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### 3. DIVERSION EFFECTS ON FISHERIES

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*DRAFT - For Discussion Only*

**Distinguishing Characteristics**  
October 15, 1997

**E - 0 0 1 5 1 0**

E-001510

# Diversion Effects on Fisheries Supporting Information

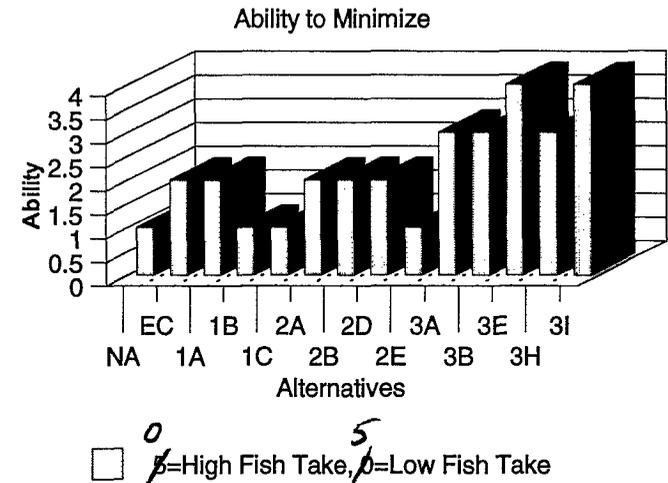
## Definition

“Diversion Effects on Fisheries” are intended to include only the **direct effects on fisheries due to the export diversion intake and associated fish facilities**. These will vary depending on diversion location, size, type, method of handling bypassed fish, and annual volume of water diverted. The effects on flow patterns in the Delta as a result of the diversion are addressed in the distinguishing characteristic for “Delta Flow Circulation”. The loss of fish due to diversion to another route is covered in this effect.

## Summary

Alternatives that export all or the majority of the export water out of the south Delta have higher diversion effects on fisheries than alternatives that export water from the north Delta. The through-Delta alternatives with new screens and pumps on the Sacramento River partially reduce these effects by reducing movement of fish from the Sacramento River into the interior Delta, but generate additional effects (e.g. blocking upstream fish migration, handling and pump damage) that must be resolved. Storage adds a degree of operational flexibility that can be used to reduce the diversion effects by altering the export timing to periods when fish are not near the diversion intake. Alternative variations with an isolated facility have the greatest potential to reduce diversion effects because the diversion point is located away from the interior Delta and nearer the outer limit of the tidal influence where state-of-the-art screens are more effective. Isolated facilities also reduce the loss of fish into interior Delta channels from their primary migration routes, thus improving overall survival. For some species with pelagic larvae abundant in the lower Sacramento River (e.g. delta smelt and striped bass), isolated conveyance facilities increase the potential for loss from the north Delta over existing conditions, because larval fish pass through the fish screens and lost.

## Diversion Effects



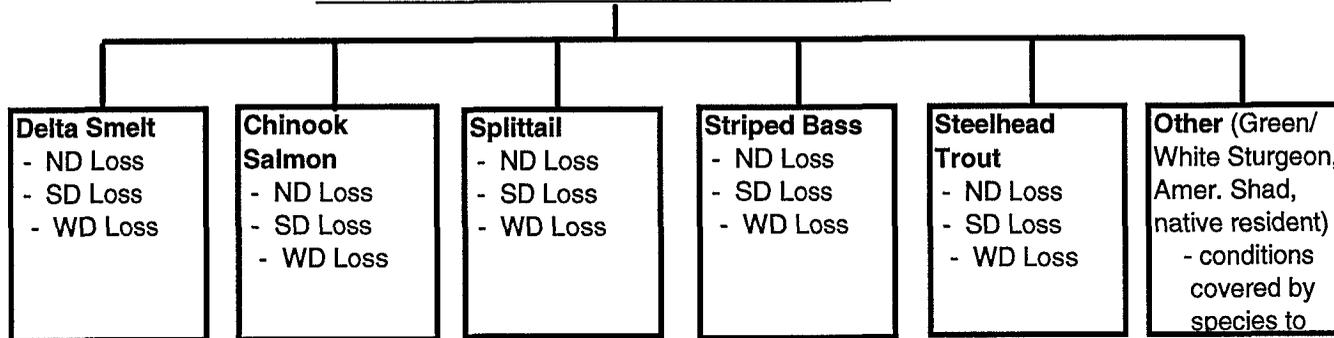
The chart at the right shows preliminary estimates of how well the alternatives minimize diversion effects. The alternatives that do the most to reduce diversion effects get a score of “5” and those that do the least get a score of “0”.

