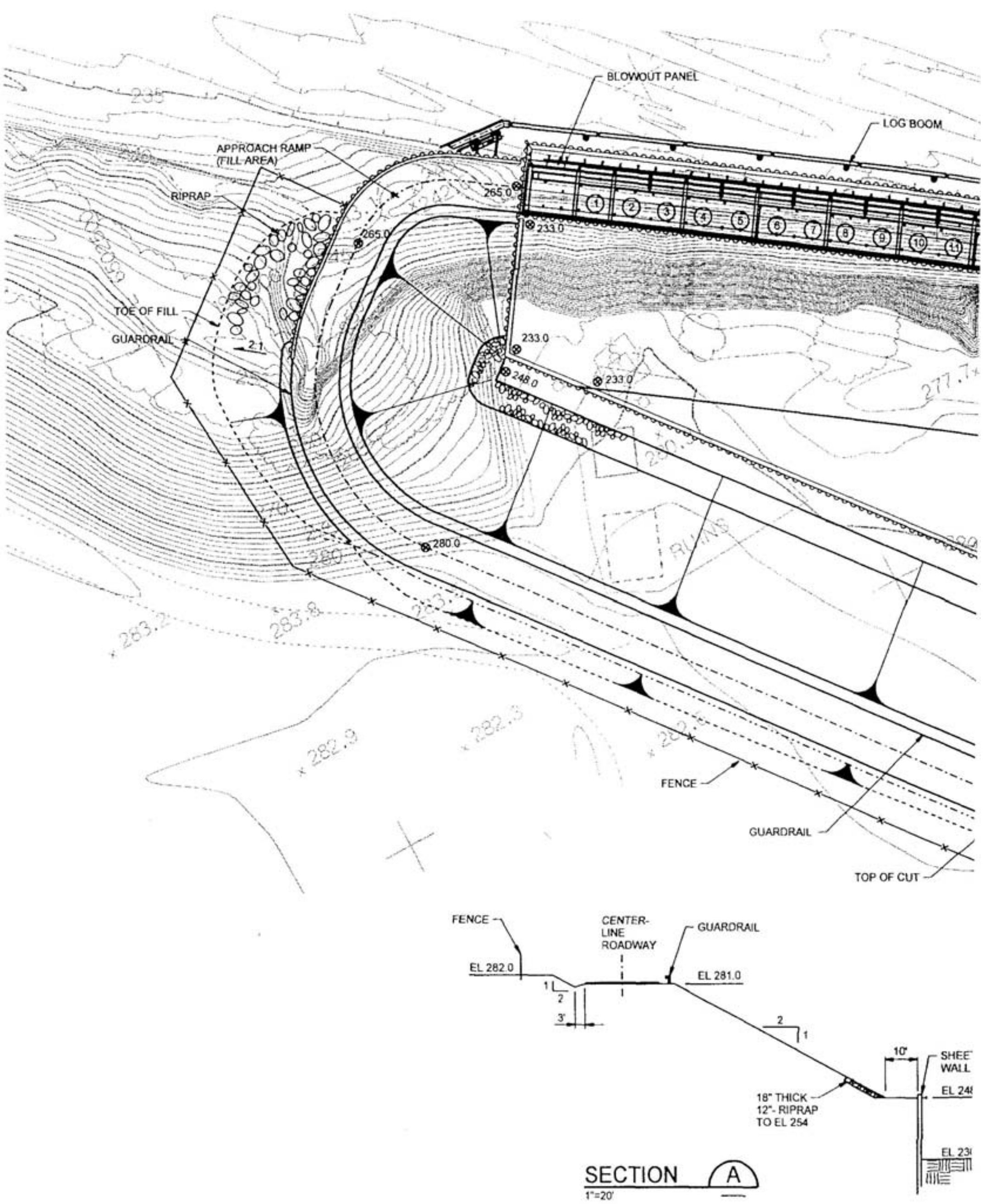
Cost Estimate

The costs will vary depending on the site. Experience has shown that the flat plate screens on the river are approximately double the cost of the vee screens in the channel for the same quantity of flow.

Sketch

Alternative No.: DF-01

☒ Original ☐ Alternative



Value Alternative

Project: Through Delta Facility
Location: Sacramento, California

Alternative No:
DF-27

Title:
Provide trashracks and head gates on the river side of the levee and locate the intake structure on the land side

Description of Original Concept:

The original concept locates the entire intake structure on the river side of the levee. This requires the levee to be reconstructed to tie into the new intake. To prevent possible flooding, head gates are provided downstream of the fish screen and upstream of the pumping station.

Description of Alternative Concept:

To keep the size of the vee screens smaller and to protect the pump station from floods, put trashracks and head gates on the Sacramento River, followed by eight 10 ft. by 10 ft. box culverts under the new levee.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☒ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☒ Decreased

Cost Savings Summary

First Cost Savings:

O&M Savings: No Costs Developed

Life Cycle Cost Savings:

Advantages/Disadvantages

Alternative No.: DF-27

Advantages of Alternative Concept

- Keeps important structures on the dry side of the levee
- Meets State Reclamation Board requirements for head gates and land side gates
- Consistant with a flow line design of the box culverts
- Can be built across the existing levee and thus not create an embayment on the river
- Can also be applied to the Original Concept screen and pump location
- Can be applied either on the existing river bank or levee or at an embayment further back

Disadvantages of Alternative Concept

- Will require approval of State Reclamation Board and Corps of Engineers (as would any concept)

Discussion

Alternative No.: DF-27

This concept allows for diversion of 4,000 cfs at the minimum design river level or at any higher level including floods, but keeps the height of the fishscreen structure and pump station low relative to the existing topography. With this approach, the top of the fish screen structure could be at elevation +5 MSL at Hood instead of elevation +30 MSL as indicated in the Original Concept. The pump station could also be reduced in height.

Although the curent preference of the State Reclamation Board and Corps of Engineers is to have pipes pass over the levees at an elevation above the flood stage. There are many irigation diversions which have “culvert” penetrations through levees. This approach is the most energy efficient approach for the proposed 4,000 cfs diversion.

If a low trash rack and head gate structure were built directly on the river bank, the highway would not have to be realigned over the new structure.

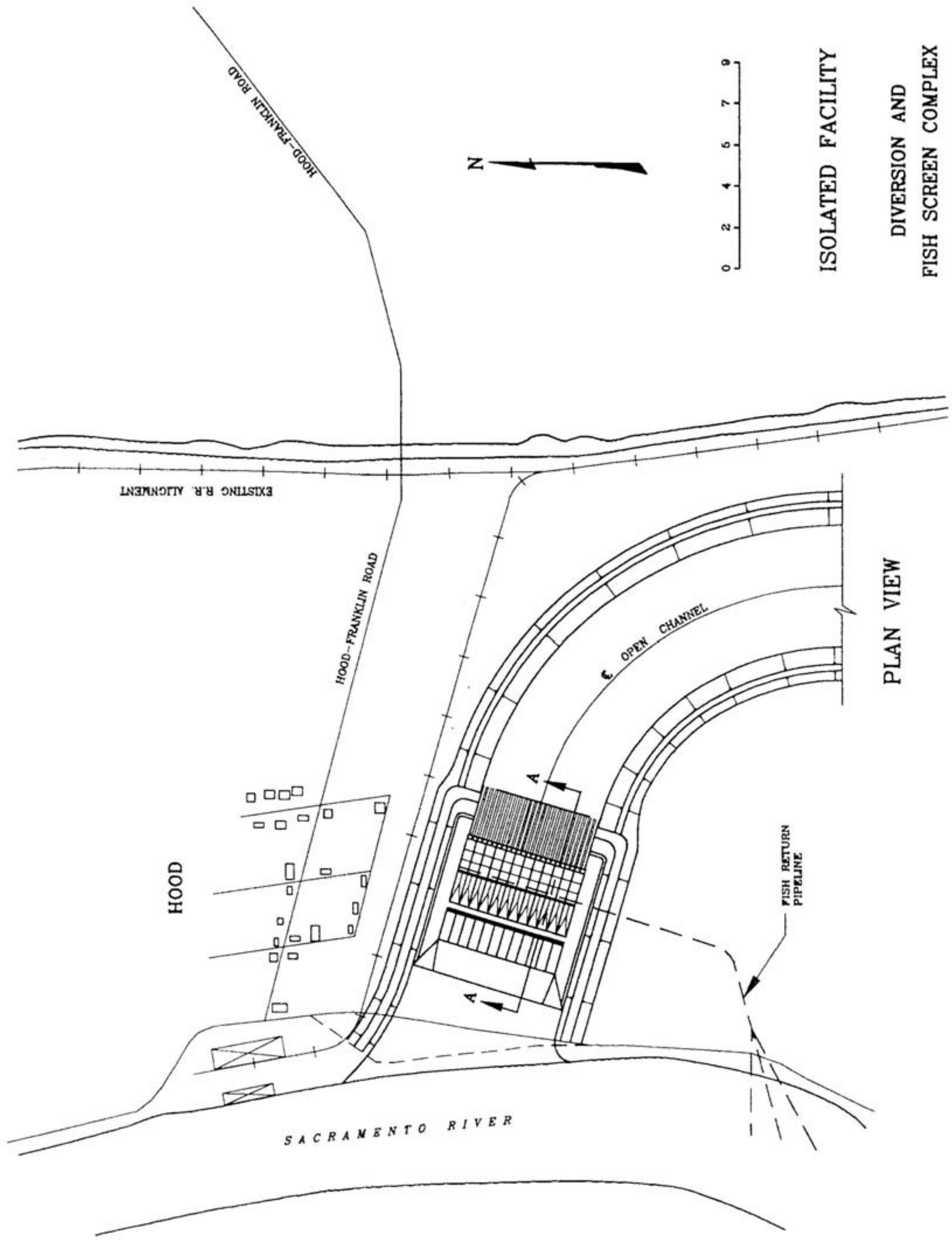
This approach also allows the canal fish screens and pump station to be isolated from the river for maintenance. Extra stop logs and lifting mechanisms would not be required.

