CALFED Preliminary Alternatives

December 22, 1995

CALFED/131

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Annotated Action List .....
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Annotated Action List .....
CALFED Ten Alternatives Submitted For CALFED Staff Submittal December 20, 1995
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Alternatives Dropped as Not Applicable

Alternative #	Notes
312	Dropped by T. Cannon - upstream actions n/a to Delta ssp.
314	Dropped by D. Wagenet - see Alternative 324
316	Dropped - better coverage of topics in Alternative 326
318	Dropped by S. Robertson - upstream actions n/a/ to Delta spp.
328	Dropped by S. Robertson - upstream actions n/a to Delta spp.
339	No listing

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Section 1. Instructions to Teams

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Alternative Generation Teams
December 8, 1995

Expertise>>>>>	Fish/Diversion	Habitat/Flood Protection	Water Supply /Demand	Water Quality /Land Use
Team/Theme				
A. Fish/Div	Tom Cannon	Jim Sherar	Stuart Robertson	**Don Wagenet**
B. WaterSupply /Demand	Russ Brown	Dean Ruiz	**Larry Rodriquez**	Peter Mangarella
C. Habitat and Water Quality /Land Use	Paul Wisheropp	**Craig Stevens**	Ben Everett	Peter Standish-Lee

bold = team leader

Schedule for Generation of Preliminary Alternatives
December 8, 1995

Friday, Dec. 8:	prepare trial alternative to test recipe and tools
Tuesday, Dec. 12:	obtain final agreement on format for presentation and distribute to all teams
Tuesday, Dec. 12:	submit first-draft 2-page descriptions of alternatives (at least 10 by each team)
Thursday, Dec. 14:	submit more first-draft descriptions of alternatives (at least 10 more by each team)
Monday, Dec. 18:	submit final set of first-draft descriptions of alternatives (at least 10 more by each team)
Wednesday, Dec. 20:	complete internal team review of all preliminary alternatives and begin production
Friday, Dec. 22:	submit draft descriptions of preliminary alternatives to CALFED staff

Format: Description of A Preliminary Alternative -- December 8, 1995

2 Pages Total

Title: (one line)

Identification of Theme, Subtheme, and Approach:

(one paragraph, one-quarter page)

Solution Overview:

(one paragraph, one-quarter page)

(refer to CALFED 14 primary objectives)

Actions Selected: (one-three sentences providing narrative overview of actions selected from each of the following "action supercategories")

Habitat Restoration:

.

.

.

Improvements to System Reliability:

Preliminary Assessment:

(one paragraph, one-three sentences)

(refer to CALFED solution principles)

WordPerfect 6.1
Times Roman

CALFED Alternative Generation -- December 8, 1995

Recipe for Generation of Preliminary Alternatives

1. Select and describe the theme, subtheme, and approach to be used in generating alternative (see separate list of themes, subthemes, and approaches)

2. Review and adjust implementation levels (as appropriate for the selected theme, subtheme, and approach) for core actions (see separate list)

3. Select other "noncore" actions using these action selection criteria:

   -- actions must *follow logically* from the selected theme, subtheme, and approach

   --actions must be *functionally consistent* with each other and emphasize synergies and linkages where possible

   --actions should be selected based on *preliminary ratings of performance* against the performance measures

   --actions must achieve a *preliminary impression* of equity and other solution principles

4. Perform preliminary assessment of the alternative (comprised of core and selected noncore actions) against the solution principles

5. Prepare 2-page description of the alternative (see attached format)

Materials to be Used in Alternative Generation

- format for 2-page description of an alternative
- action-selection tools:

  --preliminary list of themes, subthemes, and approaches
  --list of core actions with implementation levels
  --refined action matrix with implementation levels
  --ratings of actions against performance measures

- trial description of alternative
- schedule

CALFED Bay-Delta Program
Phone List

		Phone	Fax	E-Mail	Address
Bookman-Edmonston		852-5080	852-6385		
Binder, Chuck		ext. 218			3100 Zinfandel Drive, Suite 170
Robertson, Stuart					Rancho Cordova, CA 95670
CALFED Bay-Delta Program		657-2666	654-9780		
Breitenbach, Rich	USBR				1416 9th Street, Suite 1155
Daniel, Dick	CDF&G				Sacramento, CA 95814
Gross, Sharon	USF&W				
Kelly, Judy	EPA				
McReynolds, Zach	Finance				
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Kishel, Jeff		ext. 505		jeff_kishel@smtpgw.mw.com	Walnut Creek, CA 94598
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Gardiner, Charles				pamsf@aimnet.com	101 The Embarcadero, Suite 210
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Strategic Insights		415/941-4950	415/941-4952		
Lathrop, John				strat@batnet.com	575 Los Altos Avenue
					Los Altos, CA 94022
Tetra Tech					
Batts, David	•	415/974-1221	415/971-5914		• 180 Howard Street, Suite 250
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Wagenet, Don		852-6166			
Woodward-Clyde		510/893-3600	510/874-3268		
Baily, Tom					500 12th Street, Suite 100
Mangarella, Peter		510/874-3022			Oakland, CA 94607
Standish-Lee, Peter		916/368-0988			

Themes for Development of Additional Alternatives

Themes were developed based on the eight conflict resolution strategies used to develop the 32 edge alternatives. Taken individually each the of these resolution strategies provides a focus for combining actions towards the development of an alternative. According to the resolution strategies these themes will be as follows:

- Enhance fish populations by increasing fish productivity.
- Enhance fish populations by reducing diversion impacts on fish.
- Improve habitat quality without converting existing land use patterns.
- Improve habitat quality and quantity through conversion of existing land uses.
- Reduce competition for water during critical periods by reducing demand.
- Reduce competition for water during critical periods by increasing supply availability.
- Improve water quality by reducing pollutant discharges to the Bay-Delta system.
- Improve water quality by increasing instream management measures.

Alternatives will be developed which focus on the general objectives of the themes identified above. In addition to actions selected to meet the objective of a particular theme additional actions will be included from the core actions, which will be common among all alternatives. The level of implementation of the core actions may vary between alternatives relative to the theme. Each alternative will be developed with the guidance of the solution principles and the core actions to ensure that while the alternative is focused on a particular theme some level of equity among stakeholder is achieved.

The themes were developed with a broad enough focus that an number of different sub-themes might be developed. The broadness of the themes allows for various approaches to be developed which will satisfy the objectives of the themes or sub-themes. In this way a number of individual alternatives, based on sub-themes and approaches may be developed from a single theme. This approach should also develop alternatives that address the interests of individual stakeholders. The themes are listed again below, each with an example set of sub-themes and approaches which might be used in the develop individual alternatives.

- **Enhance fish populations by enhancing fish productivity.**

  Sub-themes:
  - Increase the populations of commercial species.
  - Increase the population threatened or endangered species.

  Approaches:
  - Increase hatcheries production.
  - Increase aquatic habitat.
  - Manage instream flows and/or temperatures.

- **Enhance fish populations by reducing fish diversion impacts.**

  Sub-themes:

Reduce diversion impacts in the Delta.
Reduce Diversion impacts upstream of the Delta.
Approaches:
Install diversion screens.
Consolidate in-delta diversions:
Modify timing of diversions.

- **Improve habitat quality without converting existing land use patterns.**

Sub-themes:
Focus on improving existing habitats within the Delta.
Focus on aquatic habitat upstream of the Delta.
Approaches:
Restoration of spawning gravels.
Improve/restore shaded riparian cover.
Manage instream flows and temperatures.

- **Improve habitat quality and quantity through conversion of existing land uses.**

Sub-themes:
Convert land uses in the Delta.
Convert land uses upstream of the Delta.
Approaches:
Setback levees.
Convert Delta islands.
Land acquisition program.

- **Reduce competition for water during critical periods by reducing demand.**

Sub-themes:
Reduce demands in specific regions (i.e. export areas, supply areas).
Reduce demands in all areas.
Approaches:
Implement transfers.
Implement water markets and pricing structures.
Increase conservation measures.

- **Reduce competition for water during critical periods by increasing supply availability.**

Sub-themes:
Increase storage capabilities.
Increase efficiency of water movement through the Delta.
Approaches:
Increase surface water/ground water conjunctive use projects.
Develop new or expanded off-stream storage capacities.

Develop thru-Delta conveyance facility.

- **Improve water quality by reducing pollutant discharges to the Bay-Delta system.**

Sub-themes:
Reduce pollutant discharges from agricultural sources.
Reduce pollutant discharges from municipal/industrial sources.
Approaches:
Increase levels of treatment for discharges.
Modify land use practices and patterns to reduce pollutant discharges.
Control volume and timing of discharges.

- **Improve water quality by increasing instream management measures**

Sub-themes:
Increase instream flows to dilute pollutant discharges.
Increase habitat quality (i.e wetland areas) to improve quality of instream flows.
Approaches:
Increase storage to augment instream flows.
Increase wetland protection and enhancement practices.

Section 2. Alternatives from Habitat/Land Use/Water Quality Team

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"100" Team Craig 12-18-95

CALFED Alternatives Development				
Summary of Team C Alternatives				
Alternative	Description	Primary Preparer	Status	Comments
101	WQ - Treat ag discharges		Old format	
102	WQ - Ag discharges thru land practices		Old format	
103	WQ - Volume & timing of ag discharges		Old format	
104	WQ - Treat M&I discharges		Old format	
105	WQ - Volume & timing of M&I discharges		Old format	
106	Ecosystem WQ using stored water to dilute		New format	
107	Diverter WQ using stored water to dilute		Old format	
108	Eco WQ using reduced in demand to dilute		Old format	
109	Diverter WQ using reduced demand to dilute		Old format	
110	WQ - Watershed mgmt using habitat		Old format	
111	WQ - Watershed mgmt using BMP's		Old format	
112	Diverter WQ using Delta physical improvements		Old format	
113	Eco WQ using Delta physical improvements		Old format	
114	Existing Habitat (Ex Hab)	Unger	Old format	
115	Converting Habitat (Conv. Hab.)	Unger		
116	Balanced Habitat (Bal. Hab.)	Unger		
117	WQ Dilution + Ex. Hab.	Wisheropp	Old format	
118	WQ Dilution + Conv. Hab.	Wisheropp		
119	WQ Dilution + Bal. Hab.	Wisheropp		
120	WQ Physical + Ex. Hab.	Standish-Lee	Old format	Peter redoing
121	WQ Physical + Conv. Hab.	Standish-Lee	Old format	Peter redoing
* 122	WQ Physical + Bal. Hab.	Standish-Lee	Old format	Peter redoing
123	WQ Watershed Mgmt. + Ex. Hab.	White	Old format	
124	WQ Watershed Mgmt. + Conv. Hab.	White		
125	WQ Watershed Mgmt. + Bal. Hab.	White		
126	WQ Discharge Mgmt. + Ex. Hab.	Stevens	~~New format~~	
127	WQ Discharge Mgmt. + Conv. Hab.	Stevens	New format	
* 128	WQ Discharge Mgmt. + Bal. Hab.	Stevens		

* = good candidate for combination alternative

Please note corrected Descriptions for #122-128

Date SUMMARY.XLS

Title: Improving water quality primarily by treating agricultural wastewater. **(Alternative #101)**

Identification of Theme, Sub-theme, and Approach:

Theme: Improve water quality by reducing pollutant discharges to the Bay-Delta system
Sub-theme: Reduce pollutant discharges from agricultural sources
Approach: Increased level of treatment for discharges.

Solution Overview:

Selected all actions to treat agricultural drainage, including implementing core actions for agricultural treatment at the maximum. Then we implemented at the maximum all core actions that reduce pollutant discharges to the Bay-Delta , as these support the main theme. We then determined who would be hurt by implementing these actions and added actions to achieve equity. Farmers, municipal and industrial users, and mine owners would be impacted by this alternative. Few actions were found to achieve equity (123, 127, 207, 221 and 232).

Actions Selected:

Restore: Bay-Delta Habitats:

None selected

Restore Upstream Habitats:

None selected

Reduce Effects of Diversions:

None selected.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

A number of actions were included under the categories of water conservation, water reclamation , land fallowing and retirement, whose purpose was to reduce agricultural water usage and thereby reduce discharges that drain to the Bay-Delta.

Enhance Water Supplies:

Core watershed management practices to protect water quality were implemented at the maximum level.

Increase Supply Predictability:

None selected

Managing Water Quality:

Core actions related to treatment of discharges were all implemented at the maximum level. Non-core actions related to treating agricultural drainage were implemented at the maximum level.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative should improve in-stream and Delta water quality which would benefit, the ecosystem, diverters of Delta water, and Delta recreationists. It would provide a small amount of additonal water , and improve supply reliability slightly, through water recalamation. The main burden of this alternative would be on farmers. Selected actions would mitigate these impacts, but not completely. This alternative would probably reduce agricultural production and farm income. There will be a limited increase in the number of upstream wetlands due to the program to treat agricultural wastewater, and an improvement in the quality of refuge wetlands and waterfowl habitat because of the treatment of agricultural wastewater. The ecosystem, and especially the fish, would benefit from improved water quality, especially reductions in pesticide residues and toxic heavy metals from mine drainage

C42.06 - Retire lands with drainage and disposal problems - max

C42.07 - Improve pest-control practices -max

C42.08 - Manage irrigation tailwater to reduce pesticides - max

42.1 - Treat drainage to reduce pollutants - max

C43.1 - Retain and manage stormwater runoff - max

43.3 - Construct wetlands to treat wastewater effluent - max (for agriculture, could be more than 10%)

C45.1 - Manage discharges from abandoned mines - max

C45.2 - Remediate abandoned mining sites discharging pollutants

Improving System Reliability:

Title: Improving water quality primarily by reducing agricultural wastewater generation by modifying land use patterns and practices. **(Alternative #102)**

Identification of Theme, Sub-theme, and Approach:

Theme: Improve water quality by reducing pollutant discharges to the Bay-Delta system
Sub-theme: Reduce pollutant discharges from agricultural sources
Approach: Modify land use patterns and practices to reduce discharges

Solution Overview:

Selected all actions to minimize the quantities of agricultural drainage from farmlands. Then implemented at the maximum all core actions that reduce pollutant discharges to the Delta. as these support the main theme. Then determined who would be hurt by implementing these actions and added actions to achieve equity. Farmers, municipal and industrial users would be impacted by this alternative. Few actions were found to achieve equity (86, 127, 134, 135, and 207). Another form of mitigation could be for urban users to fund the retirement of agricultural land (need to add this action to list) .

Actions Selected:

Restore: Bay-Delta Habitats:

One action was selected, to convert a minimum amount of agricultural land in the Delta to wetlands, to benefit water quality.

Restore Upstream Habitats:

None selected

Reduce Effects of Diversions:

An action to acquire water for refuge habitat use was selected to compensate for the reduction in source water for refuges and the reduction in instream flows resulting from reduced agricultural drainage.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

A number of actions were included under the categories of water conservation, water reclamation , land fallowing and retirement, and land and easement purchases whose purpose was to reduce agricultural water usage and thereby reduce discharges that drain to the Bay-Delta.

Enhance Water Supplies:

Core actions to protect water quality through watershed management were included at the maximum level.