**Alternative 1** variations with the existing diversion configuration have the most diversion effects. Some improvements are provided by improved fish protection facilities at the Delta pumping plants and by improved timing of diversions allowed by new storage and increased diversion capacity at the south Delta pumping plants. However, greater pumping capacity and higher potential for upstream (negative) Old and Middle River flows with improved south Delta facilities may increase losses at the south Delta pumping plants.

**Alternative 2** variations have uncertain performance (0-3) with improvements provided by improved fish facilities and less fish being drawn into the interior Delta from the west (by minimizing negative net Central Delta flows), but uncertainties created by (1) Hood diversion screens blocking upstream migrant salmon, steelhead, sturgeon, shad, striped bass, delta smelt, and splittail moving through the Delta (alts 2A,B, D), (2) lack of screens to keep fish from moving into interior Delta at Hood (alt 2E), (3) Hood screens potentially damaging larval and juvenile fish during entrainment or bypass handling, and (4) higher net upstream flows in Old and Middle River from the central Delta toward the south Delta pumping plants (all alt 2s).

**Alternative 3** variations also have varied performance but generally have fewer diversion effects than the alternative 2 variations. Alternative 3E and 3I have the greatest reduction in diversion effects (values of 4) from existing conditions because of fully isolated diversion facilities. Fully isolated facilities (1) eliminate south Delta diversion losses completely, (2) do not block upstream migrating fish behind screens, and (3) do not draw fish into the interior Delta. Fully isolated facilities do not reach the full potential benefit, because fish with larval stages (e.g. delta smelt and striped bass) would be lost to entrainment. Alternative with partially isolated facilities (3A, B, H) offer performance (1-3) that is intermediate between alternatives 2 and the fully isolated alternatives as they have a combination of through-Delta and isolated facilities. Alternatives 3A and 3B provide more certain benefits (2 and 3, respectively) than alternative 2, because screens do not block upstream migrants and there would not be higher upstream flows in Old and Middle River toward the south Delta pumping plants. Alternative 3H retains some of the uncertainty (3-4) of its counterpart alternative 2E, because of the unscreened opening on the Sacramento River near the head of Georgiana Slough and the unknown potential of fish retention in the expanded habitat areas downstream of the diversion point. However, having a small isolated facility provides better performance than alternative 2E, because flows into the unscreened entrance to the interior Delta would be lower and there would be lower net upstream flows in Old and Middle River toward the south Delta pumping plants.