It also can allow for a low deck level for the trashrack structure for seasonal use.

Sketch

Alternative No.: DF-27

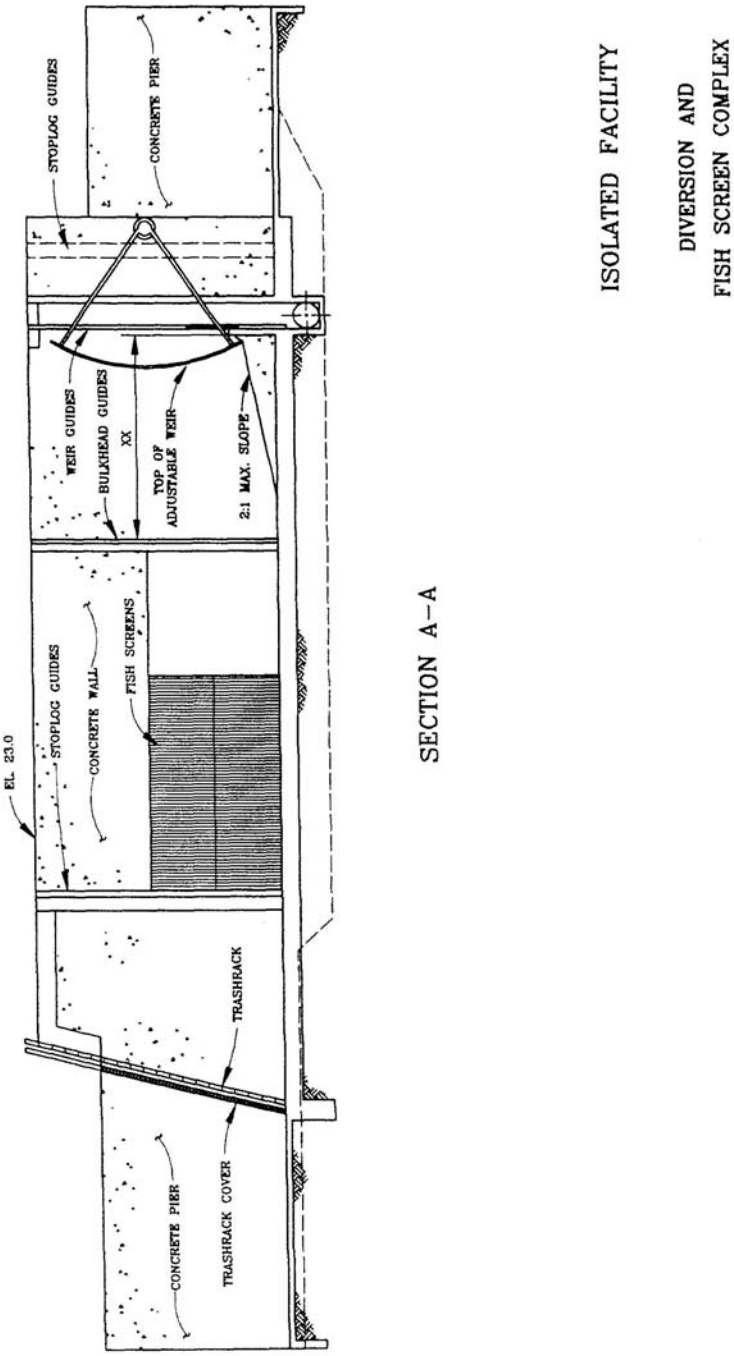
☒ Original ☐ Alternative



Sketch

Alternative No.: DF-27

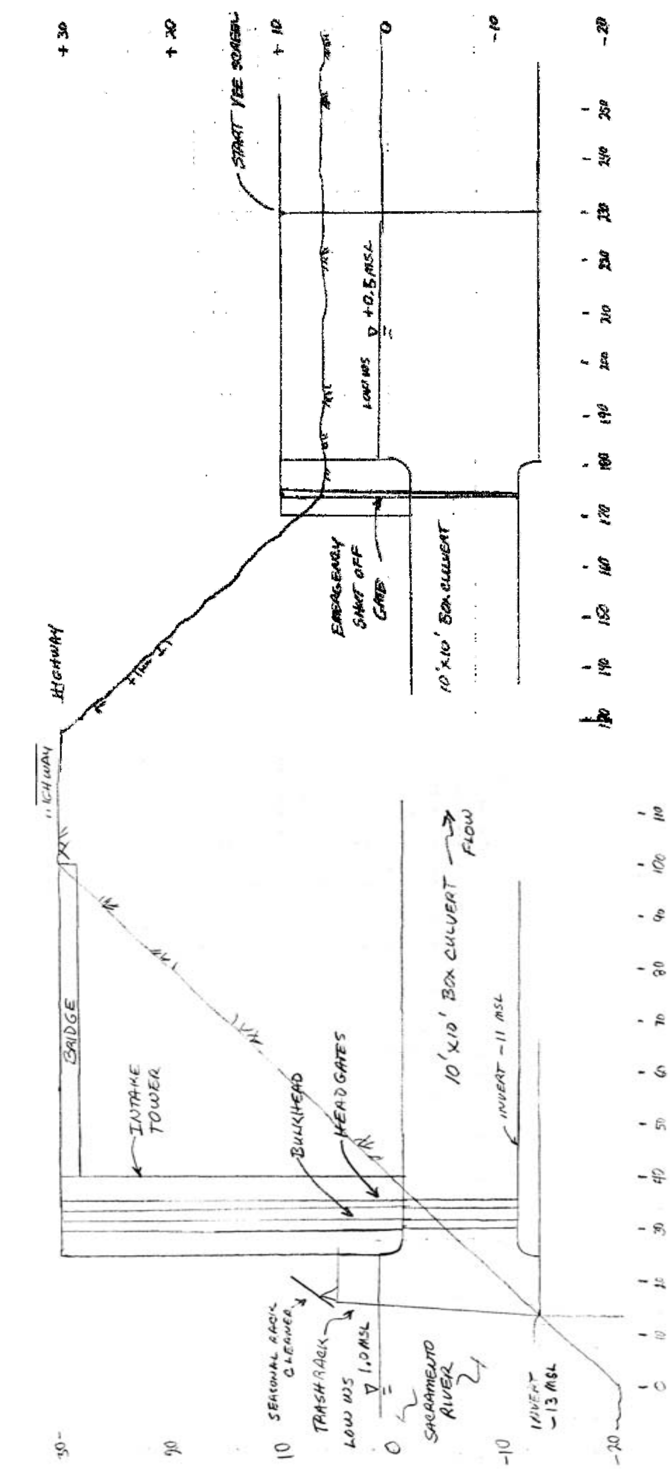
☒ Original ☐ Alternative



Sketch

Alternative No.: DF-27

☐ Original ☒ Alternative



Calculations

Alternative No.: DF-27

☐ Original ☒ Alternative

Intake on Sacramento at Hood

Design Flow – 0 → 4,000 cfs

Trash Rack Velocity – 2.5 fps

Box Culvert Velocity – 5.0 fps

Fish Screen Velocity – 0.2 fps

Trash rack on river – Assume 8-500 cfs

Trash Rack Area 14’ x 14’ = 196 sf/bay

Box Culvert Area 10’ x 10’ = 100 sf/bay

Box Channel 14’ x 115’ = 1,610 sf/total

Assume 4 – 1,000 cfs fish screens

Primary Screen – 900 cfs – 14’ x 160’

Secondary Screen – 100 cfs – 7’ x 36’

Bypass Flow = 50 cfs per Vee Screen

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Environmental Strategy

ENVIRONMENTAL STRATEGY

This memorandum presents a strategy for addressing environmental concerns during the development of the Through Delta Facility concept. The strategy includes process and resource considerations. The process strategy includes an approach to addressing the requirements of the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). In addition, the process needs to consider the needs of the regulatory agencies and the information required for a successful permit process. The resource strategy presents a summary of key environmental concerns – the focus areas for future studies.