Increase Supply Predictability:

An action to allow urban districts to fund mine drainage cleanup in lieu of more stringent cleanup of their discharges was included to provide flexibility

Managing Water Quality:

Core actions related to discharges were selected at the maximum level. Additional actions were chosen to reduce the amount of agricultural wastewater through the management of land uses and practices. Actions were also selected to modify cropping and irrigation practices to reduce the amount of water being discharged, and to transport agricultural drainages to other watersheds.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative should improve in-stream and Delta water quality (especially salinity) which would benefit, the ecosystem, diverters of Delta water, and Delta recreationists. It would provide a small amount of additional water , and improve supply reliability slightly, through water reclamation. The main burden of this alternative would be on farmers, urban users, and mine owners. Selected actions would mitigate these impacts, but not completely. This alternative would probably reduce agricultural production and farm income. There will be a reduction in the acreage of irrigated farmlands and a commensurate reduction of the quantify and quality of subsurface and tailwater drainage. The acquisition of replacement water is needed for refuges dependent on agricultural wastewater . No mitigation is provided for decreases in water for non-managed wetlands dependent on agricultural drainage water. The ecosystem, and especially the fish, would benefit from improved water quality, especially reductions in pesticide residues, salinity and toxic heavy metals from mine drainage. This alternative would also reduce the recirculation of salts in the San Joaquin Valley. The fallowing and retirement of agricultural lands would result in increased water supplies for other users.

Detailed List of Actions Selected: (Alternative #102)

Restore: Bay-Delta Habitats:

4.3 - Convert agricultural lands to wetlands - min

Restore Upstream Habitats:

Reduce Effects of Diversions:

17.1 - Acquire water for refuge habitat use - max (and for instream fish flows)

Enhancement of Anadromous Fish Populations:

Reducing the Reliance on Delta Exports:

C25.1 - increase agricultural water conservation - max - (to help farmers reduce cost of treatment by reducing water usage).

26.2 - User reclaimed water for agricultural irrigation - max (to provide farmers with a cleaner source of water that would reduce the need for other measures).

C27.1 - Encourage land fallowing during during drought periods - max

C27.2 - Develop incentive programs for land retirement. - max

27.3 - Purchase lands or easements - max

Enhance Water Supplies:

C29.2 - Manage riparian zones to protect water quality - max

C29.3 - Manage land uses to protect water quality - max

Increase Supply Predictability:

39.18 - Allow urban districts to fund mine cleanup in lieu of urban cleanup.

Managing Water Quality:

C39.21 - Enforce wastewater discharge requirements - including agricultural drainage water -max

C42.01 - Implement source control regulations for pollutants - max

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42.02 - Implement pollutant-load limits in San Joaquin River

C42.03 - Reduce or control volume of agricultural discharges -max

42.04 - Modify cropping and irrigation practices - max

42.05 - Export agricultural drainage to other watersheds -max

C42.06 - Retire lands with drainage and disposal problems - max

C42.07 - Improve pest-control practices -max

C42.08 - Manage irrigation tailwater to reduce pesticides - max

C43.1 - Retain and manage stormwater runoff - max

C45.1 - Manage discharges from abandoned mines - max

C45.2 - Remediate abandoned mining sites discharging pollutants

Improving System Reliability:

Title: Improving water quality primarily by reducing the volume of agricultural wastewater generation and the timing of discharges to coincide with high in-stream flows. **(Alternative #103)**

Identification of Theme, Sub-theme, and Approach:

Theme: Improve water quality by reducing pollutant discharges to the Bay-Delta system
Sub-theme: Reduce pollutant discharges from agricultural sources
Approach: Control volume and timing of discharges

Solution Overview:

Selected all actions to minimize the volume of agricultural drainage from farmlands and takes advantage of the dilution capacity of streams by synchronizing discharges with periods of high stream flows. Then implemented at the maximum all core actions that reduce pollutant discharges to the Delta. as these support the main theme. Then determined who would be hurt by implementing these actions and added actions to achieve equity. Farmers, municipal and industrial users would be impacted by this alternative. Few actions were found to achieve equity (86, 123, 128, 134, and 135) . Another form of mitigation could be for urban users to fund the retirement of agricultural land (need to add this action to list) .

Actions Selected:

Restore: Bay-Delta Habitats:

None selected

Restore Upstream Habitats:

None selected

Reduce Effects of Diversions:

An action to acquire water for instream fish flows was selected to replace the reduction in instream flows due to reduced agricultural discharges.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

A number of actions were included under the categories of water conservation, water reclamation , land fallowing and retirement, and land and easement purchases whose purpose was to reduce agricultural water usage and redirect drainages, and thereby

reduce discharges that lead to the Bay-Delta.

Enhance Water Supplies:

Core actions to protect water quality through watershed management were included at the maximum level.

Increase Supply Predictability:

None selected.

Managing Water Quality:

Core actions related to discharges were selected at the maximum level. Additional actions were chosen to allow agricultural wastewater to be stored and released when flows are high, to allow dilution. An action was also selected to modify cropping and irrigation practices to reduce the amount of water being discharged.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative should improve in-stream and Delta water quality (especially salinity) which would benefit, the ecosystem, diverters of Delta water, and Delta recreationists. It would provide some additional water and improved supply reliability through reclamation and land retirement. The main burden of this alternative would be on farmers, urban users, and mine owners. Selected actions would mitigate these impacts, but not completely. This alternative would probably reduce agricultural production and farm income. There will be a reduction in the acreage of irrigated farmlands and a commensurate reduction of the quantity and mass loadings of subsurface and tailwater drainage. This alternative would require farmers to construct holding facilities to allow the timing of discharges. The acquisition of replacement water is needed for refuges dependent on agricultural wastewater . No mitigation is provided for decreases in water for non-managed wetlands dependent on agricultural drainage water. The ecosystem, and especially fish, would benefit from improved water quality, particularly in wet years, when large flows for dilution are available. Reductions in agricultural drainage flows could result in reduced instream volumes, particularly in the San Joaquin River. This has been offset by including the action to purchase water for fish and wildlife. Water quality improvements would be focused on reductions in pesticide residues, salinity and toxic heavy metals from mine drainage. This alternative would also reduce the recirculation of salts in the San Joaquin Valley. Because of the bioaccumulation of heavy metals and other toxins in the estuary, this alternative may not provide as much benefit as other alternatives that prevent or remove toxics from the water supply.

Detailed List of Actions Selected: Alternative #103

Restore: Bay-Delta Habitats:

Restore Upstream Habitats:

Reduce Effects of Diversions:

17.1 - Acquire water for refuge habitat use - max (and to supplement instream flows)

Enhancement of Anadromous Fish Populations:

Reducing the Reliance on Delta Exports:

25.1 - increase agricultural water conservation - max - (to help farmers reduce cost of treatment by reducing water usage).

26.3 - reclaim saline agricultural drainage water - max - residual brine not discharged to surface waters

26.4 - Recycle and treat water for potable reuse - max (from agricultural source)

26.5 - Use reclaimed water for non-potable municipal and industrial uses - max (from agricultural source)

26.6 - Use reclaimed water to repel salinity intrusion - max (to repel salinity in groundwater)

27.1 - Encourage land fallowing during during drought periods - max

27.2 - Develop incentive programs for land retirement. - max

27.3 - Purchase lands or easements - max

Enhance Water Supplies:

29.2 - Manage riparian zones to protect water quality - max

29.3 - Manage land uses to protect water quality - max

Increase Supply Predictability:

Managing Water Quality:

38.1 - Increase water storage capacities at user locations (intended to store agricultural wastewater to allow timing of discharges) - max

29.21 - Enforce wastewater discharge requirements - including agricultural drainage water -max

12/14/95

42.01 - Implement source control regulations for pollutants - max

42.02 - Implement pollutant-load limits in San Joaquin River

42.03 - Reduce or control volume of agricultural discharges -max

42.04 - Modify cropping and irrigation practices - max

42.06 - Retire lands with drainage and disposal problems - max

42.07 - Improve pest-control practices -max

42.08 - Manage irrigation tailwater to reduce pesticides - max

42.09 - Manage drainage timing to reduce instream impacts - max (timing should coincide with high down-stream flows and high tides in the Delta)

43.1 - Retain and manage stormwater runoff - max

43.3 - Construct wetlands to treat wastewater effluent - max (for agricultural wastewater to reduce volumes)

45.1 - Manage discharges from abandoned mines - max

45.2 - Remediate abandoned mining sites discharging pollutants - max

Improving System Reliability:

Title: Improving water quality primarily by treating municipal runoff and municipal and and industrial wastewater. **(Alternative #104)**

Identification of Theme, Sub-theme, and Approach:

Theme: Improve water quality by reducing pollutant discharges to the Bay-Delta system
Sub-theme: Reduce pollutant discharges from municipal/industrial sources
Approach: Increase levels of treatment for discharges.

Solution Overview:

Selected all actions to treat municipal and industrial waste discharges and stormwater runoff, including implementing core actions for treatment of those sources at the maximum level. Then we implemented at the maximum all core actions that reduce pollutant discharges to the Bay-Delta , as these support the main theme. We then determined who would be hurt by implementing these actions and added actions to achieve equity. Municipal and industrial users, mine owners, and farmers would be impacted by this alternative. Only one action was found to achieve equity (207).

Actions Selected:

Restore: Bay-Delta Habitats:

None selected

Restore Upstream Habitats:

None Selected

Reduce Effects of Diversions:

None selected.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

Actions were selected to temporarily fallow and permanently retire agricultural land, primarily those lands with drainage problems.

Enhance Water Supplies:

Core watershed management actions were selected regarding practices to protect water quality were implemented at the maximum level.

Increase Supply Predictability:

Actions were selected to recycle and reclaim urban wastewater as a treatment of wastewater leading to its reuse. An action to allow urban districts to fund mine drainage cleanup in lieu of more stringent cleanup of their discharges was included to provide flexibility.

Managing Water Quality:

Core actions related to discharges were all selected at the maximum level. Non-core actions related to treating municipal and industrial discharges were also implemented at the maximum level. The construction of wetlands to treat urban wastewater is a central strategy of this alternative.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative should improve in-stream and Delta water quality which would benefit, the ecosystem, diverters of Delta water, and Delta recreationists. It would provide a small amount of additonal water , and improve supply reliability slightly, through water reclamation. The main burden of this alternative would be on urban users, mine owners, and, to a lesser extent, farmers. Few actions would mitigate these impacts, but not completely. This alternative would increase treatment requirements on urban users and increase the need for treatment facilities. There will be some increase in the number of upstream wetlands and wetlands in export areas due to the program to treat urban wastewater, and an improvement in the quality of refuge. The ecosystem, and especially fish, would benefit from improved water quality, especially reductions in urban and industrial waste constituents and toxic heavy metals from mine drainage

Detailed List of Actions Selected: Alternative #104

Restore: Bay-Delta Habitats:

Restore Upstream Habitats:

Reduce Effects of Diversions:

Enhancement of Anadromous Fish Populations:

Reducing the Reliance on Delta Exports:

27.1 - Encourage land fallowing during drought periods - max

27.2 - Develop incentive programs for land retirement -max

Enhance Water Supplies:

C29.2 - Manage riparian zones to protect water quality - max

C29.3 - Manage land uses to protect water quality - max

Increase Supply Predictability:

26.4 - Recycle and treat water for potable reuse - max

26.5 - Use reclaimed water for non-potable municipal and industrial uses

39.18 - Allow urban districts to fund mine cleanup in lieu of urban cleanup.

39.21 - Enforce wastewater discharge requirements - max (for agricultural drainage water)

Managing Water Quality:

C42.01 - Implement source control regulations for pollutants - max

42.02 - Implement pollutant-load limits in San Joaquin River -max (from municipal and industrial sources)

C42.03 - Reduce or control volume of agricultural discharges -max

C42.06 - Retire lands with drainage and disposal problems - max

12/22/95

C42.07 - Improve pest-control practices -max

C42.08 - Manage irrigation tailwater to reduce pesticides - max

C43.1 - Retain and manage stormwater runoff - max

43.2 - Treat discharges to remove problem constituents

43.3 - Construct wetlands to treat wastewater effluent - max (could be more than 10%)

C45.1 - Manage discharges from abandoned mines - max

C45.2 - Remediate abandoned mining sites discharging pollutants

Improving System Reliability:

12/22/95

Title: Improving water quality primarily by reducing the volume of municipal and industrial wastewater generation and the timing of wastewater and runoff discharges to coincide with high in-stream flows. **(Alternative #105)**

Identification of Theme, Sub-theme, and Approach:

Theme: Improve water quality by reducing pollutant discharges to the Bay-Delta system
Sub-theme: Reduce pollutant discharges from municipal and industrial sources
Approach: Control volume and timing of discharges

Solution Overview:

Selected all actions to minimize the volume of municipal and industrial discharges and to take advantage of the dilution capacity of streams by synchronizing discharges with periods of high stream flows. Then implemented at the maximum all core actions that reduce pollutant discharges to the Delta. as these support the main theme. Then determined who would be hurt by implementing these actions and added actions to achieve equity. Municipal and industrial users and mine owners would be impacted by this alternative. Only one action was found to achieve equity (86) .

Actions Selected:

Restore: Bay-Delta Habitats:

None selected

Restore Upstream Habitats:

None selected

Reduce Effects of Diversions:

An action was included to purchase water supplies for instream fish flows to replace reduced instream flows from urban discharges.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

A number of actions were included under the categories of water conservation, water reclamation , and land fallowing and retirement whose purpose was to reduce urban water usage and redirect effluent and thereby reduce

discharges that lead to the Bay-Delta.

Enhance Water Supplies:

Core actions to protect water quality through watershed management were included at the maximum level.

Increase Supply Predictability:

An action to allow urban districts to fund mine drainage cleanup in lieu of more stringent cleanup of their discharges was included to provide flexibility

Managing Water Quality:

Core actions related to discharges were selected at the maximum level. Additional actions were chosen to allow municipal and industrial wastewater to be stored and released when flows are high, to allow dilution.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative would improve in-stream and Delta water quality which would benefit, the ecosystem, diverters of Delta water, and Delta recreationists. It would provide some additional water and some improved supply reliability through reclamation. The main burden of this alternative would be on urban and industrial users, and mine owners. Selected actions would mitigate these impacts, but not completely. This would require municipal and industrial users to create holding areas for water storage to allow the timing of discharges. The ecosystem, and especially fish, would benefit from improved water quality. Reductions in municpal discharge flows could result in reduced instream volumes. This has been offset by including the action to purchase water for fish and wildlife. Water quality improvements would be focused on reductions in the problem constituents from municipal and industrial uses and from mine drainage. There would be some increase in the number of upstream wetlands because of the program to treat urban wastewater through the construction of wetlands. Because of the bioaccumulation of heavy metals and other toxins in the estuary, this alternative may not provide as much benefit as other alternatives that prevent or remove toxics from the water supply.

Detailed List of Actions Selected: Alternative #105

Restore: Bay-Delta Habitats:

Restore Upstream Habitats:

Reduce Effects of Diversions:

17.1 - Acquire water for refuge* habitat use - max (this action should be to acquire water for instream flows)

Enhancement of Anadromous Fish Populations:

Reducing the Reliance on Delta Exports:

C25.1 - increase agricultural water conservation - max - (to help farmers reduce cost of treatment by reducing water usage).