### 3. Diversion Effects on Fisheries



To  
Decision  
Matrix

**Table 3.1 Summary (How Well Each Alternative Minimizes Fish Losses at Diversion)**

Alternative	Delta Smelt				Chinook Salmon				Splittail				Striped Bass				Steelhead Trout				Total Score
	WD	SD	ND	total	WD	SD	ND	total	WD	SD	ND	total	WD	SD	ND	total	WD	SD	ND	total	
<i>importance</i>	2	2	1		1	1	2		1	2	2		2	2	1		1	1	2		
Exist. Cond.	0	0	2	<b>0</b>	0	0	1	<b>1</b>	1	1	2	<b>1</b>	0	1	2	<b>1</b>	0	0	1	<b>1</b>	<b>1</b>
No-action	0	1	2	<b>1</b>	0	2	2	<b>2</b>	1	2	2	<b>2</b>	1	2	2	<b>2</b>	0	2	2	<b>2</b>	<b>2</b>
1A	0	1	2	<b>1</b>	0	2	2	<b>2</b>	1	2	2	<b>2</b>	1	2	2	<b>2</b>	0	2	2	<b>2</b>	<b>2</b>
1B	0	0-1	2	<b>0-1</b>	0	1-3	2	<b>1-2</b>	1	2	2	<b>2</b>	1	1	2	<b>1</b>	0	1-2	2	<b>1-2</b>	<b>1-2</b>
1C	0	0-1	2	<b>0-1</b>	0	1-3	2	<b>1-2</b>	1	2	2	<b>2</b>	1	1	2	<b>1</b>	0	1-2	2	<b>1-2</b>	<b>1-2</b>
2A	3	0-1	1-2	<b>1-2</b>	3	1-3	3	<b>2-3</b>	3	2	1-2	<b>2-3</b>	3	1	1-2	<b>2</b>	3	1-2	3	<b>2-3</b>	<b>2-3</b>
2B	3	0-1	1-2	<b>1-2</b>	3	1-3	3	<b>2-3</b>	3	2	1-2	<b>2-3</b>	3	1	1-2	<b>2</b>	3	1-2	3	<b>2-3</b>	<b>2-3</b>
2D	3	0-1	1-2	<b>1-2</b>	3	1-3	3	<b>2-3</b>	3	2	1-2	<b>2-3</b>	3	1	1-2	<b>2</b>	3	1-2	3	<b>2-3</b>	<b>2-3</b>
2E	3	0-1	2-4	<b>1-2</b>	3	1-3	1-4	<b>1-3</b>	3	2	2-4	<b>2-3</b>	3	1	2-3	<b>2</b>	3	1-2	1-3	<b>1-4</b>	<b>1-3</b>
3A	4	3	0-1	<b>3</b>	4	3	3	<b>3</b>	4	3	2-3	<b>3</b>	4	3	0-1	<b>3</b>	4	3	3	<b>3</b>	<b>3</b>
3B	4	3	0-1	<b>3</b>	4	3	3	<b>3</b>	4	3	2-3	<b>3</b>	4	3	0-1	<b>3</b>	4	3	3	<b>3</b>	<b>3</b>
3E	5	4	0	<b>3</b>	5	5	4	<b>4.5</b>	5	5	1	<b>3</b>	5	5	0	<b>4</b>	5	5	4	<b>4.5</b>	<b>4</b>
3H	4	3	1-3	<b>3</b>	4	3	2-4	<b>3-4</b>	4	3	2-4	<b>3-4</b>	4	3	2	<b>3</b>	4	3	2-4	<b>3-4</b>	<b>3-4</b>
3I	5	4	0-1	<b>3</b>	5	5	5	<b>5</b>	5	5	1	<b>3</b>	5	5	1	<b>4</b>	5	5	5	<b>5</b>	<b>4</b>

WD = West Delta, SD = South Delta, ND = North Delta; *importance refers to importance of the location for the species (not across species)*

Values are on a scale from 0 to 5; with 5 representing the best performance and 0 representing the worst performance.

E - 0 0 1 5 1 3

### Supporting Information for Table 3.1

The CALFED Interagency Fish Facilities Technical Team (DWR, DFG, USBR, NMFS, USFWS, USGS, USEPA, and independent advisory panel) investigated the major fish passage facility issues and alternatives within the CALFED Bay-Delta program. The team's July 28, 1997 status report, *Fish Screening and Fish Passage Analysis of the CALFED Bay-Delta Program Phase II Delta Conveyance Alternatives*, was used here for primary information on the performance of the alternatives relating to diversion effects on fisheries. In addition the July 1997 draft environmental impacts technical report, *Fisheries and Aquatic Resources*, was used as a reference.