The overall environmental strategy is to invest resources wisely. Key elements of the environmental strategy are as follows.

- Confirm how the Delta Cross Channel (DCC) is to be operated prior to initiating any public or agency consultation activities or detailed studies on the Through Delta Facility.
- Consider a phased approach to environmental compliance. Assuming alternatives selection will drive the next phase of activities, consider a Program EIS/EIR.
- With a Program EIR/EIS approach, do not invest significant resources in project design and field studies of the various alternatives.
- Early consultation with the regulatory agencies should be initiated as soon as possible, with Memoranda of Agreement documenting the approach to regulatory compliance.

Process Strategy

Two general processes are described: (1) environmental documentation, and (2) regulatory compliance.

Environmental Documentation

The Through Delta Facility will require discretionary action by the Department of Water Resources and the U.S. Bureau of Reclamation, warranting preparation of environmental documents pursuant to CEQA and NEPA, respectively.

Lead and Responsible Agencies

CEQA and NEPA each require selection of one Lead Agency for the preparation of environmental documents. For the Through Delta Facility, it is clear that the Department of Water Resources and the U.S. Bureau of Reclamation are the obvious choices for the CEQA and NEPA Lead Agencies, respectively. Responsible Agencies are those agencies that also have discretionary authority over the project, but are not the primary authority (that would be the Lead Agency). For the purposes of this memorandum, Responsible Agencies include federal Cooperating Agencies and other agencies with discretionary authority over the project. Responsible Agencies would include the following.

- U.S. Fish and Wildlife Service, because of their authority under the Endangered Species Act. Potentially a formal Cooperating Agency.

- National Marine Fisheries Service, because of their authority under the Endangered Species Act. Potentially a formal Cooperating Agency.

- U.S. Army Corps of Engineers, because of their authority under the Clean Water Act. Potentially a formal Cooperating Agency.

- State Historic Preservation Officer, because of their review authority for federal actions under the National Historic Preservation Act.

- California Department of Fish and Game, because of their authority under the California Endangered Species Act and other provisions of the Fish and Game Code. Also considered a CEQA Trustee Agency.

- Central Valley Regional Water Quality Control Board, because of their authority under the federal Clean Water Act and state Porter-Cologne Water Pollution Control Act.

- State Water Resources Control Board, because of their authority under the Water Code to regulate the diversion of water.

- The Reclamation Board, because of their authority to issue Encroachment Permits for projects affecting “project” levees.

- Local Reclamation Districts, because of their authority to issue Encroachment Permits for projects affecting their levees.

- State Lands Commission, because of their authority to issue Land Use Leases for projects affecting state lands (including riverbeds).

- California Department of Transportation, because of their authority to issue Encroachment Permits for projects affecting state highways (Highway 160).

Other agencies could have a reasonable claim to discretionary project authority (for example, the U.S. Coast Guard). In addition, local governments and the Delta Protection Commission will expect the opportunity to review the proposal.

EIR/EIS Approach

Because of the size of the project and the anticipated level of public and agency interest, it is assumed that an EIR will be required under CEQA and an EIS will be required under NEPA. There is no chance that a lesser level of environmental review would be acceptable.

Because of convention and perceived ease of use, environmental documentation likely will consist of a single, combined EIR/EIS. This is based on the fundamental assumption that the Bureau will contribute funding to the project, and that the Bureau is willing to prepare an EIS at the same time that the Department is ready to prepare an EIR. A continuing dialogue should be maintained with the Bureau on this matter. If necessary, it is possible to proceed with an EIR only.

The environmental document should be prepared to match the decision at hand, and provide the necessary disclosure of relevant information to the decision makers. At this stage of the project, the key decision appears to be the selection of a preferred alternative. The CALFED Record of Decision provides considerable flexibility, and the Value Engineering process has developed a wide range of potentially feasible alternatives. The selection of a preferred alternative requires the disclosure of environmental consequences, but there is considerable risk of wasted resources associated with detailed study of each of the alternatives. For example, critical time and money could be invested in site-specific biological and cultural resource investigations of each of the alternatives when that level of detail is unnecessary for the informed selection of a preferred alternative. Not only would these types of investigations consume time and money, they would require a substantial design investment to identify the specific project footprint and other unnecessary details.

In consideration of this risk, a Program EIR/EIS should be considered. A Program EIR/EIS can provide the decision makers with the information necessary to select a preferred alternative, and a subsequent project-level EIR/EIS can provide a focused analysis of the preferred alternative to meet all detailed environmental and regulatory requirements. The Program EIR/EIS can be prepared following completion of the Pre-Feasibility Study. The Project EIR/EIS can be prepared following completion of preliminary design (approximately 15 percent level).

The resources to be considered in the Program EIR/EIS are described under the Resource Strategy.

One very important element of the EIR/EIS approach is the resolution of issues associated with Delta Cross Channel operations. The CALFED Record of Decision states that the Through Delta Facility “is an action to be considered only after…a thorough assessment of Delta Cross Channel (DCC) operation strategies and confirmation of continued concern over water quality impacts from DCC operations.” Because the Record of Decision is a fundamental precursor to the Through Delta Facility studies, there needs to be a general statement regarding the conclusions of the “thorough assessment” of DCC operation strategies prior to substantial commencement of the Program EIR/EIS.

Level of Detail

For a Program EIR/EIS to provide sufficient information to decision makers, the following information should be developed. Note that many of these items are in addition to what is typically provided during a preliminary design process, and therefore need special attention by the Division of Engineering.

- The general “footprint” of each of the alternatives – the approximate area that will be used for project facilities.
- The general extent of any required dredging of downstream channels to accommodate increased flows, and a general description of how dredge spoils will be used or disposed.
- The general area (footprint) required for construction of each of the alternatives, including staging areas, temporary construction easements, and (perhaps most importantly) borrow pits.

- A general description of the infrastructure to be used to support the construction of the project and during project operation. For example, even a high-level Program EIR/EIS needs to discuss the possibility of hundreds of truck trips between the borrow pit and construction area.

- A rough approximation of the numbers and types of construction equipment and construction workers, and the expected number of operations staff that could be required.

Note that these items need to be provided in a very general manner, and the Division of Engineering need not spend more than a day or two developing this information. Refinements can be made for the Project EIR/EIS. Because these items are often deferred to the construction contractor, speculation required and there is some risk that project construction will occur in a manner other than that described in the environmental document.

Regulatory Compliance

At the final stages of the planning process, assuming the best, a series of permits will be issued by many different regulatory agencies (see list of Responsible Agencies above). These permits, together with signing a Record of Decision, constitute the successful resolution of the entitlement process and the authorization to move into the construction phase. In order to hope for a successful process, the dialogue needs to begin now.

Although each regulatory process is important, the focus of this memorandum is on the fish and wildlife agencies: the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Game. The basic roles and responsibilities of these agencies are described in Table 1.

Table 1 – Key Agency Roles and Responsibilities

Agency	Authority	Discussion
U.S. Fish and Wildlife Service	Endangered Species Act Migratory Bird Treaty Act	Seek to avoid "take" or minimize to the extent practicable. Extensive power to prescribe costly and time-consuming mitigation obligations. Primary focus on delta smelt and several key terrestrial species (e.g., giant garter snake), including habitat impacts. Critical input for fish screen design. Engaged on federal actions pursuant to Section 7 of the federal ESA.
National Marine Fisheries Service	Endangered Species Act Magnuson-Stevens Act	Seek to avoid "take" or minimize to the extent practicable. Extensive power to prescribe costly and time-consuming mitigation obligations. Primary focus on salmonids, sturgeon, and "essential fish habitat." Critical input for fish screen design. Engaged on federal actions pursuant to Section 7 of the federal ESA.
Department of Fish and Game	Cal Endangered Species Act Fish and Game Code	Generally follows avoidance, minimization, and mitigation prescriptions of the federal agencies, but has authority for independent review. Also likely to prescribe extensive Swainson's hawk mitigation requirements. Almost all encroachments within waterways will require a Streambed Alteration Agreement.