C25.2 - Increase municipal and industrial water conservation - max

26.1 - Recharge groundwater with reclaimed water - max

26.4 - Recycle and treat water for potable reuse - max (from M&I source)

26.5 - Use reclaimed water for non-potable municipal and industrial uses - max (from M&I source)

26.6 - Use reclaimed water to repel salinity intrusion - max (to repel salinity in groundwater)

C27.1 - Encourage land fallowing during during drought periods - max

C27.2 - Develop incentive programs for land retirement. - max

Enhance Water Supplies:

C29.2 - Manage riparian zones to protect water quality - max

C29.3 - Manage land uses to protect water quality - max

Increase Supply Predictability:

39.18 - Allow urban districts to fund mine cleanup in lieu of urban cleanup - max

12/22/95

Managing Water Quality:

38.1 - Increase water storage capacities at user locations (intended to store municipal wastewater to allow timing of discharges) - max

C39.21 - Enforce wastewater discharge requirements - including agricultural drainage water -max

C42.01 - Implement source control regulations for pollutants - max

42.02 - Implement pollutant load limits on the San Joaquin River (for M&I uses)

C42.03 - Reduce or control volume of agricultural discharges -max

C42.06 - Retire lands with drainage and disposal problems - max

C42.07 - Improve pest-control practices -max

C42.08 - Manage irrigation tailwater to reduce pesticides - max

C43.1 - Retain and manage stormwater runoff - max

43.6 - Retain and manage urban wastewater and industrial discharges - max

43.3 - Construct wetlands to treat wastewater effluent - max (to reduce volumes)

C44.1 - Limit dredging to avoid fish migration periods - max

C45.1 - Manage discharges from abandoned mines - max

C45.2 - Remediate abandoned mining sites discharging pollutants - max

Improving System Reliability:

12/22/95

Title: Improve ecosystem water quality by increasing instream flows to dilute contaminants using stored water. **(Alternative #106)**

Identification of Theme, Sub-theme, and Approach:

Theme: Improve water quality by increasing instream management measures
Sub-theme: Increase instream flows to dilute pollutant discharges
Approach: Increase yield by increasing runoff and adding storage to improve ecosystem water quality..

Solution Overview:

Includes all actions to store water upstream or in the Delta to improve water quality by making releases timed to coincide with periods of poor water quality. Also includes at the maximum all core actions that increase instream flows at times when they would be beneficial, since these support the main theme. In some cases core actions designed to provide other benefits were included to be implemented in a manner beneficial to water quality. Non-ecological water users would be impacted by these actions, so actions to supplement the water supply were also included to achieve equity.

Actions Selected:

Restore Bay-Delta Habitats:

Core actions that protect, preserve, and enhance existing wetland habitat in the Delta were included at the maximum level of implementation. This type of habitat removes some toxicants from water.

Restore Upstream Habitats:

Core actions that protect water quality were included at the maximum level of implementation. Actions include the management of flows and temperatures, restricting livestock grazing in riparian zones (to avoid cattle-related pollutants from entering the water), and revegetating degrading riparian areas (to prevent sediment due to erosion from entering the water.

Reduce Effects of Diversions:

Core actions that provide additional flows or allow operation of Delta channels and exports to benefit Delta water quality were included at the maximum level of implementation. Real-time monitoring would be used to monitor water quality and guide operation of the Delta Cross Channel and export pumps. Some of these are actions intended to benefit fish, but these could also be used for dilution of pollutants where the timing would be beneficial. Non-core actions that would allow the modification of reservoir operations to provide dilution flows were also added, including the purchase of water for dilution flows.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

A number of actions involving water conservation, water reclamation and land fallowing were included to provide additional water supply to be used for dilution flows.

Enhance Water Supplies:

Watershed management actions were included to increase the effective yield from watersheds and to improve the water quality of the watershed. Additional storage was included to allow the retention of this extra yield. The location and nature of this storage is not specified, but would be upstream of the Delta, since additional Delta conveyance is not provided.

Increase Supply Predictability:

Actions to facilitate water transfers are included, and these transfers would be timed to provide water quality benefits. Actions to encourage conjunctive use were included to provide an alternative source of water for diverters to allow more water to stay instream.

Managing Water Quality:

Core actions that provided benefits to water quality were all included at the maximum level of implementation. An action to use water stored upstream to dilute pollutants in the San Joaquin River was also included.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative would improve instream and Delta water quality by increasing flows during times when water quality is poor. This would benefit the estuary, anadromous fish, and would improve water quality for some upstream and Delta diverters. Incidental benefits for export water quality would also occur. The main burden of this alternative would be on diverters who would likely have less water since reservoir releases would be used for water quality. Selected actions to increase water supply through the construction of additional storage capacity, the fallowing of some farmland, and through watershed management are included. Dilution flows would also be acquired and provided through the timing of water transfers. This alternative would achieve water quality at a heavy water cost, and may not provide as much water quality benefit as alternatives that reduce pollutant loads, because of the bioaccumulation of some pollutants in the estuary.

Detailed List of Actions Selected (Alternative #106):

Restore Bay-Delta Habitats:

C2.2 - Restore/preserve channel islands -max (for the water-cleaning ability of the wetland vegetation).

C4.1 - Enhance existing wetlands - max (for the water-cleaning ability of the wetland vegetation).

C4.4 - Protect existing wetland habitat - max (for the water-cleaning ability of the wetland vegetation).

Restore Upstream Habitats:

C9.1 - Manage flows and temperatures in upstream habitats - max (to improve water quality

C11.1 - Restrict livestock grazing in riparian corridors - max (to prevent pollutant entry into streams)

C11.2 - Revegetate degraded riparian habitats - max (to prevent pollutant entry into streams)

Reduce Effects of Diversions:

13.2 - Modify upstream reservoir operations - max (to provide the water for dilution flows)

13.3 - Modify Delta inflow timing pattern - max (to provide flows to dilute pollutants in the Delta)

C13.4 - Provide instream pulse flows for fish passage - max (would not be considered if it restricts use of water for water quality)

C13.5 - Provide instream pulse flows for fish attraction - max (would not be considered if it restricts use of water for water quality)

C14.1 - Modify central Delta channel operations - (to allow control of additional flows to repel salinity in the central Delta)

C14.2 - Modify export operations criteria - (to allow increased Delta outflow and in-Delta flows when needed for ecosystem water quality)

C14.3 - Use real-time monitoring and adaptive management - max (to be used to monitor water quality and time reservoir releases accordingly)

C17.1 - Acquire water for refuge habitat use - (water would actually be acquired for water quality purposes)

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

C25.1 - Increase agricultural water conservation - max (to provide additional water supply for water quality)

C25.2 - Increase municipal and industrial water conservation - max (to provide additional water supply for water quality)

26.1 - Recharge groundwater with reclaimed water

26.6 - Use reclaimed water to repel salinity intrusion (both in the Delta and in groundwater basins)

C27.1 - Encourage land fallowing during drought periods - max

C27.2 - Develop incentive programs for land retirement - max

Enhance Water Supplies:

29.1 - Manage vegetation cover to increase yield (to provide additional water supply for water quality)

29.2 - Manage riparian zones to protect water quality - max

C29.3 - Manage land uses to protect water quality - max

29.4 - Modify weather to increase precipitation (to provide additional water supply for water quality)

33 - Additional unspecified storage (to provide additional yield for water quality flows)

Increase Supply Predictability:

C37.1 - Coordinate diversion and conveyance of transfers - max (timed to provide water quality benefits)

C37.2 - Establish brokerage for water transfers - max (to provide control mechanism for timing transfers)

38 - Long Term Planning for Drought Contingencies - (to provide substitute water sources to allow reservoir supplies to be used for water quality purposes)

C39.04 - Coordinate groundwater/surface water management - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.14 - Establish incentives for conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

)39.15 - Modify California Water Code to encourage conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.22 - Water resources data amd information management - max (to provide information for timing of releases for water quality)

Managing Water Quality:

C42.01 - Implement source control regulations for pollutants - max (for agricultural pollutants)

C42.03 - Reduce or control volume of agricultural discharges - max

C42.06 - Retire lands with drainage disposal problems - max

C42.07 - Improve pest control practices - max

C42.08 - Manage irrigation tailwater to reduce pesticides - max

42.11 - Dilute pollutants in Delta inflows from SJR using stored water - max

C43.1 - Retain and manage stormwater runoff - max

C44.2 - Use techniques to localize sediment movement - max (to minimize water quality impacts of dredging)

C44.3 - Dispose dredge materials at nonaquatic habitat sites - max (to minimize water quality impacts of dredging)

C45.1 - Manage discharges from abandoned mines - max

C45.2 - Remediate abandoned minig sites discharging pollutants - max

Improving System Reliability:

PRELIMINARY ALTERNATIVE 106
(WATER QUALITY GROUP)

TITLE: **Improve ecosystem water quality by increasing instream flows to dilute contaminants using stored water.**

SOLUTION OVERVIEW

Theme. This alternative is designed to store water upstream to improve water quality by making available to dilute pollutant discharge. Stored water would be released to coincide with periods of poor water quality in the Delta ecosystem or its tributaries. This alternative also includes core actions that increase instream flow; these core actions would be implemented at their maximum levels when they would be beneficial for water quality. Because non-environmental water users could be adversely affected by these actions, other actions to supplement water supplies are included to achieve a more equitable Delta solution.

Key Actions. The unique character of this alternative is represented by these actions:

- construct new on-stream storage upstream of Delta
- dilute pollutants in Delta inflows from San Joaquin River

ACTIONS SELECTED FOR THE ALTERNATIVE

Bay-Delta Habitat Restoration. Core actions that protect, preserve, and enhance existing wetland habitat in the Delta were included at the maximum level of implementation. These types of aquatic and wetland habitats would assist in removing some toxicants from water.

Upstream Habitat Restoration. Core actions that would improve water quality were included at the maximum level of implementation. Actions include management of flows and temperature for anadromous fish habitat, restricting livestock grazing in riparian zones, and revegetating degraded riparian areas (to prevent eroded sediments from entering streams).

Reduction in Effects of Diversions. Actions to manage Delta inflows such as modifying upstream reservoir operations would be used to provide dilution flows to address Delta water quality problems. Core actions that provide additional flows or allow operation of Delta channels and exports to benefit Delta water quality were included at the maximum level of implementation. Core actions intended to benefit fish, such as providing instream pulse flows, would also be used for dilution of pollutants where the timing would be appropriate.

Management of Anadromous Fish. Management of anadromous fish populations would rely on core actions, such as improving hatchery operations and improving regulation of commercial and recreational take.

Reduction in Reliance on Delta Exports. A number of core actions involving water conservation, water reclamation, and land fallowing in Delta tributary areas (especially in the San Joaquin River drainage) and export areas were included at maximum implementation levels to provide additional water supply for dilution flows.

Water Supply Enhancement. A key action included in this alternative is the construction of new on-stream storage upstream of the Delta, although the location and nature of this storage is not specified. Watershed management actions were included to increase the effective yield from watersheds and to improve the water quality of resulting water yield. Additional on-stream storage would be used to manage this added yield.

Increasing Water Supply Predictability. Core actions such as various means of facilitating water transfers and encouraging conjunctive use are included in this alternative at maximum implementation levels. Water transfers would be timed to provide water quality benefits in the Delta. Conjunctive use actions were included to provide an alternative source of water for diverters to allow more instream flows during periods important for managing water quality.

Management of Water Quality. This alternative includes a key action of diluting pollutants in Delta inflow from the San Joaquin River using stored water. Core actions that provide benefits to water quality were all included at the maximum level of implementation.

Improvements to System Reliability. Improving the reliability of the Delta flood control system would rely on core actions, such as managing and stabilizing existing levees at the highest priority sites and providing funding for levee maintenance and stabilization.

PRELIMINARY ASSESSMENT

Ecosystem Quality. This alternative would benefit water quality in the aquatic habitats of the estuary and upstream (e.g for anadromous fish). In addition, the increased flows for pollutant dilution may have substantial habitat benefits for aquatic resources.

Water Supply. The main burden of this alternative would be on diverters who would likely have less water since reservoir releases would be used for water quality. Selected actions to increase water supply through the construction of additional storage capacity, the fallowing of some farmland, and through watershed management are included. Dilution flows would also be acquired and provided through the timing of water transfers.

Water Quality. This alternative would substantially improve instream and Delta water quality by increasing flows during times when water quality is poor and would improve water quality for some upstream and Delta diverters. Incidental benefits for export water quality would also occur. This alternative would achieve water quality at a heavy water cost, and may not provide as much water quality benefit as alternatives that reduce pollutant loads, because of the bioaccumulation of some pollutants in the estuary.

Reliability of Delta Functions. System reliability would be improved only to the core level of implementation. This alternative therefore may not achieve equity from the standpoint of this program objective.

Title: Improve the water quality for Delta diversions by increasing instream flows to dilute contaminants using stored water. **(Alternative #107)**

Identification of Theme, Sub-theme, and Approach:

Theme: Improve water quality by increasing instream management measures
Sub-theme: Increase instream flows to dilute pollutant discharges
Approach: Increase yield by increasing runoff and adding storage to improve water quality for Delta diversions

Solution Overview:

Includes all actions to store water upstream or in the Delta to improve water quality by making releases timed to coincide with periods of poor water quality. Also includes at the maximum all core actions that increase instream flows at times when they would be beneficial, since these support the main theme. In some cases core actions designed to provide other benefits were included to be implemented in a manner beneficial to water quality. Non-ecological water users would be impacted by these actions, so actions to supplement the water supply were also included to achieve equity.

Actions Selected:

Restore Bay-Delta Habitats:

Core actions that protect, preserve, and enhance existing wetland habitat in the Delta were included at the maximum level of implementation. This type of habitat removes some toxicants from water.

Restore Upstream Habitats:

Core actions that protect water quality were included at the maximum level of implementation. Actions include the management of flows and temperatures, restricting livestock grazing in riparian zones (to avoid cattle-related pollutants from entering the water), and revegetating degrading riparian areas (to prevent sediment due to erosion from entering the water.

Reduce Effects of Diversions:

Core actions that provide additional flows or allow operation of Delta channels and exports pumps to benefit export water quality were included at the maximum level of implementation. Real-time monitoring would be used to monitor water quality and guide operation of the Delta Cross Channel and export pumps to guide good quality water to the export pumps. Some of these are actions intended to benefit fish, but these could also be used for dilution of pollutants where the timing would be beneficial. Non-core actions that would allow the modification of reservoir operations to provide dilution flows were also added.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

A number of actions involving water conservation, water reclamation and land fallowing were included to provide additional water supply to be used for dilution flows.

Enhance Water Supplies:

Watershed management actions were included to increase the effective yield from watersheds and to improve the water quality of the watershed. Additional storage was included to allow the retention of this extra yield. The location and nature of this storage is not specified, but would be upstream of the Delta, since additional Delta conveyance is not provided.

Increase Supply Predictability:

Actions to encourage conjunctive use were included to provide an alternative source of water for diverters to allow more water to stay instream.

Managing Water Quality:

Core actions that provided benefits to water quality were all included at the maximum level of implementation. An action to use water stored upstream to dilute pollutants in the San Joaquin River was also included.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative would improve instream and Delta diversion water quality by increasing flows during times when water quality is poor. This would benefit the Delta diverters (particularly the state and federal projects), anadromous fish, and would improve water quality for some upstream and Delta diverters. Incidental benefits for estuary water quality would also occur. The main burden of this alternative would be on diverters who would likely have less water since reservoir releases would be used for water quality. Selected actions to increase water supply through the construction of additional storage capacity, the fallowing of some farmland, and through watershed management are included. This alternative would achieve water quality at a heavy water cost, and may not provide as much water quality benefit to the estuary as alternatives that reduce pollutant loads, because of the bioaccumulation of some pollutants in the estuary.

Detailed List of Actions Selected (Alternative #107):

Restore Bay-Delta Habitats:

C2.2 - Restore/preserve channel islands -max (for the water-cleaning ability of the wetland vegetation).

C4.1 - Enhance existing wetlands - max (for the water-cleaning ability of the wetland vegetation).

C4.4 - Protect existing wetland habitat - max (for the water-cleaning ability of the wetland vegetation).