The diversion effects on fisheries for each alternative are rated here on a scale from 0 to 5. ("0 represents poor performance and "5" represents high performance.) The following rankings by alternative are based on qualitative assessments using available information.

**Existing and No-Action Conditions**      **Score = 1 and 2, respectively**

Existing conditions are given a score of 1 because existing fish facilities and operational constraints to protect fish. Low performance under existing conditions from high entrainment and handling losses and poor habitat conditions are only slightly improved under the no-action through improved fish facilities and operations; thus the No-Action alternative was given a score of 2.

**Alternative - 1A**      **Score = 2**

This alternative assumes that existing fish protective facilities will be brought up to their original design standards. Since no new facilities are proposed this alternative is basically a continuation of the status quo. Fish that are salvaged at the fish facilities must be transported for release. The existing South Delta export diversion effects on fisheries would continue to be high due to fish being drawn into the dead-end of the south Delta where they are subject to (1) poor habitat conditions and high predator concentrations, (2) entrainment into south Delta pumps, or (3) handling damage at the fish facilities. Due to these continuing effects on fisheries, alternative 1A has been given a score of 2.

**Alternative - 1B**      **Score = 1-2**

This alternative includes an inter-tie between the SWP and CVP (Clifton Court Forebay and Tracy facilities), new state-of-the-art fish screens at the Tracy Fish Protective Facility and new state-of-the-art fish screens for Clifton Court Forebay. Screening for

Clifton Court Forebay has several design issues that must be resolved. The inter-connection provides some degree of operational flexibility between the SWP and CVP that could be used to lessen the impacts of the diversion. The new screens lessen the diversion effects on the fishery but the continued diversion from the South Delta remains a significant problem. The screens would have beneficial impacts on juvenile and adult life stages of most Delta species relative to the no-action alternative. Entrainment of egg and larval life stages of resident species, including striped bass, delta smelt, longfin smelt and Sacramento splittail, would continue. Entrainment of planktonic invertebrates (i.e., native mysids and rotifers) would also continue. Higher potential flows upstream toward the south Delta pumping plants caused by improved south Delta conveyance facilities and Head of Old River barrier may decrease fish survival and negate some of the benefits and cause uncertainty. The addition of the Head of Old River barrier would reduce diversion losses of downstream migrating juvenile San Joaquin salmon. Alternative 1B is judged to provide less certainty for improving diversion losses than alternative 1A. Therefore, alternative 1B has been given a score of 1-2.

**Alternative - 1C**      **Score = 1-2**

This alternative provides the same fish facilities as alternative 1B. The addition of surface storage for this alternative could improve operational flexibility between the SWP and CVP that could be used to slightly lessen the impacts of the diversion. The addition of flow control structures could require fish passage facilities as a site specific issue. The export diversion effects on fisheries are expected to be almost identical to alternative 1B. Therefore, alternative 1C has been given a score of 1-2.

**Alternative - 2A**      **Score = 2-3**

This alternative provides the same fish facilities as alternative 1B and adds a 10,000 cfs screened through Delta diversion at Hood. The screened diversion at Hood could reduce the number of outmigrating Sacramento River fish entering the Central Delta from either the north Delta or the west Delta (by providing a higher net Central Delta outflow). However, fish concentrated in the remaining Sacramento River flow could continue to move into the Central Delta through the unscreened Georgiana Slough. Flows into Georgiana Slough would reduce somewhat with the new diversion at Hood. Depending on the change in movement into Georgiana Slough, Alternative 2A may provide slight beneficial impacts for outmigrating Sacramento River fish which would lessen the diversion effects at the South Delta export facilities from those in alternative 1B. The new screen at Hood could produce a substantial adverse impact on upstream migrating fish by blocking or hindering movement from the Delta into the lower Sacramento River. Salmon and steelhead would be less effected as they would be able to negotiate the planned fish ladder; however, striped bass, delta smelt, splittail, sturgeon, and American shad would not be able to pass through the ladder. The