Following completion of the preliminary feasibility studies by the Division of Engineering and completion of the Delta Cross Channel operations studies, the Department should engage the Bureau of Reclamation (in its capacity as federal Lead Agency) and request early consultation with the fish and wildlife agencies. The purposes of early consultation are to:

- Reintroduce the agencies to the concept of a Through Delta Facility.
- Introduce the agencies to the alternatives under consideration.
- Seek input on fish screen design and potential operational requirements.
- Seek input on likely mitigation requirements (e.g., ratios) for shaded riverine aquatic cover, wetlands, and other sensitive habitats.
- Describe the anticipated process for compliance with CEQA and NEPA, as well as the anticipated milestones for regulatory (e.g., ESA) compliance.
- Seek confirmation of the level of analysis required for each agency to take action on the Program EIR/EIS and the Project EIR/EIS.

A desired outcome of this process, and a recommended strategy, is to seek approval of a Memorandum of Agreement from each agency regarding the anticipated processes for review and approval of the Program EIR/EIS and the subsequent Project EIR/EIS. The purpose of such a document is to confirm expectations about the level of detail to be provided in each environmental document. For example, the Fish and Wildlife Service will accept National Wetland Inventory data in the Program EIR/EIS and should not expect a full delineation of all jurisdictional waters.

Resource Strategy

The resource strategy is intended to provide focus to the significant environmental resources of concern, and addresses these issues in terms of a Program EIR/EIS and a future project-level EIR/EIS focusing on the preferred alternative. For the process of selecting a preferred alternative, the focus should be on the “differentiators” – those resources of concern that will strongly influence the selection. The list of potential resources of concern is taken from Appendix G of the State CEQA Guidelines – the Initial Study checklist. All recommendations in this section should be reconsidered following agency consultation and public scoping activities.

Aesthetics

This is a significant resource of concern, especially for alternatives involving a new intake structure on the water side of the levee. It is not a differentiator. For the Program EIR/EIS, viewsheds should be considered using only basic concepts of the proposed facilities. Rudimentary visual simulations should be prepared. For the Project EIR/EIS, additional design information – especially for the in-river intake – will be necessary, and a more robust visual simulation can be prepared.

Agricultural Resources

This is a significant resource of concern, especially for alternatives involving a new isolated conveyance facility. It is not a differentiator. Such impacts likely would be significant and unavoidable. An accurate estimate of farmland to be removed from production can be made for the Program EIR/EIS, and mitigation can be negotiated. Impacts to specific agricultural facilities can be deferred to the Project EIR/EIS.

Air Quality

This is a significant resource of concern, but rigorous (quantitative) analysis can be deferred to the Project EIR/EIS. It is not a differentiator. The significant concern is primarily from the construction stage, including ozone precursor and toxic emissions from construction equipment. Because substantial construction will be required under all project alternatives, impacts will likely be significant regardless of the alternative selected. For the Program EIR/EIS, the relative differences between the alternatives can be roughly quantified using tools such as the URBEMIS model. Similar methods using more solid assumptions can be used for the Project EIR/EIS.

Biological Resources

This is a significant resource of concern, and a likely differentiator. Biological resources are described below in terms of potential fish impacts and impacts to terrestrial species and habitats.

Fish

Impacts to fish need to be considered in detail for the Program EIR/EIS, and this will be a great challenge considering the uncertainty regarding the Pelagic Organism Decline and other ongoing fish issues of concern. Include as much information as is available in the Program EIR/EIS to allow informed decision-making on this critical resource. This information likely would include the following.

- System wide effects based on the CALSIM model, including how operation of the Through Delta Facility would affect the entire water system.
- Regional effects in the Delta resulting from changes in salinity using one of the accepted Delta hydrodynamic models.
- Local effects associated with changes in migration corridors (including olfactory cues), entrainment and impingement, and predation.

The benefit of this approach is that the Project EIR/EIS can focus on specific concerns of the preferred alternative – for example, operational strategies to minimize impacts and the sonic effects of pile driving – and refer back to the Program EIR/EIS for the “big picture.” Please see the *Fisheries Strategy* memorandum for additional information.

Terrestrial Species and Habitats

The effects of a Through Delta Facility on terrestrial species and habitats needs to be described at both a Program EIR/EIS and Project EIR/EIS level. Specific resources to be considered include loss of habitat associated with the installation of new facilities (especially new conveyance features), potential for reductions in populations of special-status plant and animal species such as the Delta tule-pea and giant garter snake, and potential for mortality of special status species during construction. For the Program EIS/EIR, this information can be developed using database searches (e.g., National Wetlands Inventory, California Natural Diversity Database). Although not rigorous, these tools should provide the necessary information for informed comparison among the alternatives. For the Project EIR/EIS, detailed field surveys will be required for the preferred alternative.

Cultural Resources

This is a significant resource of concern, but not a differentiator. For the Program EIS/EIR, an appropriate level of detail can be developed using database searches (e.g., California Historical Resources Information System, Sacred Lands Database) and literature searches. For the Project EIR/EIS, detailed field surveys will be required for the preferred alternative.

Geology and Soils

This is not a significant resource of concern and not a differentiator. The Program EIR/EIS should discuss the general geology and soils conditions of the various alternative sites using readily available information, and should disclose basic facts such as the greater geological integrity of conditions near Hood. The Project EIR/EIS can incorporate additional information

Hazards and Hazardous Materials

This is a significant resource of concern, but not a differentiator. The Program EIR/EIS can rely on searches of hazardous waste sites and areas of potential contamination along all alternative configurations to present a comparative assessment of encountering hazardous materials during construction. Following the selection of a preferred alternative, a Phase 1 environmental site assessment can be prepared and subsequent studies performed if necessary. Effects on mosquitoes should be considered in both documents at an appropriate level of detail.

Hydrology and Water Quality

This is a significant resource of concern, and a likely differentiator. The broad category of hydrology and water quality is described below in terms of potential hydrologic changes, potential changes in flood risk, and anticipated changes in water quality.

Hydrology

For the Program EIR/EIS, information needs to be presented that describes the effectiveness of each of the alternatives in terms of meeting the overall objective of reducing export salinity, and the unintended consequences of Through Delta Facility operations (such as salinity increases at Emmaton). This information likely would include the following.

- System wide effects based on the CALSIM model, including how operation of the Through Delta Facility would affect the entire water system. This analysis can serve as the basis for several categories of indirect (secondary) effects such as fish impacts and growth inducement.

- Regional effects in the Delta resulting from changes in salinity using one of the accepted Delta hydrodynamic models. Again, this can be the basis for analyzing several categories of secondary effects.

With a thorough analysis at the program level, the Project EIR/EIS can focus on local hydrologic effects of the preferred alternative such as scour and sedimentation impacts.

Flood Risk

The addition of 4,000 cfs of new water into the Mokelumne River corridor could exacerbate existing hydraulic constraints. The Program EIR/EIS should evaluate hydraulic effects under typical hydrologic conditions and discuss a commitment to cease operations during flood periods. In order to complete this analysis at the programmatic level, the Division of Engineering will need to determine any required dredging activities in downstream channels. In addition, all alternatives that affect the levee system will need to consider potential changes in flood risk. The specific engineering details of maintaining levee integrity can be addressed in the Project EIR/EIS.

Water Quality

All alternatives need to demonstrate their effectiveness in meeting the fundamental project objective – reducing export salinity. As described above, this can be determined using existing models of Delta hydrodynamic conditions. Although the focus has been on reducing salinity, the evaluation also needs to consider water quality parameters of primary concern. These are expected to include total organic carbon, mercury (including changes in methylation processes), and individual salinity metrics such as chlorides and bromides. All of these critical analyses need to be presented in the Program EIR/EIS. Site-specific water quality effects of the proposed alternative (e.g., erosion control) can be addressed in the Project EIR/EIS.

Land Use and Planning

This is not a significant resource of concern and not a differentiator. Proposed alternative facilities would be located mostly in Sacramento County; with some facilities located in San Joaquin County, (the county line generally follows the Mokelumne and North Fork Mokelumne River). The affected towns of Hood, Locke, and Walnut Grove are unincorporated, and public projects are generally considered consistent with local zoning requirements. Potential conflicts with existing land uses could occur, however, including conflicts with operation of lands owned (or controlled) by The Nature Conservancy. This resource can be addressed at a broad level in the Program EIR/EIS, and in a more focused manner in the Project EIR/EIS.

Mineral Resources

This is not a significant resource of concern and not a differentiator. This resource can be addressed in the Program EIR/EIS using maps available from the California Department of Conservation (Division of Mines and Geology), and would not have to be addressed further.