Restore Upstream Habitats:

C9.1 - Manage flows and temperatures in upstream habitats - max (to improve water quality

C11.1 - Restrict livestock grazing in riparian corridors - max (to prevent pollutant entry into streams)

C11.2 - Revegetate degraded riparian habitats - max (to prevent pollutant entry into streams)

Reduce Effects of Diversions:

13.2 - Modify upstream reservoir operations - max (to provide the water for dilution flows)

13.3 - Modify Delta inflow timing pattern - max (to provide flows to dilute pollutants in the Delta)

C13.4 - Provide instream pulse flows for fish passage - max (would not be considered if it restricts use of water for water quality)

C13.5 - Provide instream pulse flows for fish attraction - max (would not be considered if it restricts use of water for water quality)

C14.1 - Modify central Delta channel operations - (to allow control of additional flows of good quality water into the central Delta for export)

C14.2 - Modify export operations criteria - (to allow increased diversions when needed for export water quality)

C14.3 - Use real-time monitoring and adaptive management - max (to be used to monitor water quality and time reservoir releases accordingly)

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

C25.1 - Increase agricultural water conservation - max (to provide additional water supply for water quality)

C25.2 - Increase municipal and industrial water conservation - max (to provide additional water supply for water quality)

26.1 - Recharge groundwater with reclaimed water

26.6 - Use reclaimed water to repel salinity intrusion (both in the Delta and in groundwater basins)

C27.1 - Encourage land fallowing during drought periods - max

C27.2 - Develop incentive programs for land retirement - max

Enhance Water Supplies:

29.1 - Manage vegetation cover to increase yield (to provide additional water supply for water quality)

C29.2 - Manage riparian zones to protect water quality - max

29.3 - Manage land uses to protect water quality - max

29.4 - Modify weather to increase precipitation (to provide additional water supply for water quality)

33 - Additional unspecified storage (to provide additional yield for water quality flows)

Increase Supply Predictability:

38 - Long Term Planning for Drought Contingencies - (to provide substitute water sources to allow reservoir supplies to be used for water quality purposes)

C39.04 - Coordinate groundwater/surface water management - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.14 - Establish incentives for conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.15 - Modify California Water Code to encourage conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.22 - Water resources data amd information management - max (to provide information for timing of releases for water quality)

Managing Water Quality:

C42.01 - Implement source control regulations for pollutants - max (for agricultural pollutants)

C42.03 - Reduce or control volume of agricultural discharges - max

C42.06 - Retire lands with drainage disposal problems - max

C42.07 - Improve pest control practices - max

C42.08 - Manage irrigation tailwater to reduce pesticides - max

42.11 - Dilute pollutants in Delta inflows from SJR using stored water - max

C43.1 - Retain and manage stormwater runoff - max

C44.2 - Use techniques to localize sediment movement - max (to minimize water quality impacts of dredging)

C44.3 - Dispose dredge materials at nonaquatic habitat sites - max (to minimize water quality impacts of dredging)

C45.1 - Manage discharges from abandoned mines - max

C45.2 - Remediate abandoned minig sites discharging pollutants - max

Improving System Reliability:

ALT108 (1B)

Title: Improve ecosystem water quality primarily by diluting or avoiding contaminants dissolved in the source waters by increasing flows through reduction of water demands and changing the timing of diversions.

Theme: Increase instream and Delta flows to dilute contaminants and avoid diversions when water quality is poor
Subtheme: Increase flows by reducing water demands and changing the timing of diversions
Approach/primary purpose: To improve water quality to meet ecosystem requirements

Solution overview: This alternative improves water quality for ecological needs by utilizing three types of actions that 1) serve to increase quantities of water available in the Delta and tributary instream flows in order to dilute the concentrations of contaminants; 2) alter the timing of Delta and upstream diversions in order to leave more water available in the system for dilution; and 3) change the timing of diversions to avoid periods of poor water quality. All core measures that reduce the quantities of contaminants entering the aquatic system are included because those actions support the main theme. Equity actions are included to reduce impacts on water users who must make do with smaller supplies. The overall improvement in the quality of diverted and delivered water supplies is in itself a benefit that helps to achieve equity.

Actions Selected:

Restore Bay-Delta Habitats:
Core actions maximized that improve water quality in Bay-Delta receiving waters and associated aquatic habitats.

Restore Upstream Habitats:
Core actions maximized that improve water quality in Bay-Delta receiving waters and associated aquatic habitats.

Reduce Effects of Diversions:
Core actions maximized that improve water quality in Bay-Delta receiving waters and associated aquatic habitats by reducing demands and altering their timing to increase the quantities of instream flow available for dilution. This afforded some flexibility to manage Delta inflows to improve water quality for ecosystem needs. Facilities and/or operations to modify Central Delta channel flows provide capabilities to change the flow split between the Sacramento and Mokelumne systems and inflows into the San Joaquin River distributaries to dilute contaminants and displace water of poor quality. Modification of Delta and export diversions and increasing export capacity also provide capability to maintain higher instream flows when needed to maintain water quality requirements where needed for aquatic biota. Equity is achieved because higher exports can be made when the flows are not needed for dilution.

Enhancement of Anadromous Fish Populations:
None selected

Reduce Reliance on Delta Exports:
Reliance on Delta exports is reduced by implementing demand reducing actions such as water conservation, land fallowing and retirement, free market pricing, and water reclamation (the latter because it reduces the demand for Delta exports by providing substitute supplies).

Enhance Water Supplies:
Water transfer core actions can be timed and maximized so that the increased flows in upstream channels and the Delta dilute contaminants of concern.

Increase Supply Predictability:
Core actions to increase supply reliability in the service areas through implementation of integrated long term water management measures can reduce the need for upstream and Delta diversions and increase quantities of instream flow available for dilution.

Managing Water Quality:
Some agricultural water quality management measures such as those directed at drainage volume control can also reduce agricultural demands

Improving System Reliability:
Some core actions that improve system reliability (notably levee maintenance practices can also improve water quality by reducing contaminant and sediment discharges.

Preliminary Assessment:
This alternative would improve instream and Delta water quality for ecological needs by increasing quantities of water available in the Delta and tributary instream flows thereby diluting the concentrations of contaminants, altering the timing of Delta and upstream diversions which leaves more water available in the system for dilution; and changing the timing of diversions to avoid periods of poor water quality. Overall quantities of contaminants entering the aquatic system are also reduced. The main burden of this alternative is on water users whose supplies will be reduced. Equity actions are included to reduce impacts on those water users who must make do with smaller supplies. Reclamation and desalination will augment service area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available. The overall improvement in the quality of diverted and delivered water supplies is in itself a benefit that helps to achieve equity.

ALT109 (B2)

Title: Improve diversion and service area water quality primarily by diluting or avoiding contaminants dissolved in the source waters by increasing flows through reduction of water demands and changing the timing of diversions.

Theme: Increase instream and Delta flows to dilute contaminants and avoid diversions when water quality is poor
Subtheme: Increase flows by reducing water demands and changing the timing of diversions
Approach/primary purpose: To improve water quality to meet diversion and export beneficial use requirements

Solution overview: This alternative improves water quality for export and diversion needs by utilizing three types of actions that 1) serve to increase quantities of water available in the Delta and tributary instream flows in order to dilute the concentrations of contaminants; 2) alter the timing of Delta and upstream diversions in order to leave more water available in the system for dilution; and 3) change the timing of diversions to avoid periods of poor water quality. All core measures that reduce the quantities of contaminants entering the aquatic system are included because those actions support the main theme. Equity actions are included to reduce impacts on water users who must make do with smaller supplies. The overall improvement in the quality of diverted and delivered water supplies is in itself a benefit that helps to achieve equity.

Actions Selected:

Restore Bay-Delta Habitats:
Core actions maximized that improve water quality in Bay-Delta receiving waters and associated diversions.

Restore Upstream Habitats:
Core actions maximized that improve water quality in Bay-Delta receiving waters and associated diversions.

Reduce Effects of Diversions:
Core actions maximized that improve water quality in Bay-Delta receiving waters and associated aquatic habitats by reducing demands and altering their timing to increase the quantities of instream flow available for dilution. This afforded some flexibility to manage Delta inflows to improve water quality for diversion needs. Facilities and/or operations to modify Central Delta channel flows provide capabilities to change the flow split between the Sacramento and Mokelumne systems and inflows into the San Joaquin River distributaries to dilute contaminants and displace water of poor quality. Modification of Delta and export diversions and increasing export capacity also provide capability to maintain higher instream flows when needed to maintain water quality requirements where needed for beneficial uses of diverted waters. Some equity is achieved because higher exports can be made when water quality is good and the flows are not needed for dilution.

Enhancement of Anadromous Fish Populations:
None selected

Reduce Reliance on Delta Exports:
Reliance on Delta exports is reduced by implementing demand reducing actions such as water conservation, land fallowing and retirement, free market pricing, and water reclamation (the latter because it reduces the demand for Delta exports by providing substitute supplies).

Enhance Water Supplies:
Water transfer core actions can be timed and maximized so that the increased flows in upstream channels and the Delta dilute contaminants of concern.

Increase Supply Predictability:
Core actions to increase supply reliability in the service areas through implementation of integrated long term water management measures can reduce the need for upstream and Delta diversions and increase quantities of instream flow available for dilution.

Managing Water Quality:
Some agricultural water quality management measures such as those directed at drainage volume control can also reduce agricultural demands

Improving System Reliability:
X Some core actions that improve system reliability (notably levee maintenance practices can also improve water quality by reducing contaminant and sediment discharges.

Preliminary Assessment:
This alternative would improve instream and Delta water quality for export and diversion needs by increasing quantities of water available in the Delta and tributary instream flows thereby diluting the concentrations of contaminants, altering the timing of Delta and upstream diversions which leaves more water available in the system for dilution, and changing the timing of diversions to avoid periods of poor water quality. Overall quantities of contaminants entering the raw water sources are also reduced. The main burden of this alternative is on water users whose supplies will be reduced. Equity actions are included to reduce impacts on those water users who must make do with smaller supplies. Reclamation and desalination will augment service area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available. The overall improvement in the quality of diverted and delivered water supplies is in itself a benefit that helps to achieve equity.

Title: Improve water quality with land use management, including wetland and riparian management. **(Alternative #110)**

Identification of Theme, Subtheme, and Approach:
Theme: Improve water quality by increasing instream management measures
Subtheme: Manage watershed land use to improve instream water quality
Approach: Using habitat (especially wetland) and enhancement practices

Solution Overview:
This alternative includes the maximum of all core actions to manage land use to maintain or improve water quality, using wetland and riparian areas to help maintain instream water quality. The core actions that are designed to provide water quality benefits and those core actions that indirectly provide benefits are included at the maximum level.

Actions Selected:

Restore Bay-Delta Habitats:

A number of actions were selected to preserve and restore existing wetlands and riparian areas to help improve water quality.

Restore Upstream Habitats:

A number of actions were selected to reduce pollutant loading to rivers from land use practices.

Reduce Effects of Diversions:

Core actions were included that would provide additional dilution flow in the Delta.

Enhancement of Anadromous Fish Populations:

None Selected

Reducing the Reliance on Delta Exports:

Core actions were included that would provide additional dilution flow in the Delta.

Enhance Water Supplies:

Core actions were included to manage land uses to protect water quality.

Increase Supply Predictability:

Core actions were included that would provide additional dilution flow in the Delta.

Managing Water Quality:

Core actions were added to treat and avoid introduction of poor quality water into the rivers.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative would improve water quality by applying best management practices to watershed land uses. It would benefit the ecosystem, diverters of Delta waters, and Delta recreationists. The main burden would be on farmers because it would replace existing farm land with wetlands . Additional burden could be on maintainence of river banks and levees. Restoration of existing wetlands and creation of new wetlands could place additional demands on water supply Some form of compensation would be needed to mitigate the impacts on land owners. Actions for this compensation are not specifically identified..

Detailed List of Actions Selected (Alternative #110):
(need to correct the action numbers to new numbering system)

Restore Bay-Delta Habitats:

C8 - Restore/preserve channel islands -max (for the water-cleaning ability of the wetland vegetation).

C16 - Protect existing riparian habitat.

C18 - Enhance existing wetlands - max (for the water-cleaning ability of the wetland vegetation).

C19 - Expand wetland acquisition program.

C21 - Protect existing wetland habitat - max (for the water-cleaning ability of the wetland vegetation).

13 - Establish new areas of riparian habitat.

14 - Reestablish historic riparian areas.

20 - Convert agricultural land to wetlands

Restore Upstream Habitats:

C45 - Manage flows and temperatures in upstream habitats - max (to improve water quality

C55 - Restrict livestock grazing in riparian corridors - max (to prevent pollutant entry into streams)

C56 - Revegetate degraded riparian habitats - max (to prevent pollutant entry into streams)

57 - Protect riparian lands through purchase/easements.

Reduce Effects of Diversions:

C68 - Provide instream pulse flows for fish passage - max (would not be considered if it restricts use of water for water quality)

C69 - Provide instream pulse flows for fish attraction - max (would not be considered if it restricts use of water for water quality)

C71 - Modify central Delta channel operations - (to allow control of additional flows for water

quality)

C72 - Modify export operations criteria - (to allow increased Delta outflow and in-Delta flows when needed for water quality)

C73 - Use real-time monitoring and adaptive management - max (to be used to monitor water quality and time reservoir releases accordingly)

C86 - Acquire water for refuge habitat use - (water would actually be acquired for water quality purposes)

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

C123 - Increase agricultural water conservation - max (to provide additional water supply for water quality)

C124 - Increase municipal and industrial water conservation - max (to provide additional water supply for water quality)

C133 - Encourage land fallowing during drought periods - max

C134 - Develop incentive programs for land retirement - max

Enhance Water Supplies:

C140 - Manage riparian zones to protect water quality - max

C141 - Manage land uses to protect water quality - max

Increase Supply Predictability:

C183 - Coordinate diversion and conveyance of transfers - max (timed to provide water quality benefits)

C184 - Establish brokerage for water transfers - max (to provide control mechanism for timing transfers)

C193 - Coordinate groundwater/surface water management - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C203 - Establish incentives for conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C204 - Modify California Water Code to encourage conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C211 - Water resources data amd information management - max (to provide information for timing of releases for water quality)

Managing Water Quality:

C218 - Implement source control regulations for pollutants - max (for agricultural pollutants)

C220 - Reduce or control volume of agricultural discharges - max

C223 - Retire lands with agricultural drainage problems - max

C224 - Improve pest control practices - max

C225 - Manage irrigation tailwater to reduce pesticides - max

C230 - Retain and manage stormwater runoff - max

C237 - Use techniques to localize sediment movement - max (to minimize water quality impacts of dredging)

C238 - Dispose dredge materials at nonaquatic habitat sites - max (to minimize water quality impacts of dredging)

C242 - Manage discharges from abandoned mines - max

C243 - Remediate abandoned minig sites discharging pollutants - max

Improving System Reliability:

None selected

Title: Improve water quality with land use management using watershed best management practices **(Alternative #111)**

Identification of Theme, Subtheme, and Approach:
Theme: Improve water quality by increasing instream management measures
Subtheme: Manage watershed land use to improve instream water quality
Approach: Using best watershed land use management practices.

Solution Overview:
This alternative includes the maximum of all core actions to manage land use to maintain or improve water quality, using watershed management practices to help maintain instream water quality. The core actions that are designed to provide water quality benefits and those core actions that indirectly provide benefits are included at the maximum level.

Actions Selected:

Restore Bay-Delta Habitats:

An action was selected to clean up existing toxic areas. A number of core actions were selected to improve water quality through wetlands.

Restore Upstream Habitats:

A number of actions were selected to reduce pollutant loading to rivers from land use practices and to modify gravel mining practices.

Reduce Effects of Diversions:

Core actions were included that would provide additional dilution flow in the Delta.

Enhancement of Anadromous Fish Populations:

None Selected

Reducing the Reliance on Delta Exports:

Core actions were included that would provide additional dilution flow in the Delta.

Enhance Water Supplies:

Core actions were included to manage land uses to protect water quality.

Increase Supply Predictability:

Core actions were included that would provide additional dilution flow in the Delta.