screens would have to be lifted periodically to pass these blocked fish, but some delay or blocked migration would be likely. Also the new screen, pumps, and fish handling facilities would increase the potential losses to more delicate larval and juvenile fish that would otherwise under existing conditions not be subjected to such facilities. Though many larvae will likely survive the entrainment process at the new Hood facility and benefit from improved habitats downstream (from setback levees), some will be damaged by the process. These combined benefits and potential detrimental effects in combination with the uncertainties of increased negative flows in Old and Middle River provide only a slight overall benefit (score of 2-3) from the No-Action and alternative 1 variations.

**Alternative - 2B**      **Score = 2-3**

This alternative provides the same fish facilities as alternative 2A. The addition of surface storage for this alternative could improve operational flexibility between the SWP and CVP that could be used to lessen the impacts of the diversion. The addition of flow control structures could require fish passage facilities as a site specific issue. The export diversion effects on fisheries are expected to be almost identical to alternative 2A but the storage allows more flexibility to cease diversions at critical fish times. Despite this potential improvement the overall performance and uncertainties related to Alternative 2B are similar to Alternative 2A, thus the performance score is assessed at 2-3.

**Alternative - 2D**      **Score = 2-3**

This alternative provides nearly the same benefits, effects, and uncertainties as alternatives 2A and 2B. The creation of large amounts of "shallow water aquatic habitat" along the migratory corridors leading to and from the Mokelumne River could improve survival of those larvae fish entrained from the Sacramento River at Hood as compared to variations of Alternative 1 and Alternative 2A and 2B. Like Alternative 2A and 2B, Alternative 2D's screen system could block or detain migrating fish from moving into the lower Sacramento River from the Delta. Therefore, alternative 2D has been given a score of 2-3.

**Alternative - 2E**      **Score = 1-3**

Though south Delta facilities are similar to other variations of alternatives 1 and 2, unlike other variations of alternative 2, Alternative 2E does not have a Hood diversion facility, and instead diverts water through an opening near the head of Georgiana Slough. Though this reduces the handling, screen, and pump damage potential, as well as potential blockage of upstream migrating fish by the screen, lack of a screen invokes substantial uncertainty as to the fate of downstream migrating juvenile salmon and steelhead. Under this alternative fish diverted from the river would hopefully survive and thrive in the expanded

Mokelumne River corridor and be able to move west with the more positive net Central Delta outflows (to the west rather than south). Considerable differences in professional opinion remain on how successful or detrimental the corridor may be to fish. Analytical methods sufficient to answer the question on how well this performs are not available during the time frame of the programmatic EIR/EIS. Due to the uncertainties that can only be answered by years of study and perhaps only by large scale pilot studies, the performance of this alternative cannot be accurately rated with certainty at this time. Therefore, alternative 2E has been given a score of 1-3 to reflect this uncertainty, as well as the potential beneficial or detrimental consequences.

**Alternative - 3A      Score = 3**

This alternative provides the same fish facilities as alternative 1B but adds a screened diversion at Hood and a 5,000 cfs isolated conveyance facility to the South Delta export facilities. The isolated facility will reduce entrainment for the majority of in-Delta fish by substituting north Delta diversion for south Delta diversion. Reducing cross Delta flows will be incrementally beneficial for Sacramento River and Delta fish, by reducing fish drawn into the south Delta. Fish species that spawn and rear in the central and south Delta, including delta smelt, striped bass, and Sacramento splittail, will benefit. However, continuing reliance on the South Delta fish facilities to collect and haul fish away from a dead end area continues to be a compromise to the system. Up to 10,000 cfs would continue to be diverted through the South Delta export facilities. The two new north Delta diversion facilities would substantially reduce the loss of salmon and steelhead, and larger juveniles of delta smelt and splittail to the interior Delta from the Sacramento River. However, smaller striped bass, delta smelt, and splittail would be subjected to entrainment loss or damage from screens and pumps, as well as fish, depending on the level of mortality associated with the Hood screen and on any change in movement of fish into Georgiana Slough.