Noise

Depending on the alternative, this could be a significant resource of concern but is not a differentiator. Noise should be briefly considered in the Program EIR/EIS using local noise criteria and general rules of thumb regarding construction noise. Potential noise impacts will depend upon the proximity of sensitive receptors to construction activity. In addition, episodic noise during project operations should be considered in the Program EIR/EIS. Following the selection of a preferred alternative, the focus should change to detailed noise studies leading to detailed mitigation strategies.

Population and Housing

This is a significant resource of concern and could be a differentiator. This resource includes growth inducing impacts and environmental justice.

Growth Inducing Impacts

It is expected that improving export water quality (common among all alternatives) will have a secondary consequence of allowing increased exports. Many factors affect the amount of water exported from the Delta – including water supply contracts, export capacity, and regulatory limitations – and these factors can affect exports to a greater degree than 10-20 percent variations in electrical conductivity. Recent experience has shown, however, that any change that could allow exports to increase is subject to extensive scrutiny and potential litigation. This is especially true for the Through Delta Facility, a project that many perceive as a precursor to a Peripheral Canal. One of the flashpoints is the potential for increases in deliveries to stimulate growth in the contractors' service area (e.g., Santa Clarita). The potential for this to occur needs to be described in the Program EIR/EIS using data on changes in deliveries from the CALSIM modeling. The process of linking changes in deliveries to growth in the service areas needs to be carefully described following the approach currently favored by the Department (e.g., for the South Delta Improvements Project).

Environmental Justice

Environmental justice generally means disproportionate effects to minority and low-income populations. All CALFED projects need to consider this topic carefully. Although improving export water quality is considered a positive effect to water user (including EJ communities), the location of the Through Delta Facility cannot be chosen based on the characteristics of the affected communities. This is especially important considering the potentially affected communities of Hood, Locke, and Walnut Grove have a high potential for EJ populations. This topic can be addressed in the Program EIR/EIS using readily available data. Pending successful navigation of this issue at the programmatic level, additional consideration in the Project EIR/EIS should not be required.

Public Services

This is not a significant issue of concern and not a differentiator. Public services include local providers of water, wastewater, police, fire, and other municipal services. This topic can be deferred to the Project EIR/EIS (i.e., not addressed in the Program EIR/EIS).

Recreation

This is a significant issue of concern and a potential differentiator. The Program EIR will need to consider two broad categories of recreation: fishing and boating. The analysis of potential fish impacts (described above) needs to consider important sport fisheries such as striped bass. In addition, the potential for Through Delta Facilities to affect navigation (primarily recreational boating traffic) needs to be carefully considered. For the Program EIR/EIS, there should be an extensive effort to collect information on boating traffic in the affected waterways using standard recreation survey methods. Data from these surveys will help the decision makers in their selection of a preferred alternative. For the Project EIR/EIS, additional, focus analysis should occur with regard to the boating safety impacts of new facilities.

Transportation and Traffic

This is a significant issue of concern, especially during the construction phase when many truck trips could occur. It is not a differentiator. The Program EIR/EIS needs to consider, at a very high level, the number of construction vehicles expected to use local roadways in order to access project construction areas. The general project area is sparsely populated, which makes the addition of construction traffic much more noticeable. For the Program EIR/EIS, existing traffic conditions on affected roadways and existing road conditions should be generally characterized (not quantified) and evaluated. A qualitative analysis should be sufficient to provide decision makers with an appropriate level of detail to make an informed selection of a preferred alternative. For the Project EIR/EIS, an additional assessment of road conditions and potential safety hazards should be performed.

Utilities and Service Systems

This is not a significant issue of concern, and not a differentiator. The Program EIR/EIS should include a general characterization of large utilities potentially affected by the various alternatives (with a commitment to avoid or replace affected utilities), and include a general statement that smaller municipal facilities are likely to be present and will be evaluated in detail during the design phase and in the Project EIR/EIS.

Cumulative Impacts

This is not a significant issue of concern, and not a differentiator. Although the assessment of cumulative effects (project effects together with the effects of past, present, and reasonably foreseeable future actions) is not a significant consideration, it will require careful consideration. The analysis of cumulative effects is often a target for litigation, and the Program EIR/EIS should follow the current Department approach for preparing cumulative analyses (e.g., South Delta Improvements Project). Both the Program EIR/EIS and the Project EIR/EIS should address cumulative effects – the former at a broad level (e.g., other statewide actions affecting water quality and the Delta ecosystem) and the latter at a narrow level (e.g., a list of other activities near the preferred alternative).

Fish Strategy

FISH STRATEGY

The fish strategy adopted for this exercise was to minimize the fish and wildlife impacts associated with the alternatives, and to mitigate all unavoidable impacts. Of specific concern are the listed species (Federal and State), the anadromous fishes (fish that migrate past the project site), and other species of concern.

The listed species of concern include:

- Chinook salmon – winter run, spring run and fall run (candidate),
- Steelhead rainbow trout.
- Delta smelt, and
- Green sturgeon

The anadromous fishes include:

- Chinook salmon – fall, late fall, winter, and spring runs,
- Steelhead rainbow trout,
- Green sturgeon,
- White sturgeon,
- Striped bass,
- American shad, and

Other species of concern include:

Outmigration Concerns/Strategies

Sacramento River Juveniles

Anadromous fishes are subject to the influence of the project during both their upstream migration (as adults), and their downstream migration (as juveniles). Various species have various life stages exposed to the project. The project includes a point of diversion on the Sacramento River near Hood (but could be located between Georgiana Slough and Hood).

Chinook salmon outmigrants on the Sacramento River include a fry migration, a smolt migration, and yearling migrants. The fry migration is bank oriented, downstream displacement of these fish, resulting from the territorial occupation of suitable habitat upstream by early emerging fish.

The smolt migration is an obligatory movement to the ocean, when the fish have reached a stage of development that allows them to survive in the ocean, or “smolted.” Fish that either grow slowly, or are spawned late in the season, must remain upstream until conditions suitable for their migration and survival. These often leave the system as “yearlings.” Migration timing includes:

- Fall Run
- Late Fall Run
- Winter Run
- Spring Run

Steelhead rainbow trout have a similar outmigration, but the young leave as leave as yearlings or two year olds. Thus, due to the location of the intake, the Chinook salmon criteria should be adequate in this site.

Green, and white, sturgeon, are thought to pass by the intake as eggs or larvae, and cannot be effectively screened. Thus, a curtailment of diversions could be needed to protect these fish.

Striped bass spawn in open water, and their eggs and larvae drift downstream past the intake site, and develop in the entrapment zone, generally in Suisun Bay. Again, the curtailment of diversions could be needed to protect these fish.

Delta smelt are present seasonally at the project intake site, and in the past the US Fish and Wildlife Service (USFWS), has required very conservative fish screen criteria to protect this fragile species. We assume that the approach velocity criterion will be 0.2 fps, which for a 4000 cfs diversion will require approximately 20,000 square feet of active fish screen surface area.

San Joaquin River Juveniles

Anadromous fishes (Chinook salmon and Steelhead rainbow trout), on the San Joaquin River, also exhibit migratory behavior. The Chinook salmon, fall run, and spring run, and Steelhead rainbow trout migratory patterns and issues are similar if not the same as those described on the Sacramento River.

Recent activity, driven by a Court Decision to restore flows and fisheries to the San Joaquin River, will make this a high priority item.

Mokelumne River/Consumnes River Outmigrants

These fish outmigrate past the discharge point of the proposed project and will be prone to follow the flow (wall of water) to the export pumps in the south Delta. These fish, and fish of San Joaquin River origin, may require improvements at the south Delta, CCWD, CVP, and SWP fish protective facilities. The ROD specifically lists the construction of a new screened intake at Clifton Court Forebay (SWP), a new screened diversion for the Tracy Pumping Plant (CVP), or an expansion of the SWP capacity to accommodate the CVP.

Fish Screens

The provision of fish screens at the intake of the Through Delta Facility, with a 4000 cfs capacity, will be mandatory. We believe that the regulatory agencies will require the use of

Delta Smelt criteria (0.2 fps approach velocity and 1.75 mm clear bar space on welded wedge wire).

A 3000 cfs fish screen, which met all Agency fish screening criteria, was completed in 2002, at the Glenn-Colusa Irrigation District (GCID) intake, near Hamilton City on the Sacramento River. Although built to the 0.33 fps salmon approach velocity, doubling the cost of the GCID facility and adjusting for inflation would provide an approximate cost estimate for the fish screen for this project.

Upstream Migration Concerns/Strategies

Anadromous fish upstream migrants (adults) are subject to delay, confusion, and loss at the project site. These fish are thought to follow a "home stream" olfactory cue, to get back to their natal stream.

The proposed project will increase the volume of Sacramento River source water in the Central Delta, which will attract Sacramento River upstream migrants into the Central Delta via the San Joaquin River. At the same time, the presence of this water in the Central Delta will confuse fish seeking the San Joaquin River and its tributaries. Both groups of fish will be subject to delay, and straying.