Managing Water Quality:

Core actions were added to treat and avoid introduction of poor quality water into the rivers.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative would improve instream water quality through a series of actions that emphasize watershed land use management. This alternative would benefit the ecosystem, diverters of Delta water, and Delta recreationists. The main burden of this alternative would be on farmers and owners of land that would be modified under these actions. Some form of compensation would be needed to mitigate the impacts on land owners. Actions for this compensation are not specifically identified.

Detailed List of Actions Selected (Alternative #111):
(need to correct the action numbers to new numbering system)

Restore Bay-Delta Habitats:

C2.2 - Restore/preserve channel islands -max (for the water-cleaning ability of the wetland vegetation).

C16 - Protect existing riparian habitat.

C18 - Enhance existing wetlands - max (for the water-cleaning ability of the wetland vegetation).

C19 - Expand wetland acquisition program.

C21 - Protect existing wetland habitat - max (for the water-cleaning ability of the wetland vegetation).

20 - Convert agricultural land to wetlands.

26 - Clean up sites containing toxic substances.

Restore Upstream Habitats:

C45 - Manage flows and temperatures in upstream habitats - max (to improve water quality

49 - Modify gravel mining practices.

C55 - Restrict livestock grazing in riparian corridors - max (to prevent pollutant entry into streams)

C56 - Revegetate degraded riparian habitats - max (to prevent pollutant entry into streams)

57 - Protect riparian lands through purchase/easements.

Reduce Effects of Diversions:

C68 - Provide instream pulse flows for fish passage - max (would not be considered if it restricts use of water for water quality)

C69 - Provide instream pulse flows for fish attraction - max (would not be considered if it restricts use of water for water quality)

C71 - Modify central Delta channel operations - (to allow control of additional flows for water quality)

C72 - Modify export operations criteria - (to allow increased Delta outflow and in-Delta flows when needed for water quality)

C73 - Use real-time monitoring and adaptive management - max (to be used to monitor water quality and time reservoir releases accordingly)

C86 - Acquire water for refuge habitat use - (water would actually be acquired for water quality purposes)

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

C123 - Increase agricultural water conservation - max (to provide additional water supply for water quality)

C124 - Increase municipal and industrial water conservation - max (to provide additional water supply for water quality)

C133 - Encourage land fallowing during drought periods - max

C134 - Develop incentive programs for land retirement - max

Enhance Water Supplies:

C140 - Manage riparian zones to protect water quality - max

C141 - Manage land uses to protect water quality - max

Increase Supply Predictability:

C183 - Coordinate diversion and conveyance of transfers - max (timed to provide water quality benefits)

C184 - Establish brokerage for water transfers - max (to provide control mechanism for timing transfers)

C193 - Coordinate groundwater/surface water management - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C203 - Establish incentives for conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C204 - Modify California Water Code to encourage conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C211 - Water resources data amd information management - max (to provide information for timing of releases for water quality)

Managing Water Quality:

C218 - Implement source control regulations for pollutants - max (for agricultural pollutants)

C220 - Reduce or control volume of agricultural discharges - max

C223 - Retire lands with agricultural drainage problems - max

C224 - Improve pest control practices - max

C225 - Manage irrigation tailwater to reduce pesticides - max

C230 - Retain and manage stormwater runoff - max

C237 - Use techniques to localize sediment movement - max (to minimize water quality impacts of dredging)

C238 - Dispose dredge materials at nonaquatic habitat sites - max (to minimize water quality impacts of dredging)

C242 - Manage discharges from abandoned mines - max

C243 - Remediate abandoned mining sites discharging pollutants - max

221 - Modify cropping and irrigation practices

222 - Export agricultural drainage to other watersheds

Title: Improve water quality for Delta diversions through the use of physical improvements in Delta waterways. (Alternative #112)

Identification of Theme, Sub-theme, and Approach:

Theme: Improve water quality by increasing instream management measures.

Sub-theme: Improve water quality through the use of physical improvements in Delta waterways (i.e. changes in diversions locations, barriers and weirs, channel modifications, through-Delta conveyance improvements).

Approach: Improve Delta diversion water quality.

Solution Overview:

Selected all actions to improve the water quality of Delta diversions through the use of physical improvements in the Delta waterways. Then implemented, at the maximum level, all core actions that result in improvement of Delta diversions as supported by the main theme. Then determined who would be hurt by implementing these actions and added actions to achieve equity.

Actions Selected:

Restore Bay-Delta Habitat:

None selected.

Restore Upstream Habitat:

None selected.

Reduce Effects of Diversions:

None selected.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

None selected.

Enhance Water Supplies:

Actions selected included the improvement of the current through-Delta conveyance system as well as the construction of new facilities. Improved and new conveyance facilities could be used to provide flows to Delta channels. Improvements to the Delta ecosystem would be in the form of flow direction and water quality.

Increase Supply Predictability:

Considered that a Delta watermaster would provide greater maintenance and assurance of instream flows.

Managing Water Quality:

Considered the installation of flow barriers to improve agricultural water quality in the southern Delta. Also considered installation of weirs to improve control of salinity in water diverted for western Delta municipal purposes.

Improving System Reliability:

None selected.

Preliminary Assessment:

It was ascertained that any improvements to the current through-Delta conveyance system would benefit water quality at the export pumping plants. An isolated facility designed to divert water from at least as far north as Hood would provide the greatest improvement. Diversions further north, i.e. the confluence of the Sacramento and Feather Rivers would provide even further benefit in the area of THM control.

Detailed List of Actions Selected: (Alternative #112)

Restore Bay-Delta Habitat:

C2.2 - Restore/preserve channel islands -max (for the water-cleaning ability of the wetland vegetation).

C4.1 - Enhance existing wetlands - max (for the water-cleaning ability of the wetland vegetation).

C4.4 - Protect existing wetland habitat - max (for the water-cleaning ability of the wetland vegetation).

Restore Upstream Habitat:

C9.1 - Manage flows and temperatures in upstream habitats - max (to improve water quality

C11.1 - Restrict livestock grazing in riparian corridors - max (to prevent pollutant entry into streams)

C11.2 - Revegetate degraded riparian habitats - max (to prevent pollutant entry into streams)

Reduce Effects of Diversions:

C13.4 - Provide instream pulse flows for fish passage - max (would not be considered if it restricts use of water for water quality)

C13.5 - Provide instream pulse flows for fish attraction - max (would not be considered if it restricts use of water for water quality)

C14.1 - Modify central Delta channel operations - (to allow control of additional flows for water quality)

C14.2 - Modify export operations criteria - (to allow increased Delta outflow and in-Delta flows when needed for water quality)

C14.3 - Use real-time monitoring and adaptive management - max (to be used to monitor water quality and time reservoir releases accordingly)

C17.1 - Acquire water for refuge habitat use - (water would actually be acquired for water quality purposes)

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

C25.1 - Increase agricultural water conservation - max (to provide additional water supply for water quality)

C25.2 - Increase municipal and industrial water conservation - max (to provide additional water supply for water quality)

C27.1 - Encourage land fallowing during drought periods - max

C27.2 - Develop incentive programs for land retirement - max

Enhance Water Supplies:

C29.2 - Manage riparian zones to protect water quality - max

C29.3 - Manage land uses to protect water quality - max

35.1-Construct eastside isolated transfer system

35.2-Construct westside isolated transfer system

35.3-Construct small isolated transfer facility

35.8-Convert Delta islands to storage/conveyance system

Increase Supply Predictability:

C37.1 - Coordinate diversion and conveyance of transfers - max (timed to provide water quality benefits)

C37.2 - Establish brokerage for water transfers - max (to provide control mechanism for timing transfers)

C39.04 - Coordinate groundwater/surface water management - max (to provide an alternative source of water supply during periods when flows needed for water quality)

39.07-Establish a Delta watermaster to manage flows

C39.14 - Establish incentives for conjunctive use - max (to provide an alternative

source of water supply during periods when flows needed for water quality)

C39.15 - Modify California Water Code to encourage conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.22 - Water resources data amd information management - max (to provide information for timing of releases for water quality)

Managing Water Quality:

41.1-Install flow barriers to manage South Delta quality

41.2-Install weirs to control salinity intrusion

C42.01 - Implement source control regulations for pollutants - max (for agricultural pollutants)

C42.03 - Reduce or control volume of agricultural discharges - max

C42.06 - Retire lands with agricultural drainage problems - max

C42.07 - Improve pest control practices - max

C42.08 - Manage irrigation tailwater to reduce pesticides - max

C43.1 - Retain and manage stormwater runoff - max

C44.2 - Use techniques to localize sediment movement - max (to minimize water quality impacts of dredging)

C44.3 - Dispose dredge materials at non-aquatic habitat sites - max (to minimize water quality impacts of dredging)

C45.1 - Manage discharges from abandoned mines - max

C45.2 - Remediate abandoned mining sites discharging pollutants - max

Improving System Reliability:

None selected.

Title: Improve water quality for Delta ecosystem through the use of physical improvements in Delta waterways. (Alternative #113)

Identification of Theme, Sub-theme, and Approach:

Theme: Improve water quality by increasing instream management measures.

Sub-theme; Improve water quality through the use of physical improvements in Delta waterways (i.e. changes in diversions locations, barriers and weirs, channel modifications, through-Delta conveyance improvements).

Approach: Improve Delta ecosystem water quality.

Solution Overview:

Selected all actions to improve the water quality of the Delta ecosystem through the use of physical improvements in the Delta waterways. Then implemented, at the maximum level, all core actions that result in improvement of Delta diversions as supported by the main theme. Then determined who would be hurt by implementing these actions and added actions to achieve equity.

Actions Selected:

Restore Bay-Delta Habitat:

None selected.

Restore Upstream Habitat:

None selected.

Reduce Effects of Diversions:

None selected.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

None selected.

Enhance Water Supplies:

Actions selected included the improvement of the current through-Delta conveyance system as well as the construction of new facilities. Improved and new conveyance facilities could be used to provide flows to Delta channels. Improvements to the Delta ecosystem would be in the form of flow direction and water quality.

Increase Supply Predictability:

Considered that a Delta watermaster would provide greater maintenance and assurance of instream flows.

Managing Water Quality:

Considered the installation of flow barriers to improve agricultural water quality in the southern Delta. Also considered installation of weirs to improve control of salinity in water diverted for western Delta municipal purposes.

Improving System Reliability:

None selected.

Preliminary Assessment:

It was ascertained that any improvements to the current through-Delta conveyance system would benefit the water quality of the ecosystem by providing releases to channels to improve the movement of better quality water.

Detailed List of Actions Selected:

Restore Bay-Delta Habitat:

C2.2 - Restore/preserve channel islands -max (for the water-cleaning ability of the wetland vegetation).

C4.1 - Enhance existing wetlands - max (for the water-cleaning ability of the wetland vegetation).

C4.4 - Protect existing wetland habitat - max (for the water-cleaning ability of the wetland vegetation).

Restore Upstream Habitat:

C9.1 - Manage flows and temperatures in upstream habitats - max (to improve water quality

C11.1 - Restrict livestock grazing in riparian corridors - max (to prevent pollutant entry into streams)

C11.2 - Revegetate degraded riparian habitats - max (to prevent pollutant entry into streams)

Reduce Effects of Diversions:

C13.4 - Provide instream pulse flows for fish passage - max (would not be considered if it restricts use of water for water quality)

C13.5 - Provide instream pulse flows for fish attraction - max (would not be considered if it restricts use of water for water quality)

C14.1 - Modify central Delta channel operations - (to allow control of additional flows for water quality)

C14.2 - Modify export operations criteria - (to allow increased Delta outflow and in-Delta flows when needed for water quality)

C14.3 - Use real-time monitoring and adaptive management - max (to be used to monitor water quality and time reservoir releases accordingly)

C17.1 - Acquire water for refuge habitat use - (water would actually be acquired for water quality purposes)

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

C25.1 - Increase agricultural water conservation - max (to provide additional water supply for water quality)

C25.2 - Increase municipal and industrial water conservation - max (to provide additional water supply for water quality)

C27.1 - Encourage land fallowing during drought periods - max

C27.2 - Develop incentive programs for land retirement - max

Enhance Water Supplies:

C29.2 - Manage riparian zones to protect water quality - max

C29.3 - Manage land uses to protect water quality - max

35.1-Construct eastside isolated transfer system

35.8-Convert Delta islands to storage/conveyance system

Increase Supply Predictability:

C37.1 - Coordinate diversion and conveyance of transfers - max (timed to provide water quality benefits)

C37.2 - Establish brokerage for water transfers - max (to provide control mechanism for timing transfers)

C39.04 - Coordinate groundwater/surface water management - max (to provide an alternative source of water supply during periods when flows needed for water quality)

39.07-Establish a Delta watermaster to manage flows

C39.14 - Establish incentives for conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.15 - Modify California Water Code to encourage conjunctive use - max (to

provide an alternative source of water supply during periods when flows needed for water quality)

C39.22 - Water resources data amd information management - max (to provide information for timing of releases for water quality)

Managing Water Quality:

41.1-Install flow barriers to manage South Delta quality

41.2-Install weirs to control salinity intrusion

C42.01 - Implement source control regulations for pollutants - max (for agricultural pollutants)

C42.03 - Reduce or control volume of agricultural discharges - max

C42.06 - Retire lands with agricultural drainage problems - max

C42.07 - Improve pest control practices - max

C42.08 - Manage irrigation tailwater to reduce pesticides - max

C43.1 - Retain and manage stormwater runoff - max

C44.2 - Use techniques to localize sediment movement - max (to minimize water quality impacts of dredging)

C44.3 - Dispose dredge materials at non-aquatic habitat sites - max (to minimize water quality impacts of dredging)

C45.1 - Manage discharges from abandoned mines - max

C45.2 - Remediate abandoned mining sites discharging pollutants - max

Improving System Reliability:

None selected.

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– As submitted by P. Kruger 12/20

Title: Improve habitat quality and quantity through conversion of existing land uses. **(Alternative #114)**

Identification of Theme, Sub-theme, and Approach:

Theme: Improve Habitat quality and quantity through conversion of existing land uses.

Sub-theme: None assigned.

Approach: None assigned.

Solution Overview:

Selected all actions to improve the quality and quantity of habitat in and upstream of the Delta by changing land uses. Also included at the core level of implementation or above, core actions that improve habitats without converting existing land uses and core actions that improve or increase habitat by balancing land-use conversions and improvements to existing land uses. Finally, determined who would be hurt by implementing these actions and added actions to achieve equity.

Actions Selected:

Restore Bay-Delta Habitat:

Actions selected include removal of dikes and levees and restoring natural channel configurations and floodways to create new brackish marshes, shallow freshwater habitats, wetlands, and riparian habitat. Some agricultural lands would be acquired and converted to wetlands or other habitat. New regulations prohibiting introductions of exotic species would be implemented and all regulations controlling species introductions would be more strictly enforced.

Restore Upstream Habitat:

Actions selected include removal and relocation of levees, and restoring natural channel configurations and floodways to create new brackish marshes, shallow freshwater habitats, wetlands, and riparian habitat. Some agricultural lands would be acquired and converted to wetlands or other habitat. Agricultural and urban wastewater would be used to create new wetlands.

Reduce Effects of Diversions:

In addition to core actions, this alternative would include the purchase of water for refuges and instream flows to replace water lost due to the actions in this alternative.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

Selected actions to encourage fallowing and retirement of agricultural and ranch lands having good habitat potential. Also selected action to manage vegetation for increased yield.

Enhance Water Supplies:

None selected.

Increase Supply Predictability:

None selected.