Entrainment of egg and larval life stages cannot be effectively screened and losses relative to the no-action alternative may be increased in the north Delta but with a decrease from the south Delta. Egg and larval striped bass, American shad, delta smelt, and splittail transported down the Sacramento River would be affected to the greatest degree. Entrainment, however, may be reduced by stopping diversion into the isolated facility during periods of egg and larval occurrence.

This alternative provides overall lower fish entrainment over the no-action alternative and the alternative 1 variations that continue all exports from the South Delta but South Delta export impacts remain relatively high. Therefore, alternative 3A has been given a score of 3. Replacing the open channel isolated facility with a pipeline should score the same.

**Alternative - 3B      Score = 3**

This alternative provides the same fish facilities as alternative 3A. The addition of surface storage for this alternative could improve operational flexibility between the SWP and CVP that could be used to slightly lessen the impacts of the diversion. Alternative 3B has been given a score of 3. Replacing the open channel isolated facility with a pipeline should score the same.

**Alternative - 3E      Score = 4**

This alternative is the same as alternative 3B with a 15,000 cfs isolated facility rather than a 5,000 cfs facility. As envisioned, the majority of diversions would take place through the screened intake at Hood. This would screen the majority of water at an optimum location, and would eliminate adult migration straying concerns. This alternative is the least risky from a fish facility operational and performance point of view. All bypassed fish would be returned to the Sacramento River substantially reducing the need to salvage and haul fish from the South Delta export facilities; however, entrainment losses of egg and larval delta smelt, striped bass, splittail, sturgeon, and American shad would occur at the Hood diversion facility. Losses from damage at the fish screen and bypass facility would be expected for salmon, steelhead, striped bass, delta smelt, splittail, sturgeon, American shad, and other native and non-native fish species. For this reason Alternative 3E has been given a score of 4 out of 5.

**Alternative - 3H      Score = 3-4**

This alternative is the same as Alternative 3B plus a through Delta conveyance/habitat corridor similar to alternative 2E. This alternative assumes Sacramento River water can be diverted into a Central Delta conveyance/habitat corridor without fish screens. The alternative assumes that fish diverted from the river will survive and thrive in the expanded corridor. Considerable differences in professional opinion remain on how successful or detrimental the corridor may be to fish. Analytical methods sufficient to answer the question on how well this performs are not available during the time frame of the programmatic EIR/EIS. Due to the uncertainties that can only be answered by years of study and perhaps only by large scale pilot studies, the performance of this alternative cannot be accurately rated high at this time. Despite this uncertainty compared to Alternative 2E, Alternative 3H provides additional protection with an isolated fish facility, thus reducing south Delta losses. Compared to Alternative 3A and 3B, Alternative 3H does not block upstream migrating fish at fish screens at Hood. The substantial habitat area provided in the north Delta below the diversion also potentially offers greater survival to fish entrained at the diversion. For these reasons Alternative 3H was given a score of 3-4. Replacing the open channel isolated facility with a pipeline should score the same.

**Alternative - 3I**      **Score = 4**

This alternative is the same as alternative 3E plus facilities for 3 additional in-Delta diversions. The operational considerations and hydraulic impacts of this alternative will be very complex. Because the goal is flexibility, it may be necessary to screen each of the three central Delta intakes for a full diversion to avoid excessive predation and losses of San Joaquin and Delta fish. Such facilities would be difficult to hydraulically regulate with or without screens. Although this may be an costly alternative, it does offer slightly added protection compared to Alternative 3E if it can be monitored and controlled. The central Delta screens would likely require salvage and hauling of fish. The diversion on the Sacramento River at Hood would likely operate most of the time. The performance of this alternative would be almost identical to that of alternative 3E with some added operational flexibility from the multiple intakes. Therefore, alternative 3I has been given a score of 4.