Of particular concern, due to the location of the facilities point of discharge, are fish seeking the Mokelumne and Consumnes rivers.

Sacramento River Adults

These fish, who are seeking a direct route to the Sacramento River and its tributaries, can be confused by the presence of Sacramento River water in the San Joaquin River. As a result, they enter the San Joaquin River seeking the Sacramento River, unless they find their way via the Delta Cross-channel, Georgiana Slough, Three Mile Slough, or by falling back to the tip of Sherman Island and entering the Sacramento River.

Another potential path that these fish might take is to attempt to use the Through Delta Facility (TDF) as a path. Due to the presence of three siphons, radial gates, a pumping plant, fish screen and trash rack, which would have to be negotiated, we believe this path should be blocked. The addition of a "tailrace barrier" to the alternative would solve this problem.

San Joaquin River Adults

Adult fish bound for the San Joaquin River (and its tributaries) also face confusion and delay, attributable to the presence of a wall of Sacramento River water going to the export pumps. The proposed project will add water of Sacramento River origin to the Mokelumne River, increasing the "wall" of water heading to the pumps.

Mokelumne River (and Consumnes River) bound fish will need to make a choice at the outlet of the project. The "tailrace barrier" would prevent the fish from making the wrong choice at this location.

Once the fish reach the "wall" of water, cues from the San Joaquin River source water become apparent, allowing the fish bound for the San Joaquin River basin to find their way upstream. Again, the "tailrace barrier" will assist in this regard.

Fish Ladders and Boat Locks (Upstream Passage Facilities)

To the extent that the proposed project increases the quantity of Sacramento River origin water to enter the Central and South Delta, one could expect an incremental increase in the straying of Sacramento River Basin origin fish. This in turn could result in more fish being stranded at the closed Delta Cross-channel (DCC) gates. If this was deemed significant, then a fish ladder (or a boat lock), or both, could be required at the DCC.

Plans for such a fish passage structure on the north bank of the DCC have been prepared and could be updated as needed. The issue of a boat lock at the DCC was raised, and the consensus was that such a structure was not needed for boating impacts. However, a boat lock is being used to pass upstream migrants in Montezuma Slough with excellent results. Thus, the provision of boat locks in lieu of a fish ladder might solve two problems with a single facility.

Fish Screening

FISH SCREENING

Fish Screen Strategy – On-River vs. In-Canal Location

The location of the fish screen often is the single most important factor associated with the success or failure of a project. Two basic locations, “in-river,” and “in-canal,” have been suggested for the fish screens for this project.

In-River Fish Screens

The concept of an “In-River” fish screen was developed around a desire to minimize the need for handling the fish at the fish screen. Essentially the location, on the river, is assumed to address the salvaged fish (and debris) by keeping it in the river, moving naturally downstream. The facility no longer needs a bypass, a fish friendly pump to drive the fish bypass, or an outlet structure.

Single Intake Fish Screen

The single intake structure consists of a single fish screen, sized to 4000 cfs, and built into the levee of the Sacramento River. The river is assumed to range between +1 at low (controlled flow) conditions, and +25 at flood stage. The invert is assumed to be at -15. This gives us a screen depth of 16 feet, and will result in a fish screen that is 1250 feet long.

(4000 cfs / 16 feet = 250 square feet / 0.2 fps = 1250 feet)

This intake screen length exceeds the standard in the NMFS fish screen criteria, which limits fish exposure to 60 seconds. However, given that the screen approach velocity used is 0.2 fps (to protect delta smelt), the case should be made that the “60 second” exposure criterion, which was based on a 0.4 fps screen approach velocity,
should not apply.

Multiple Intake Fish Screens

The use of multiple “in-river” fish screens and pumps, to reach (in sum) the 4000 cfs capacity desired would permit the use of “off the shelf” agricultural units to minimize the capital site costs. In concept, a vertical lift or a slant pump, with a self-cleaning cylindrical fish screen(s) would be installed. An example of the In-River ISI Screen for Vertical Pumping Station is shown at right.

There was general agreement that each station should be sized to the channel capacity associated with the site. Thus, a variety of solutions and sizes would be used to reach the in-total 4000 cfs goal. This would make Operation and Maintenance more difficult, due to the lack of standardization. However, the benefits were viewed as outweighing the costs in this case.

Because these screens are limited in capacity, multiple modules will be needed.

In-Canal Fish Screens

The concept of an "In-Canal" fish screen was presented by the staff of the project, and consisted of a "saw tooth," or "vee," arrangement of the fish screen, to minimize the exposure of fish to the screen, and to reduce the length of the structure.

In this case, the screen module would rest in the canal, and would need a fish bypass system to return the screened fish to the Sacramento River. This bypass could be a piped bypass, but it could also be a trap and truck operation. Regardless of the nature of the bypass system, measures to reduce (or eliminate) predation on the salvaged fish would be needed at the release site.

The proposed in-canal fish screen ignores the Delta Smelt 0.2 fps requirement of the USFWS. Thus, it is smaller than needed for this site. The Delta Smelt criteria have been required of all fish screens below the American River, on the Sacramento River. Thus, the screen would have to be either widened, or lengthened (or both), to achieve the needed screen surface area.

Given the complexities of the fish bypass system and the fish impacts associated with this feature, we chose to use the "in-river" fish screen.

Upstream Migrant Barrier Strategy

UPSTREAM MIGRANT BARRIER STRATEGY

The release of water diverted from the Sacramento River into the Central Delta, specifically into the South Fork of the Mokelumne River at Beaver Slough, will require the installation of measures to deal with upstream migrants attracted to the discharge.

Two ways to deal with the problem were discussed. The first solution involves allowing the upstream migrants to take this route. We would then provide fish passage facilities to get the fish through the siphons, and around the flood gates, pumping station, fish screen, and trashrack complex.

The second solution involves preventing the fish from entering the channel by installing a tailwater barrier at the discharge from the facility. This alternative depends on the ability of the fish to find alternate routes back to the Sacramento River. Studies conducted by the California Department of Fish and Game as part of the Delta Cross-channel studies conducted by CalFed, have shown that fish (Chinook salmon) have the ability to find alternate paths, such as Georgiana Slough and Three Mile Slough, and including falling all the way back to the junction of the San Joaquin and Sacramento rivers.

The collective view of the Team was that the latter alternative was the preferred solution.

The tailwater barrier, proposed for this site, would consist of a vertical bar rack with one inch clear openings, and a water discharge velocity of 1.0 foot per second. Thus, with a depth of water maintained at 10 feet, the structure would be 400 feet wide. This feature will easily fit within the right-of-way of the channel, described as approximately 600 feet.

The alternative of a ladder or boat lock around the headworks of the channel would have to pass salmonids, striped bass, sturgeon, and American shad. We are currently using a boat lock to meet the fish passage requirements in Montezuma Slough, at the Salinity Control Structure. The boat lock is left open, except when a boat is being locked through, thus providing a fish passage channel.

The fish ladder (and the boat lock if included) could be located upstream or downstream of the intake to the project. The structures would require high walls to be able to operate during flood season (when the river is at +25), although the working differential stage is substantially less.

A vertical slot ladder is the most likely candidate for this site, and if used to pass the green and white sturgeon, would need to be quite long, due to the shallow slope needed for this species. The design criteria for such a ladder are available from our recently completed studies at the UC Davis – J. Amarocho Hydraulics Laboratory.

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SECTION 5

DESIGN SUGGESTIONS

SECTION 5
DESIGN SUGGESTIONS

In addition to the Value Alternatives in the previous section, the team generated several other ideas that we have termed design suggestions. These are presented to bring attention to areas of the plan that, in the opinion of the team, should be changed. In general, these ideas were designated as design suggestions rather than Value Alternatives for one of two reasons:

1. the value improvement opportunity is relatively small
2. the concept could not be adequately evaluated or developed within the constraints of the workshop resources

Design suggestions typically are associated with issues such as:

- improved operation
- ease of maintenance
- easier construction
- reduced risk of construction claims
- clarification of construction documents
- or safer working conditions

G-01

Perform hydrologic and water quality analysis at various capacities to determine the optimum value

Several alternative diversion and discharge locations for the TDF have been suggested, with some of the diversions designed for less than 4,000 cfs. These alternatives will result in various amounts of Sacramento River water being diverted at various locations; causing various amounts of backwater on existing diversion facilities and various water quality improvements at the export pumps. To select the most cost effective diversion location and diversion amount, the magnitude of water quality benefits need to be quantified using the hydrodynamic models developed for these studies. These analyses were not available for the VE studies.