Managing Water Quality:

Considered actions to create constructed wetlands for treatment of wastewater effluent.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative would improve habitat quality and increase habitat quantity by converting existing land uses to uses that support natural habitats. It would benefit the ecosystem, recreationalists, and commercial fishermen. Some diverters of Delta waters would benefit because new wetlands could result in improved water quality. The main burden would be on farmers and ranchers because some existing farmland and ranchland would be replaced with wetlands and riparian habitats. Additional burden could be on flood control efforts and maintenance of river banks and levees. Restoration of existing wetlands and creation of new wetlands could place additional demands on water supply. Some form of compensation would be needed to mitigate the impacts on land owners. Actions for this compensation are not specifically identified..

Detailed List of Actions Selected:

Restore Bay-Delta Habitat:

- 1.1 - Convert existing leveed lands to tidal action.
- C1.2 - Protect existing shallow habitat from erosion - max.
- 1.3 - Restore tidal action to existing diked wetlands.
- C2.2 - Restore/preserve channel islands - 0.75.
- 2.3 - Restore natural channel configurations.
- C2.4 - Modify construction practices to include riverine elements - max (provides potential for substantial increase in habitat with relatively low cost).

- C3.1 - Improve and protect degraded riparian habitats - 0.60.
- 3.2 - Establish new areas of riparian habitat.
- 3.3 - Reestablish historic riparian areas.
- C3.4 - Modify levee maintenance practices - 0.35.
- C3.5 - Protect existing riparian habitat - 0.75.
- C4.1 - Enhance existing wetlands - 0.60.
- C4.2 - Expand wetland acquisition programs - max.
- 4.3 - Convert agricultural lands to wetlands.
- C4.4 - Protect existing wetland habitat - 0.65.
- 5.2 - Establish upland habitat.
- 5.4 - Clean-up sites containing toxic substances.
- C50 - Integrated habitat management programs - 0.75.
- 6.1 - Relocate levees to widen floodways.
- 6.2 - Allow river channels to meander.
- 6.3 - Acquire Delta islands as overflow areas.
- 6.4 - Restore floodways as habitat corridors.
- 7.1 - Remove or reduce nuisance species in key habitats.
- C7.2 - Improve regulation of ballast water releases - max (introduction of exotic species reduces benefits of physical habitat improvements).
- C7.3 - Improve border inspection practices - max (introduction of exotic species reduces benefits of physical habitat improvements).
- 7.4 - Inspect for invasions of nuisance species.

- 7.5 - Modify habitat to favor native species.
- 8.4 - Increase sources and availability of wildlife forage.

Restore Upstream Habitat:

- C9.1 - Manage flows and temperatures in upstream habitats - max (inadequate flow and temperature conditions reduce or eliminate benefits of physical habitat improvements).
- C9.2 - Restore and replenish spawning gravels - 0.35.
- 9.3 - Restore channel configurations.
- C9.4 - Restore shoreline habitat conditions - max.
- C10.1 - Modify passage at upstream dams/other barriers - max (greatly increases opportunities for increasing habitat).
- C10.2 - Modify natural barriers to improve passage - 0.35 (in some instances, removal of natural barriers threatens survival of upstream species and stocks).
- C11.1 - Restrict livestock grazing in riparian corridors - max.
- C11.2 - Revegetate degraded riparian habitats - max (revegetation greatly enhances benefits of removing grazing and other land use changes in riparian corridors).
- 11.3 - Protect riparian lands through purchase/easements.
- 12.1 - Modify floodways to support wetland habitats.
- 12.2 - Reuse agricultural drainage to create wetlands.
- 12.3 - Reuse urban wastewater effluent to create wetlands.
- 12.4 - Manage groundwater recharge for wetland habitat.

Reduce Effects of Diversions:

None selected.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

C27.1 - Encourage land fallowing during drought periods - max

C27.2 - Develop incentive programs for land retirement - max

27.3 - Purchase lands and easements

29.1 - Manage vegetation cover to increase yield

Enhance Water Supplies:

None selected.

Increase Supply Predictability:

None selected.

Managing Water Quality:

43.2 - Construct wetlands to treat wastewater effluent.

Improving System Reliability:

None selected.

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- As submitted by P. Unger 12/20

Preliminary Alternative 115
(Land Use/Habitat Quality Group)

TITLE: Improve Habitat Quality without Converting Existing Land Use Patterns

SOLUTION OVERVIEW

Theme. This alternative is designed to improve habitat quality without changing existing land use patterns. This would be accomplished through measures to protect existing habitat and to modify existing habitat to benefit more highly valued species. Habitat modifications would include revegetating denuded areas, replenishing spawning gravels, reducing obstacles to fish passage, removing contaminated sediments, creating shallow water habitat by filling areas of deep water, improving drainage of floodways to reduce fish-stranding hazards, and controlling exotic species. In addition, existing land use practices would be modified to improve habitat conditions. Modifications would be made to levee maintenance, gravel mining, and farming practices and to locations of water diversions.

Key Actions. The unique character of this alternative is represented by the following feature:

- improving Delta and upstream habitat without changing the existing land uses.

ACTIONS SELECTED FOR THE ALTERNATIVE

Bay-Delta Habitat Restoration. Restoration of Bay-Delta habitats would rely on core actions, such as protecting existing shallow water habitat from erosion, protecting wetlands, restoring and protecting riparian habitats, modifying levee maintenance practices to provide greater habitat value, and controlling exotic species. All core actions producing habitat improvements that do not require conversion of land use patterns are implemented above the core level. In addition, non-core actions were selected, such as reconstructing levees and river banks to include shallow water habitat, preserving the habitat values of agricultural land uses, and restoring floodways as habitat corridors (where not serving economic land uses).

Upstream Habitat Restoration. This alternative includes core actions, such as restoring high-priority sites for riparian vegetation and restricting grazing in high-priority riparian corridors, that may involve conversion of economic land uses. Such core actions are implemented at the core level. Core actions not requiring conversion of land uses, such as managing

flows and temperatures in upstream habitats, restoring and replenishing spawning gravels, and improving fish passage at dams and other barriers, are included at above the core level of implementation. These actions are supplemented by non-core actions not involving the conversion of land uses, such as improving floodway drainage to reduce fish stranding, managing crops for wildlife forage, and protecting riparian lands through easements.

Reduction in Diversion Effects. In addition to core actions, this alternative would include the purchase of water for refuges and instream flows to replace water lost due to the actions in this alternative.

Management of Anadromous Fish. This alternative would rely on core actions to benefit the management of anadromous fish, including improvements to fish hatchery operations and improvements in the management and enforcement of commercial and recreational fish harvesting. Actions beyond the core actions were not included.

Reduction in Diversion/Export Reliance. The core actions contributing to this alternative include programs for temporary land fallowing and permanent land retirement. Actions beyond the core actions were not included.

Water Supply Enhancement. In addition to core actions, this alternative would rely on non-core actions such as managing vegetation cover in watersheds to increase yield and moving diversions away from key habitats.

Increasing Water Supply Predictability. This alternative includes core actions such as programs to facilitate water transfers and long-term water planning. Actions beyond the core actions were not included.

Management of Water Quality. This alternative includes core actions to improve water quality, which would benefit Delta and upstream habitats. Also included is the non-core action to remove contaminated sediments in critical habitat sites.

Improvement to System Reliability/Vulnerability. This alternative would rely on core actions to improve system reliability, such as managing the highest priority levees, modifying agricultural practices to reduce subsidence in the most cost effective sites, and establishing an emergency levee management plan. Actions beyond the core actions were not included.

PRELIMINARY ASSESSMENT

Ecosystem Quality. Ecosystem quality would be addressed by implementing core actions, particularly habitat restoration actions not involving the conversion of economic land uses. Non-core actions address instream flows, exotic species, protections and improvements to a variety of habitats, and water quality. However, the actions of this alternative are somewhat limited and, therefore, may not lead to recovery of reduced plant and animal populations or prevent other species from becoming threatened or endangered.

Water Supply. Few actions to increase the supply or reliability of water, beyond the core actions, are included in this alternative. The benefits of this alternative are probably not equitable, although all beneficial uses would receive cleaner water.

Water Quality. Water quality in the Delta and upstream would be considerably improved under this alternative, as water quality generally improves when habitat quality improves. The benefits of improved water quality would be shared by all beneficial uses, but the costs would be borne mainly by agricultural users.

Reliability of Delta Functions. System reliability would be improved only to the core level of implementation. This alternative, therefore, may not achieve equity with regard to this program objective.

Detailed List of Actions (Alternative 115)

Because this alternative is limited to protecting and enhancing existing habitat, core actions that require changes in land use patterns are not included at above core levels of implementation. Core habitat actions not requiring land use conversion are included at above core levels of implementation.

Restore Bay-Delta Habitat

1.2 -Protect existing shallow habitat from erosion
1.4 -Reconstruct levees to include shallow water habitat
1.5 -Fill deep water to produce shallow habitat
2.1 -Reconstruct river banks and shallow areas
2.2 -Restore/preserve channel islands - **above core level**
2.4 -Modify construction practices to include riverine elements - **above core level**
3.1 -Improve and protect degraded riparian habitats - **above core level**
3.4 -Modify levee maintenance practices - **above core level**
3.5 -Protect existing riparian habitat - **above core level**
4.1 -Enhance existing wetlands - **above core level**
4.2 -Expand wetland acquisition program (without altering land uses)
4.4 -Protect existing wetland habitat - **above core level**
5.1 -Protect existing upland habitat
5.3 -Preserve the habitat values of agricultural land uses
5.4 -Clean-up sites containing toxic substances (without altering land uses)
50 -Integrated Habitat Management Programs (without altering land uses) - **above core level**
6.4 -Restore floodways as habitat corridors (without altering land uses)
7.1 -Remove or reduce nuisance species in key habitats
7.2 -Improve regulation of ballast-water releases
7.3 -Improve border inspection practices
7.4 -Inspect for invasions of nuisance species
7.5 -Modify habitat to favor native species (without altering land uses)
8.1 -Manage crops for waterfowl forage production
8.2 -Improve management of public waterfowl areas
8.3 -Implement terrestrial predator control programs
8.4 -Increase sources and availability of wildlife forage (without altering land uses)

Restore Upstream Habitat

9.1 -Manage flows and temperatures in upstream habitats - **above core level**
9.2 -Restore and replenish spawning gravels - **above core level**
9.4 -Restore shoreline habitat conditions (without altering land uses)
9.5 -Modify gravel mining practices
9.6 -Improve floodway drainage to reduce fish stranding
10.1 -Modify passage at upstream dams/other barriers - **above core level**
10.2 -Modify natural barriers to improve passage (without altering land uses) - **above core level**
11.1 -Restrict livestock grazing in riparian corridors

11.2 -Revegetate degraded riparian habitats (without altering land uses)
11.3 -Protect riparian lands through purchase/easements (without altering land uses)
11.4 -Restore flows to dewatered riparian habitats
12.1 -Modify floodways to support wetland habitats (without altering land uses)
12.4 -Manage groundwater recharge for wetland habitat (without altering land uses)

Reduce Effects of Diversions

17.1 -Acquire water for refuge habitat use (to make up for reduced agricultural drainage water)
17.? -Acquire water for instream flows (to make up for reduced agricultural drainage water)

Enhancement of Anadromous Fish Populations

Reducing the Reliance on Delta Exports

Enhance Water Supplies

29.1 -Manage vegetation cover to increase yield (without altering land uses)
36.1 -Relocate Delta export pumps from key habitats
36.4 -Relocate upstream diversions from key habitats

Increase Supply Predictability

Managing Water Quality

44.4 -Remove contaminated sediments in critical habitat

Improving System Reliability

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- As submitted by P. Unger
12/20

Preliminary Alternative 116
(Land Use/Habitat Quality Group)

TITLE: Improve Habitat Quality and Quantity through a Combination of Creating New Habitat by Converting Existing Land Uses and Preserving and Enhancing Existing Habitat

SOLUTION OVERVIEW

Theme. This alternative is designed to improve habitat quality and quantity through actions that combine changes in land uses with complementary improvements in existing land uses. For example, waterfowl forage would be increased by converting some agricultural lands to wetlands, while changing cropping and harvest practices on other lands. Similarly, the habitat value of floodways would be improved by retiring some farmlands and changing farming practices on others. Other actions selected for this alternative include clean-up of contaminated sites, controlling exotic species, improving fish passage conditions, revegetating and otherwise improving shoreline habitats, and incorporating habitat objectives in management of watershed ground cover and groundwater recharge zones. In addition, all actions to improve habitat quality and quantity that require land use conversions (i.e., Alternative 114), and all actions to improve habitat quality by preserving and enhancing existing habitats (i.e., Alternative 115) are included in this alternative.

Key Actions. The unique character of this alternative is represented by the following feature:

- improving Delta and upstream habitat by combining changes in the existing land uses with measures to preserve and enhance habitat value without changing land uses.

ACTIONS SELECTED FOR THE ALTERNATIVE

Bay-Delta Habitat Restoration. Restoration of Bay-Delta habitats would rely on core actions, such as protecting shallow water habitat from erosion, acquiring and protecting wetlands, restoring and protecting riparian habitats and channel islands, modifying levee maintenance practices to provide greater habitat value, implementing integrated habitat management programs, and controlling exotic species. All core actions producing habitat improvements are implemented above the core level. The core actions are supplemented by non-core actions, such as restoring tidal action to historical wetland areas, restoring natural

channel configurations, reconstructing and relocating levees and river banks to include shallow water habitat and floodways, filling submerged islands to produce shallow water habitat, preserving the habitat values of agricultural land uses, converting agricultural lands to wetlands, creating new riparian habitat, and restoring floodways as habitat corridors.

Upstream Habitat Restoration. This alternative includes core actions, such as restoring vegetation and restricting grazing in riparian corridors, managing flows and temperatures in upstream habitats, restoring and replenishing spawning gravels, and improving fish passage at dams and other barriers. All core actions producing habitat improvements are implemented above the core level. The core actions are supplemented by non-core habitat actions, such as improving floodway drainage to reduce fish stranding, restoring channel configurations, modifying gravel mining practices, managing crops for wildlife forage, protecting riparian lands through easements, and reusing wastewaters to create wetlands.

Reduction in Diversion Effects. In addition to core actions, this alternative would include the purchase of water for refuges and instream flows to replace water lost due to the actions in this alternative.

Management of Anadromous Fish. This alternative would rely on core actions to benefit the management of anadromous fish, including improvements to fish hatchery operations and improvements in the management and enforcement of commercial and recreational fish harvesting. Actions beyond the core actions were not included.

Reduction in Diversion/Export Reliance. The core actions contributing to this alternative include programs for temporary land fallowing and permanent land retirement. Actions beyond the core actions were not included.

Water Supply Enhancement. In addition to core actions, this alternative would rely on non-core actions such as managing vegetation cover in watersheds to increase yield and moving diversions away from key habitats.

Increasing Water Supply Predictability. This alternative includes core actions such as programs to facilitate water transfers and long-term water planning. Actions beyond the core actions were not included.

Management of Water Quality. This alternative includes core actions to improve water quality, which would benefit Delta and upstream habitats. Also included is the non-core action to remove contaminated sediments in critical habitat sites.

Improvement to System Reliability/Vulnerability. This alternative would rely on core actions to improve system reliability, such as managing the highest priority levees, modifying agricultural practices to reduce subsidence in the most cost effective sites, and establishing an emergency levee management plan. Actions beyond the core actions were not included.

PRELIMINARY ASSESSMENT

Ecosystem Quality. Ecosystem quality would be addressed by implementing core actions, including habitat restoration actions requiring conversion of economic land uses and measures to protect and enhance existing habitats. Non-core actions address instream flows; fish passage; exotic species; creation, improvement, and protection of a variety of habitats; and water quality. The habitat improvements achieved by the actions that make up this alternative would be substantial, but they may not lead to recovery of reduced plant and animal populations or prevent other species from becoming threatened or endangered unless other types of actions are also included.

Water Supply. Few actions to increase the supply or reliability of water, beyond the core actions, are included in this alternative. The benefits of this alternative are probably not equitable, although all beneficial uses would receive cleaner water.

Water Quality. Water quality in the Delta and upstream would be considerably improved under this alternative, as water quality generally improves when habitat quality improves. The benefits of improved water quality would be shared by all beneficial uses, but the costs would be borne mainly by agricultural users.

Reliability of Delta Functions. System reliability would be improved only to the core level of implementation. This alternative, therefore, may not achieve equity with regard to this program objective.

Detailed List of Actions (Alternative 116)

Because this alternative combines changes in existing land use patterns with protections and enhancement of existing habitat, all habitat actions, regardless of whether or not land use changes are involved, are included. All core habitat actions are included at above core levels of implementation.

Restore Bay-Delta Habitat

1.1 -Convert existing leveed lands to tidal action
1.2 -Protect existing shallow habitat from erosion
1.3 -Restore tidal action to existing diked wetlands
1.4 -Reconstruct levees to include shallow water habitat
1.5 -Fill deep water to produce shallow habitat
2.1 -Reconstruct river banks and shallow areas
2.2 -Restore/preserve channel islands - **above core level**
2.3 -Restore natural channel configurations
2.4 -Modify construction practices to include riverine elements - **above core level**
3.1 -Improve and protect degraded riparian habitats - **above core level**
3.2 -Establish new areas of riparian habitat
3.2 -Reestablish historic riparian areas
3.4 -Modify levee maintenance practices - **above core level**
3.5 -Protect existing riparian habitat - **above core level**
4.1 -Enhance existing wetlands - **above core level**
4.2 -Expand wetland acquisition program - **above core level**
4.3 -Convert agricultural lands to wetlands
4.4 -Protect existing wetland habitat - **above core level**
5.1 -Protect existing upland habitat
5.2 -Establish upland habitat
5.3 -Preserve the habitat values of agricultural land uses
5.4 -Clean-up sites containing toxic substances
50 -Integrated Habitat Management Programs - **above core level**
6.1 -Relocate levees to widen floodways
6.2 -Allow river channels to meander
6.3 -Acquire Delta islands as overflow areas
6.4 -Restore floodways as habitat corridors
7.1 -Remove or reduce nuisance species in key habitats
7.2 -Improve regulation of ballast-water species
7.3 -Improve border inspection practices
7.4 -Inspect for invasions of nuisance species
7.5 -Modify habitat to favor native species
8.1 -Manage crops for waterfowl forage production
8.2 -Improve management of public waterfowl areas
8.3 -Implement terrestrial predator control programs
8.4 -Increase sources and availability of wildlife forage

Restore Upstream Habitat

9.1 -Manage flows and temperatures in upstream habitats - **above core level**

9.2 -Restore and replenish spawning gravels - **above core level**
9.3 -Restore channel configurations
9.4 -Restore shoreline habitat conditions
9.5 -Modify gravel mining practices
9.6 -Improve floodway drainage to reduce fish stranding
10.1 -Modify passage at upstream dams/other barriers - **above core level**
10.2 -Modify natural barriers to improve passage - **above core level**
11.1 -Restrict livestock grazing in riparian corridors
11.2 -Revegetate degraded riparian habitats
11.3 -Protect riparian lands through purchase/easements
11.4 -Restore flows to dewatered riparian habitats
12.1 -Modify floodways to support wetland habitats
12.2 -Reuse agricultural drainage to create wetlands
12.3 -Reuse urban wastewater effluent to create wetlands
12.4 -Manage groundwater recharge for wetland habitat

Reduce Effects of Diversions

17.1 -Acquire water for refuge habitat use (to make up for reduced agricultural drainage water)
17.? -Acquire water for instream flows (to make up for reduced agricultural drainage water

Enhancement of Anadromous Fish Populations

Reducing the Reliance on Delta Exports

Enhance Water Supplies

27.1 -Encourage land fallowing during drought periods
27.2 -Develop incentive programs for land retirement
27.3 -Purchase lands or easements
29.1 -Manage vegetation cover to increase yield
36.1 -Relocate Delta export pumps from key habitats
36.4 -Relocate upstream diversions from key habitats

Increase Supply Predictability

Managing Water Quality

43.3 - Construct wetlands to treat wastewater effluent
44.4 -Remove contaminated sediments in critical habitat

Improving System Reliability

Preliminary Alternative WQ117

Title
Water Quality/Land Use
Group
Diluting Pollutants and Restoring Existing Habitat

Improve water quality by diluting pollutants with stored water and reduced diversions, and create habitat by restoring and enhancing existing habitat areas.

Key Actions

New shallow water habitat areas -create new areas of shallow water habitat in the Delta by reconstructing levees, reconstructing river banks and shallow areas, and by restoring/preserving channel islands.

New Upstream Habitats - restore a variety of Delta and upstream habitats by protecting and enhancing existing wetland, riparian, and wetland areas.

Dilution Flows - use a variety of actions, including modifying upstream reservoir operations, land fallowing and retirement, acquisition of water for instream flows, timing of water transfers, and expand use of desalination in San Joaquin Valley and southern California to reallocate water supplies to be used for dilution.

Levee Upgrades - improve levees around important economic land uses and restored freshwater habitats.

Supporting Actions

Reduce Delta Demand - Reduce demand for Delta water by reducing upstream diversions, increasing agricultural, municipal, and industrial water conservation, reclaiming agricultural, municipal, and industrial wastewater, providing incentives to implement pricing structures to reduce demand. The water saved by these actions would be used for dilution flows.

Floodways - floodways are enhanced to restore wetland habitat and to reduce fish stranding..

Water Transfers - facilitate water transfers to be timed to coincide with needs for dilution flows.

Core Actions

Bay-Delta Habitat Restoration - Support restoration of Bay-Delta habitats by core-level implementation of actions such as protecting existing shallow water habitat from erosion, restoring riverine habitat on channel islands, enhancing existing riparian and wetland habitats,

and improving efforts to prevent further introduction of undesirable exotic species. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented to avoid the conversion of existing economic land uses.

Upstream Habitat Restoration - Support restoration of upstream habitats by core-level implementation of actions in high priority areas, such as managing flows and temperatures and restoring spawning gravels in upstream anadromous fish habitats, restoring sites for riparian vegetation, and improving fish passage at upstream barriers. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented to avoid the conversion of existing economic land uses.

Reduction in Diversion Effects - Reduce diversion effects by implementing core-level actions such as implementing fish screens, installing fish barriers, improving fish salvage operations, and managing inflow and export using real-time monitoring and adaptive management.

Management of Anadromous Fish—Improve conditions for anadromous fish by implementing core actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement.

Reductions in Diversion/Export - Support non-core actions with implementation of core actions such as educating users about reclamation, conservation, water pricing and desalination feasibility.

Water Supply Enhancement - Enhance available water supplies with core actions such as incentives for conjunctive use.

Increasing Water Supply Predictability—This alternative would rely on the core-level implementation of actions such as long-term drought planning, institutions for water management, and coordination of land use and water supply planning.

Management of Water Quality—This alternative would support the key water quality actions with implementation of core actions to manage Delta water quality such as implementing source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, industrial, and mine discharges and runoff. Actions keeping with the theme of diluting pollution would be implemented at a higher level than actions outside the theme.

Improvement to System Reliability/Vulnerability—This alternative would rely on core-level implementation of actions to improve system reliability such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Alternative WQ117

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be addressed by implementing core actions plus habitat restoration not involving the conversion of economic land uses. Non-core actions address instream flows, improvements to a variety of habitats, and water quality improvement. However, because the extent of these actions is somewhat limited, it may not be sufficient to allow current populations to recover, or to prevent other species from becoming threatened or endangered. Actions to protect and restore existing habitats and reduce entrainment impacts are needed to provide better ecosystem quality benefits.

Water Supply - The actions in this alternative (beyond the core actions) to increase the supply or reliability of water are directed towards meeting environmental and water quality objectives. Agricultural and urban users would receive only incidental water supply reliability benefits. The benefits of this alternative are, therefore, probably not equitable, although all beneficial uses would receive cleaner water. Equity could be achieve by improving the quantity and reliability of Delta water supply.

Water Quality -Instream and Delta water quality would be improved by this alternative, but the ability of dilution to solve water quality is limited by the bioaccumulation of pollutants in the ecosystem. Further, dilution of pollutants occurs at a high water cost. Inclusion of other water quality strategies, such as discharge and watershed management would improve the water quality benefits of this alternative. Physical improvements in the Delta (such as changing the location of diversions) would also provide greater water quality benefits.

System Reliability—System reliability would be improved by core actions, by natural flood protection actions and actions to improve the stability of levees through reconstruction.

Preliminary Alternative WQ117

Detailed List of Actions

Because this alternative is limited to protecting and enhancing existing habitat, core habitat actions are included at above core levels of implementation. However, because water quality improvements can be achieved through a variety of methods, the core water quality improvements are not implemented above the core level.

Restore Bay-Delta Habitat

1.4 -Reconstruct levees to include shallow water habitat
1.5 -Fill deep water to produce shallow habitat
2.1 -Reconstruct river banks and shallow areas
2.2 -Restore/preserve channel islands - **above core level**
2.4 -Modify construction practices to include riverine elements
3.1 -Improve and protect degraded riparian habitats
3.4 -Modify levee maintenance practices
3.5 -Protect existing riparian habitat
4.1 -Enhance existing wetlands
4.4 -Protect existing wetland habitat
5.1 -Protect existing upland habitat
5.3 -Preserve the habitat values of agricultural land uses
5.4 -Clean-up sites containing toxic substances - **without converting economic land uses.**
50 -Integrated Habitat Management Programs - **above core level - without converting economic land uses**
6.4 -Restore floodways as habitat corridors
7.1 -Remove or reduce nuisance species in key habitats - **without converting economic land uses**
7.4 -Inspect for invasions of nuisance species
7.5 -Modify habitat to favor native species
8.1 -Manage crops for waterfowl forage production
8.2 -Improve management of public waterfowl areas
8.3 -Implement terrestrial predator control programs
8.4 -Increase sources and availability of wildlife forage - **without converting economic land uses**

Restore Upstream Habitat

9.1 -Manage flows and temperatures in upstream habitats - **above core level**
9.2 -Restore and replenish spawning gravels - **above core level**
9.4 -Restore shoreline habitat conditions - **without converting economic land uses**
9.6 -Improve floodway drainage to reduce fish stranding
10.1 -Modify passage at upstream dams/other barriers - **above core level**
10.2 -Modify natural barriers to improve passage - **above core level**
11.2 -Revegetate degraded riparian habitats - **without converting economic land uses**
11.3 -Protect riparian lands through purchase/easements - **without converting economic land uses**
11.4 -Restore flows to dewatered riparian habitats
12.1 -Modify floodways to support wetland habitats - **without converting economic land uses**

Preliminary Alternative WQ117

12.4 -Manage groundwater recharge for wetland habitat - **without converting economic land uses**

Reduce Effects of Diversions

13.1 - Decrease upstream diversions - max (to increase instream flows when needed for water quality purposes)
13.2 - Modify upstream reservoir operations - max (to provide the water for dilution flows)
13.3 - Modify Delta inflow timing pattern - max (to provide flows to dilute pollutants in the Delta)
C13.4 - Provide instream pulse flows for fish passage - max (would not be considered if it restricts use of water for water quality)
C13.5 - Provide instream pulse flows for fish attraction - max (would not be considered if it restricts use of water for water quality)
C14.1 - Modify central Delta channel operations - (to allow control of additional flows for water quality)
C14.2 - Modify export operations criteria - (to allow increased Delta outflow and in-Delta flows when needed for water quality)
C14.3 - Use real-time monitoring and adaptive management - max (to be used to monitor water quality and time reservoir releases accordingly)
C17.? - Acquire water for refuge habitat use - (water would actually be acquired for water quality purposes)

Enhancement of Anadromous Fish Populations

Reducing the Reliance on Delta Exports

24.1 - Expand desalination of Southern California supplies (to reduce the water quality impacts of exports)
24.2 - Expand desalination of San Joaquin Valley supplies (to reduce the water quality impacts of exports)
C25.1 - Increase municipal and industrial water conservation - max (to provide additional water supply for water quality)
26.1 - Recharge groundwater with reclaimed water
26.2 - Use reclaimed water for agricultural irrigation
26.3 - Reclaim saline agricultural drainage water
26.4 - Recycle and treat water for potable use
26.5 - Use reclaimed water for non-potable M&I uses
26.6 - Use reclaimed water to repel salinity intrusion (both in the Delta and in groundwater basins)

Enhance Water Supplies

C29.1 - Manage vegetation cover to increase yield
C29.2 - Manage riparian zones to protect water quality - max
C29.3 - Manage land uses to protect water quality - max

Preliminary Alternative WQ117

Increase Supply Predictability

C37.1 - Coordinate diversion and conveyance of transfers - max (timed to provide water quality benefits)
C37.2 - Establish brokerage for water transfers - max (to provide control mechanism for timing transfers)
C39.04 - Coordinate groundwater/surface water management - max (to provide an alternative source of water supply during periods when flows needed for water quality)
C39.14 - Establish incentives for conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)
C39.15 - Modify California Water Code to encourage conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)
C39.22 - Water resources data and information management - max (to provide information for timing of releases for water quality)

Managing Water Quality

C42.03 - Reduce or control volume of agricultural discharges - max
42.05 - Export agricultural drainage to other watersheds
C42.07 - Improve pest control practices - max
C42.08 - Manage irrigation tailwater to reduce pesticides - max
C43.1 - Retain and manage stormwater runoff - max
C44.2 - Use techniques to localize sediment movement - max (to minimize water quality impacts of dredging)
C44.3 - Dispose dredge materials at nonaquatic habitat sites - max (to minimize water quality impacts of dredging)

Improving System Reliability

47.1 - Reconstruct levees to higher design standards (to protect economic land uses and freshwater habitat)
47.2 - Reconstruct levees to higher seismic standards
47.3 - Relocate levees to more stable sites
48.1 - Maintain/reconstruct levees around infrastructure

OLD VERSION
AS SUBMITTED BY P.W.

Title: Improve habitat and water quality by maintaining existing land uses and providing sufficient water for dilution. **(Alternative #117)**

Identification of Theme, Subtheme, and Approach:
Theme: Improve habitat and water quality
Subtheme: Preserve existing land uses and provide additional water to rivers.

Solution Overview:
This alternative includes the maximum of all core actions to improve habitat while maintaining existing land uses. The actions would also provide instream water quality benefits. Actions that improve water quality but alter land uses were not included.

Major Actions:

The major actions in this alternative include activities that preserve existing habitat in the Delta and upstream. Water quality maintenance actions are directed to activities that occur withing existing land use constraints.

Actions Selected:

Restore Bay-Delta Habitats:

A number of actions were selected to preserve existing wetlands and riparian areas to help improve water quality. These actions would maintain existing land uses.

Restore Upstream Habitats:

A number of actions were selected to maintain instream water quality by protecting habitat while maintaining existing land uses.

Reduce Effects of Diversions:

Core actions were included that would provide additional dilution flow in the Delta.

Enhancement of Anadromous Fish Populations:

None Selected

Reducing the Reliance on Delta Exports:

Core actions were included that would conserve water and decrease demand to provide additional dilution flow in the Delta.

Enhance Water Supplies:

Actions were selected that would increase yield and therefore dilution flow, and maintain land uses.

Increase Supply Predictability:

Core actions were included that would provide additional dilution flow in the Delta.

Managing Water Quality:

Core actions were added to treat and avoid introduction of poor quality water into the rivers.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative would improve water quality by applying best management practices to watershed land uses without changing those uses. It would benefit the ecosystem by preserving existing habitat. However, because of the constraint of maintaining existing land uses, this alternative may not substantially benefit habitat.