Calculation of absolute water quality (EC) at the export pumps is informative but does not truly quantify the project benefits. During dry and critical water years, less water is exported from the Delta due to the shortage of water. This variation in export amounts needs to be considered in quantifying benefits. A better measure of benefits would be the absolute amount of salt exported from the Delta. Salt export is a measure of salts that need to be removed by downstream water users or the amount of high quality make-up water that is needed or the amount of salts applied to agricultural lands and that will damage the lands and/or be returned to the system as return flows.

Benefits associated with each of the alternative projects for a range of water year conditions need to be evaluated on a comparative basis using the hydrodynamic models. A formal cost-benefit analysis of the alternatives should be completed before selection of the "apparent best alternatives" that are to be included in more detailed studies.

G-02

Pump design strategy

The design of large flow, low head canal lift pump stations involves matching the hydraulics of the canal. The location of the pump station is usually determined by the economy of the canal earthwork.

Large axial flow pumps are available in vertical, horizontal, and slanted shaft configurations. Vertical shaft pumps are shown on the 1981 drawings of the 3,000 cfs pumping plant at GCID (copies given to DWR/DOE at VE meeting). The DWR design for the 13,300 cfs plan at CCFB uses the horizontal shaft arrangement with siphon. Slanted shaft models are more common in hydro turbines. Bulb units and 90-degree drive horizontal shaft should also be evaluated. Three units are very common in hydro applications.

For the 4,000 cfs, it is assumed that 5 to 10 pump units would be required. The larger number of pumps (smaller unit flow) would probably be most economical because they are more readily available and easier to work on.

G-03

Perform physical model to analyze sedimentation issues

For both fish screen structures and large pump stations we recommend hydraulic modeling of the total system. The total system may include the river in front of the screen, inlet structures, and forebay.

In the case of the screens, particularly a screen on the river, the modeling will help in determining the uniformity of flow in each screen bay under various pump flows and river flows. Studies that would be useful to the Department are the biological testing and hydraulic testing performed at Glenn-Colusa Irrigation District. Under low pumped flow conditions, water may actually enter the forebay at the upper screen bays and exit out the lower screen bays. Modeling will assist in determining if screen bays may need to be closed to develop uniform approach velocities on the screens under varying flow conditions. Hydraulic modeling will assist in sizing the pump station intake so that vortexing of pumps is avoided and locating baffles, if required, for flow straightening under various flow conditions. The modeling may assist in determining the size and number of the various pumps. For example the installation of 10 smaller pumps rather than the six shown, may result in more uniform flow across the forebay and the screen facility.

Sediment studies were performed by RD 108 on their on-river screen facility following the first year of operation. Significant silt built up behind the screen facilities adversely affected the uniformity of the approach velocities. From these studies, a water cleaning system was retrofitted to the facility. This cleaning system suspended the silt into the water column so that it could be easily removed downstream. The results of this study can be made available to the Department, if desired.

G-04

Conduct model study flow distribution across screens

Physical hydraulic models are sometimes used to determine flow distribution at very large fish screens. More recently, CFD math models have been used. These tools are always required if there are unusual approach conditions which would unbalance the flow distribution on the screens.

Both the GCID and Sutter Mutual projects had both physical and math models. These models also were used to visualize sediment accumulations, although they were not the more expensive type “moving bed” physical models.

Even if physical or math models are used, these screens should be designed with “field adjusted” porosity control. Normally, it is during the post construction hydraulic verification test that the screens are finally balanced to meet the approach velocity criteria.

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APPENDICES

APPENDIX
A - PARTICIPANTS

APPENDIX A – PARTICIPANTS

Day 1 (Mon) – Workshop Introduction & Design Presentations
Day 3 (Weds) – Mid-point Review
Day 5 (Fri) – Presentation of Alternatives

Name	Organization	Phone	Email	Day		
				M	W	F
John L. Robinson	Strategic Value Solutions	816.228.6160	John@StrategicValueSolutions.com	X	X	X
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Howard Wilson	CH2M Hill	530.243.5886	hwilson@ch2m.com	X	X	X

APPENDIX
B - COST INFORMATION

APPENDIX B – COST INFORMATION

Project Cost Analysis

Basis for Pricing

The following pricing information was provided to the Value Team for the current project cost estimate.

- Project costs are based on the work being performed by a contractor with prices prevailing during the second quarter of 2007.
- Project costs have not been escalated, as there is no schedule. Estimates are in current dollars.

Significant Cost Issues

Price of right-of-way acquisition has not been included in these evaluations, as the panel has no basis for current land value.

No information on power grid or adequacy of power supply was available for this study, It was assumed that power would be available at intake and pump station locations.

Siphons were considered to be constructed by open cut method. Environmental considerations may prevent this method.

Foundation conditions were generally considered to be piling.

All costs are in current dollars.

Based on recent information fish screen system prices were based in $20,000/cfs in all cases.

Conclusions

Revised project cost estimates are attached.

Through Delta Transfer Facility				3/28/2007
Divert @ Hood, Open Channel to Mokelumne				
Item	Quantity	Unit	Unit Price	Total
Mobilization & General Conditions			12%	36,583,402
Inlet Structure/Screens	1	ls		113,000,000
Pump Station	1	ls		30,000,000
TDF Canal	11.7	miles	8,000,000	93600000
Stone Lake Siphon (Snodgrass)	1	ls		6,000,000
Lost Slough Siphon	1	ls		5,200,000
Mokelumne River Siphon	1	ls		3,500,000
Hwy 160 Bridge	1	ls		8,520,683
Lambert Road Bridge	1	ls		6,800,000
Twin Cities Road Bridge	1	ls		6,100,000
Lauffer Bridge	1	ls		6,100,000
Walnut Grove Road Bridge	1	ls		6,100,000
Outlet and Miscellaneous Structures	1	ls		19,941,000
			Subtotal	**341,445,085**
	Contingency		30%	102,433,525
			Total Estimated Cost	**443,878,610**

APPENDIX
C - CREATIVE IDEA LISTING

APPENDIX C – CREATIVE IDEA LISTING

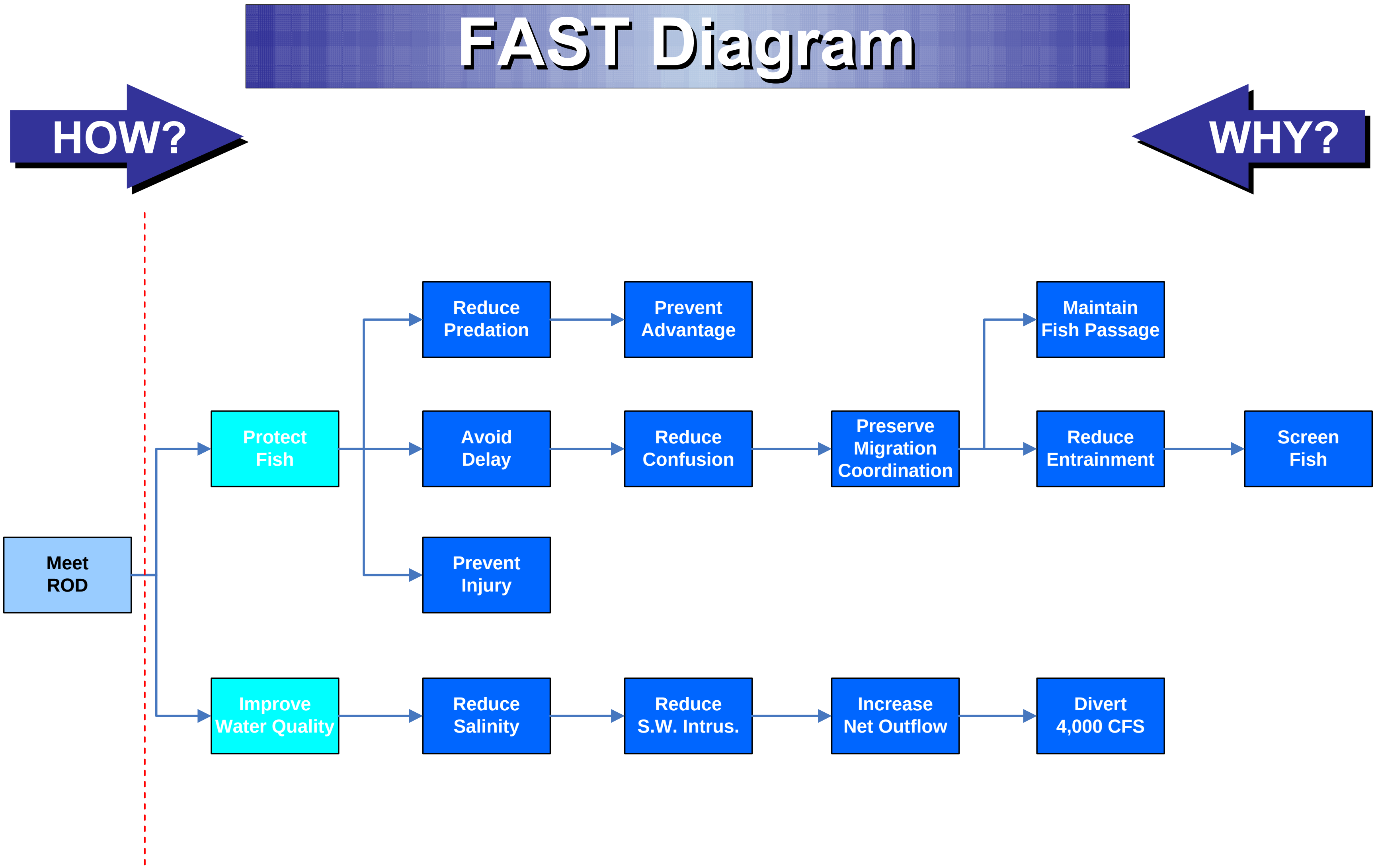
IDEA NO.	IDEA DESCRIPTION	RATING
	Convey Flow (CF)	
CF-01	Divert at Hood; open channel to South Mokelumne	5
CF-02	Add another gate at DCC	0
CF-03	Divert at Hood and open channel flow to Snodgrass Slough at Stone Lake Outlet	0
CF-04	Divert at Hood, open channel to Lost Slough with reduced footprint	7
CF-05	Divert at Hood and channel to mainstream Mokelumne	3
CF-06	Divert at Hood and channel to south edge of Brack Tract (Sycamore Slough)	0
CF-07	Divert at Hood and channel to Potato Slough	1
CF-08	Cut channel north of DCC at Meadows Slough and bring flows back to DCC Channel	0
CF-09	Divert north of Walnut Grove; pipe water to Snodgrass north of DCC 9 or box culvert)	3
CF-10	Intake structure north of Walnut Grove/Locke	7
CF-11	Divert at Georgiana Slough	2
CF-12	Screen Georgiana Slough and open DCC	1
CF-13	Divert at upper Snodgrass Slough and enlarge upper portion of Slough	1
CF-14	Divert at Georgiana and cut Tyler Island to Snodgrass slough	1
CF-15	Divert at Georgiana Slough and cut channel across Staten Island to South Fork	7
CF-16	Divert at Georgiana Slough and levee across top half of State Island to convey flows to South Fork at Beaver Slough	1
CF-17	Divert at Hood and channel across the railroad to Stone Lakes	0
CF-18	Divert north of Meadows Slough and channel to Snodgrass Slough	0
CF-19	Divert at multiple locations and consider capacity of downstream receiving channels in locating and sizing diversion	7
CF-20	Divert water to north part of Staten Island for ecosystem enhancement and conveyance	2
CF-21	Convert canal south of Lost Slough to large conveyance area across McCormick-Williamson Tract and Staten Island and outlet flows to south Fork Mokelumne	1
CF-22	Size multiple intakes to match capacity of national channels	6
CF-23	Divert less than 4,000 cfs via any of the above alternatives	0
CF-24	Do nothing	0
CF-25	Do the peripheral canal with 4,000 cfs	1
CF-26	Make the TDF a low-flow channel for a future P.C.	1
CF-27	Reduce the footprint of any new channels	0
CF-28	Use a concrete box culvert (buried)	1
CF-29	Use a concrete channel	1
CF-30	Divert at Hood and channel along I-5	1
CF-31	Build a concrete lined channel along Sacramento River to DCC and outlet to DCC or to Mokelumne	0

IDEA NO.	IDEA DESCRIPTION	RATING
CF-32	Divert at Steamboat Slough and outlet south of Walnut Grove	0
CF-33	Build Armored Island solution	0
CF-34	Use unlined channel	1
CF-35	Provide riprap in the tidal range	1
CF-36	Identify multiple locations that could be built initially at 1,000 cfs but capable of expansion	0
CF-37	Use Free Port intake and pump to Commanche Reservoir and release to Mokelumne	0
CF-38	Increase diversion capacity of the Delta Cross Channel (DCC) and add fish screens	7
	Divert Flow (DF)	
DF-01	Vertical plate screen on the river	7
DF-02	Use in-river fish screen with gates across Sacramento River to manage bypass flow	1
DF-03	Use in-river gates to raise head on river for diversion to reduce/eliminate pumps	1
DF-04	Use groins/vanes to encourage passage of sediment and debris	0
DF-05	Use smaller diversions and eliminate pumping	2
DF-06	Use smaller diversions and eliminate fish bypass	1
DF-07	Provide one 4,000 cfs pumping station	0
DF-08	Divert without pumping	1
DF-09	Use a siphon on Sacramento River and don't breach levee and outlet to a channel to Mokelumne	1
DF-10	Convert an island to a reservoir; divert using tidal head and release at 4,000 cfs	1
DF-11	Put pump on dry side of levee; and pipe to discharge location	0
DF-12	Provide in-channel screen with fish return channel	2
DF-13	Provide flood gates on intake	0
DF-14	Provide multiple (~20) inlets and outlet to multiple locations for a combined 4,000 cfs	3
DF-15	Put pump station on wet side and pipe over the levee	0
DF-16	Put pump station on dry side of levee and put suction pipe through levee with on-river screen	0
DF-17	Provide fish ladder with pump station solutions	2
DF-18	Operate only when operating the DCC and eliminate fish screens	1
DF-19	Preserve area at the intake structure to accommodate a larger diversion in the future	1
DF-20	Use multiple smaller pumps	0
DF-21	Use a pump station configured similar to GCID	0
DF-22	Use axial-flow pumps for this low head application	0
DF-23	Use multiple smaller pumps with multiple smaller intake locations	0
DF-24	Provide bypass in the screen face for in-river screen	0
DF-25	Provide a bypass in the screen face with a pump station	0
DF-26	Keep pump station close to intake structure or move down 20,000 ft per the DC report	0

IDEA NO.	IDEA DESCRIPTION	RATING
DF-27	Provide trash racks and culverts under levee to connect to head gates followed by canal filled by screen followed by pump station	7
	Outlet (O)	
O-1	Provide fish barrier	0
O-2	Capture and truck fish	0
O-3	Pump fish back to Sacramento River	0
O-4	Clarify levee elevations	0
O-5	Provide flood gates	0
O-6	Don't put a barrier on outlet and use a fish ladder at the pump station/intake structure	0
O-7	Provide erosion protection into receiving channel	0
O-8	Align discharge parallel with receiving channel	0
	General (G)	
G-1	Perform hydrologic and water quality analysis at various capacities to determine the optimum value	DS
G-2	Pump design strategy	DS
G-3	Perform physical model to analyze sedimentation issues	DS
G-4	Conduct model study flow distribution across screens	DS

APPENDIX
D – FUNCTION ANALYSIS

APPENDIX D – FUNCTION ANALYSIS



	FUNCTION		
COMPONENT	**VERB**	**NOUN**	**Comment**
Conveyance	Convey	Flow	0 - 4,000 cfs
	Prevent	Flooding	
	Mitigate	Environmental Impact	
	Isolate	Flow	
	Protect	Flow	
	Mitigate	Irrigation Impacts	
	Speed	Delivery	
	Prevent	Disruption	
	Prevent	Seepage	
	Prevent	Farm Drainage	
Intake	Control	Flow	0-4,000 cfs
	Screen	Fish	0.2 f/s
	Avoid	Impingement	
	Prevent	Flooding	
	Minimize	Environmental Impact	
	Maintain	Fish Passage	Fish Ladder bypass
	Prevent	Sedimentation	
	Exclude	Debris	
Pump Station	Ensure	Supply	0 – 4,000 cfs
	Add	Head	10 ft. lift
Outlet	Deliver	Flow	East of Sac River 0-4,000 cfs
	Isolate	Flood Flow	
	Exclude	Fish	Fish Barrier

APPENDIX
E - LIST OF MATERIALS PROVIDED

APPENDIX E – MATERIALS PROVIDED

Ref#	Document	Prepared by	Date
1	Through Delta Transfer Facility Pre-Feasibility Study	State of California, The Resources Agency, Department of Water Resources, Division of Engineering	March 2007
2	Pelagik Fish Action Plan	Resources Agency, CalDWR, California Department of Fish and Game	March 2007
3	Technical Memorandum – Through Delta Water Transfer Facility Alternative Studies Review		March 2007
4	Maintenance of Fish and Wildlife in the Sacramento – San Joaquin Estuary in Relation to Water Development	California Department of Fish and Game, G. Ray Arnett, Director	April 1973