Detailed List of Actions Selected (Alternative #117):

Restore Bay-Delta Habitats:

C2.2 - Restore/preserve channel islands -max (for the water-cleaning ability of the wetland vegetation).

C3.5 - Protect existing riparian habitat.

C4.1 - Enhance existing wetlands - max (for the water-cleaning ability of the wetland vegetation).

C4.4 - Protect existing wetland habitat - max (for the water-cleaning ability of the wetland vegetation).

5.4 - Clean up sites containing toxic substances.

Restore Upstream Habitats:

C9.1 - Manage flows and temperatures in upstream habitats - max (to improve water quality

9.5 - Modify gravel mining practices.

C11.2 - Revegetate degraded riparian habitats - max (to prevent pollutant entry into streams)

11.3 - Protect riparian lands through purchase/easements.

Reduce Effects of Diversions:

13.1 - Decrease upstream diversions - max (to increase instream flows when needed for water quality purposes)

13.2 - Modify upstream reservoir operations - max (to provide the water for dilution flows)

13.3 - Modify Delta inflow timing pattern - max (to provide flows to dilute pollutants in the Delta)

C13.4 - Provide instream pulse flows for fish passage - max (would not be considered if it restricts use of water for water quality)

C13.5 - Provide instream pulse flows for fish attraction - max (would not be considered if it restricts use of water for water quality)

C14.1 - Modify central Delta channel operations - (to allow control of additional flows for water quality)

C14.2 - Modify export operations criteria - (to allow increased Delta outflow and in-Delta flows when needed for water quality)

C14.3 - Use real-time monitoring and adaptive management - max (to be used to monitor water quality and time reservoir releases accordingly)

C17.1 - Acquire water for refuge habitat use - (water would actually be acquired for water quality purposes)

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

24.1 - Expand desalination of Southern California supplies (to reduce the water quality impacts of exports)

24.2 - Expand desalination of San Joaquin Valley supplies (to reduce the water quality impacts of exports)

C25.1 - Increase municipal and industrial water conservation - max (to provide additional water supply for water quality)

26.1 - Recharge groundwater with reclaimed water

26.2 - Use reclaimed water for agricultural irrigation

26.3 - Reclaim saline agricultural drainage water

26.4 - Recycle and treat water for potable use

26.5 - Use reclaimed water for non-potable M&I uses

26.6 - Use reclaimed water to repel salinity intrusion (both in the Delta and in groundwater basins)

Enhance Water Supplies:

C29.1 - Manage vegetation cover to increase yield

C29.2 - Manage riparian zones to protect water quality - max

C29.3 - Manage land uses to protect water quality - max

Increase Supply Predictability:

C37.1 - Coordinate diversion and conveyance of transfers - max (timed to provide water quality benefits)

C37.2 - Establish brokerage for water transfers - max (to provide control mechanism for timing transfers)

C39.04 - Coordinate groundwater/surface water management - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.14 - Establish incentives for conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.15 - Modify California Water Code to encourage conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.22 - Water resources data and information management - max (to provide information for timing of releases for water quality)

Managing Water Quality:

C42.03 - Reduce or control volume of agricultural discharges - max

42.05 - Export agricultural drainage to other watersheds

C42.07 - Improve pest control practices - max

C42.08 - Manage irrigation tailwater to reduce pesticides - max
42.11 Dilute pollutants in Delta inflows from SJR using stored water.
C43.1 - Retain and manage stormwater runoff - max

C44.2 - Use techniques to localize sediment movement - max (to minimize water quality impacts of dredging)

C44.3 - Dispose dredge materials at nonaquatic habitat sites - max (to minimize water quality impacts of dredging)

Improving System Reliability:

None selected

Preliminary Alternative WQ118

Group

Water Quality/Land Use

Title

Diluting Pollutants and Creating New Habitat

Improve water quality by diluting pollutants with stored water and water from reduced diversions and create habitat by converting land used for economic purposed into habitat areas.

Key Actions

New Shallow Water Habitat Areas - Create new areas of shallow water habitat in the Delta by subjecting existing leveed lands to tidal action and restoring tidal action to existing diked wetlands.

New Upstream Habitats - Create a mosaic of habitat types upstream of the Delta at the minimum level of implementation.

Dilution Flows - Use a variety of actions, including land fallowing and retirement, acquisition of water for instream flows, timing of water transfers, and expand use of desalination in San Joaquin Valley and southern California, to reallocate water supplies to be used for dilution.

Levee Upgrades - Improve levees around important economic land uses and restored freshwater habitats.

Supporting Actions

Reduce Delta Demand - Reduce demand for Delta water by increasing agricultural, municipal, and industrial water conservation; expanding desalination in the San Joaquin Valley and southern California; reclaiming agricultural, municipal, and industrial wastewater; providing incentives to implement pricing structures to reduce demand; and fallowing and retiring farmland. The water saved by these actions would be used for dilution flows.

Water Transfers - Facilitate water transfers to be timed to coincide with needs for dilution flows.

Natural Flood Protection - Enhance levee flood protection and create new habitat by allowing rivers to meander, relocating levees to create floodways, and modifying floodways to support wetland habitats.

Core Actions

Bay-Delta Habitat Restoration - Support restoration of Bay-Delta habitats by implementing core-level actions such as protecting existing shallow water habitat from erosion, restoring riverine habitat on channel islands, enhancing existing riparian and wetland habitats, and improving efforts to prevent further introduction of undesirable exotic species. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented to the conversion of land used for economic purposes into habitat areas.

Upstream Habitat Restoration - Support restoration of upstream habitats by implementing core-level actions, such as managing flows and temperatures and restoring spawning gravel in upstream anadromous fish habitats, restoring sites for riparian vegetation, and improving fish passage at upstream barriers, in high priority areas. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented to the conversion of land used for economic purposes into habitat areas.

Reduction in Diversion Effects - Reduce diversion effects by implementing core-level actions such as implementing fish screens, installing fish barriers, improving fish salvage operations, and managing inflow and export using real-time monitoring and adaptive management.

Management of Anadromous Fish - Improve conditions for anadromous fish by implementing core actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement.

Reductions in Diversion/Export Reliance - Reduce reliance on diversions/exports by implementing core actions such as educating users about reclamation, conservation, water pricing, and desalination feasibility; and encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement - Enhance available water supplies with core actions such as providing incentives for conjunctive use.

Increasing Water Supply Predictability - Improve supply predictability by implementing core-level actions such as long-term planning for drought, establishing institutions for water management, and coordinating land use and water supply planning.

Management of Water Quality - Improve water quality by implementing key water quality actions and core-level actions, such as implementing source control regulations for agricultural drainage and retiring lands with drainage problems, to manage Delta water quality and implementing other cost-effective management of urban, industrial, and mine discharges and runoff. Actions keeping with the theme of diluting pollution would be implemented at a higher level than actions outside the theme.

Improvement to System Reliability/Vulnerability - Supplement key actions in this alternative by implementing core-level actions to improve system reliability such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be addressed by implementing core actions plus habitat restoration involving only the conversion of economic land uses. Noncore actions address instream flows, improvements to a variety of habitats, and water quality improvement. However, because the extent of these actions is somewhat limited, it may not be sufficient to allow current populations to recover or to prevent other species from becoming threatened or endangered. Actions to protect and restore existing habitats and reduce entrainment impacts are needed to provide greater ecosystem-quality benefits.

Water Supply - The actions in this alternative, beyond the core actions, to increase the supply or reliability of water are directed toward meeting environmental and water quality objectives. Agricultural and urban users would receive only incidental water supply reliability benefits. Therefore, the benefits of this alternative may not be equitable, although all beneficial uses would receive cleaner water. Equity could be achieved by improving the quantity and reliability of the Delta water supply.

Water Quality - Instream and Delta water quality would be improved by this alternative, but the ability of dilution to solve water quality is limited by the accumulation of pollutants in the ecosystem. Further, dilution of pollutants occurs at a high water cost. Inclusion of other water quality strategies, such as discharge and watershed management, would improve the water quality benefits of this alternative. Physical improvements in the Delta (e.g., changing the location of diversions) would also provide greater water quality benefits.

System Reliability - System reliability would be improved by core actions, by natural flood protection actions, and by actions to improve the stability of levees through reconstruction.

ORIGINALLY SUBMITTED BY PW.

Title: Improve habitat and water quality by converting existing land uses and providing sufficient water for dilution. **(Alternative #118)**

Identification of Theme, Subtheme, and Approach:
Theme: Improve habitat and water quality
Subtheme: Convert existing land uses and provide additional water to rivers.

Solution Overview:
This alternative includes the maximum of all core actions to improve habitat while allowing for conversion of land uses. The actions would also provide instream water quality benefits. Actions that improve water quality through maintaining existing land uses were not included.

Major Actions:

New and expanded habitat is provided under this alternative by changing land uses. Water quality is improved by changing land uses that influence water quality.

Actions Selected:

Restore Bay-Delta Habitats:

A number of actions were selected to add new wetlands and riparian areas to help improve water quality. These actions would alter existing land uses.

Restore Upstream Habitats:

A number of actions were selected to maintain instream water quality by improving habitat by changing land use practices.

Reduce Effects of Diversions:

Core actions were included that would provide additional dilution flow in the Delta.

Enhancement of Anadromous Fish Populations:

None Selected

Reducing the Reliance on Delta Exports:

Core actions were included that would conserve water to provide additional dilution flow in the Delta.

Enhance Water Supplies:

Actions were selected that would increase yield and therefore dilution flow, and

Reduce Reliance on Delta Exports - maximum core actions selected to reduce reliance on Delta exports by implementing demand reducing actions such as water conservation, temporary land fallowing, retirement incentives, free market pricing and water reclamation for agricultural and industrial uses.

Manage Contaminant Discharges and Maintain Adequate Dilution Flows - core actions maximized to reduce the quantities of contaminants entering the aquatic system thereby improving water quality in Bay-Delta receiving waters and associated aquatic habitats. Examples include implementing source controls for agricultural drainage constituents, mine and industrial discharges, urban runoff, limited enlargements to existing reservoirs, and numerous demand reduction measures such as water conservation, temporary land fallowing, retirement incentives, free market pricing and water reclamation (the latter because it reduces the demand for Delta exports by providing substitute supplies).

Core Actions

Manage Agricultural Drainage - Agricultural water quality management measures directed at subsurface drainage volume control will reduce agricultural demands thereby increasing in-Delta flows and inflows, and reduce drainage. Other measures, such as those directed at the elimination of pesticides from tailwaters, also can reduce agricultural water supply demands on the Delta and improve the quality of Delta inflows.

Improving System Reliability - core actions to increase supply reliability in the service areas through implementation of integrated long term water management measures can reduce the need for upstream and Delta diversions and increase quantities of instream flow available for dilution.

Preliminary Assessment.

Equity actions are included to reduce or eliminate Delta impacts where possible, however in-Delta losses of economic land uses can only be mitigated by payments or land trades.

Ecosystem Quality - The major benefit is achieved by relocating the export diversion from the current South-Delta location to the Sacramento River, where diversions can be better timed to avoid fish migration periods and bypass flows can be maintained past new fish screens. This alternative would improve in-Delta and export water quality for ecological and service area needs by increasing the quantity and quality of water available in the Delta and changing the timing of diversions to avoid periods of poorer water quality. Modification of export diversion location and increasing export capacity coupled with the capability to make in-Delta releases of Sacramento River water (when there would be no interference with anadromous fish migrations) provide capabilities to release Delta channel flows when needed to maintain water quality requirements for in-Delta uses

and aquatic biota.

Water Supply and Conveyance - Supply predictability is greatly improved with this alternative because there will be virtually no threat of interruption due to Delta levee failures and threatened and endangered species constraints on exports will be far less in magnitude and frequency. Increased storage and reclamation will augment service area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available when needed.

Water Quality - Modification of export diversion location and increasing export capacity coupled with the capability to make peripheral Delta releases of Sacramento River water, provide capabilities to release Delta channel flows where and when needed to maintain water quality requirements for in-Delta uses and aquatic biota. This alternative would improve in-Delta and export water quality for ecological and service area needs by increasing the quantity and quality of water available in the Delta and changing the timing of diversions to avoid periods of poorer water quality. Quantities of contaminants entering the aquatic system from upstream are also reduced. Overall in-Delta and export water quality is improved by direct access to, and releases of, higher quality Sacramento River water. Eastside releases would be very effective in flushing contaminants and freshening stagnant channel reaches. The volume and salt load in agricultural drainage will be greatly reduced due to the improved quality of irrigation water. Core actions are maximized to further improve water quantity and quality in Bay-Delta receiving and exported waters, and improve habitats. Specifically, the actions would 1) serve to increase the quality and quantity of water available in the Delta thereby decreasing the concentrations of contaminants; 2) alter the distribution and timing of flows in the Delta making more water available in the system for dilution of contaminants and beneficial use; and 3) change the locations and timing of diversions to avoid periods of poor water quality and reduce entrainment of high fish populations. This affords flexibility to manage Delta inflows and exports to improve water quality for ecosystem and export needs.

System Reliability - The probability of a prolonged shutdown of the water projects and local diversions will be greatly reduced. Implementation of selected island in-filling will allow remaining agricultural, recreational and associated land uses to continue, while relieving a significant amount of hydrostatic pressure on the levee system. Maximum core levee maintenance actions will provide additional protection against flood- and seismically-induced levee failures, and reduce future risks of system-failure-induced shutdowns and export curtailments.

than actions outside the theme.

Improvement to System Reliability/Vulnerability—Actions in this alternative to improve system reliability, such as reconstruction of levees, would be supplemented with core-level implementation of actions such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality -Ecosystem quality would be addressed by implementing core actions plus non-core habitat restoration actions involving the protection and enhancement of existing habitats. Non-core actions address instream flows, improvements to a variety of habitats, and water quality improvements. However, because the extent of these actions is limited to existing habitat areas, it probably would not be sufficient to allow current populations to recover, or to prevent other species from becoming threatened or endangered. Actions to further improve instream flows and temperatures and to reduce entrainment impacts are needed to provide better ecosystem quality benefits.

Water Supply - No actions to increase the supply or reliability of water, beyond the core actions, are included in this alternative. The benefits of this alternative are, therefore, probably not equitable, although all beneficial uses would receive cleaner water. Equity could be achieve by improving the quantity and reliability of Delta water supply.

Water Quality - This action would make considerable progress in cleaning up water flowing into upstream reservoirs, but would not address downstream water quality sources except at the core level. Providing actions to address downstream water pollutant sources would improve the effectiveness of this alternative in providing improved Delta water quality.

System Reliability -System reliability would be improved by core actions and non-core actions to reconstruct levees. This alternative would provide a high degree of improvement to system reliability, but opportunities to blend flood control with habitat creation would be minimized by the restriction on conversion of economic land uses.

Preliminary Alternative WQ23

stream) - **without converting economic land uses**
9.5 - Modify gravel mining practices (also for erosion control and habitat protection)
9.6 -Improve floodway drainage to reduce fish stranding
10.1 -Modify passage at upstream dams/other barriers - **above core level**
10.2 -Modify natural barriers to improve passage - **above core level**
11.1 - Restrict livestock grazing in riparian corridors
11.2 -Revegetate degraded riparian habitats - **without converting economic land uses**
11.3 -Protect riparian lands through purchase/easements - **without converting economic land uses**
11.4 - Restore flows to dewatered riparian habitats
12.1 -Modify floodways to support wetland habitats - **without converting economic land uses**
12.4 -Manage groundwater recharge for wetland habitat - **without converting economic land uses**

Reduce Effects of Diversions:

Enhancement of Anadromous Fish Populations:

Reducing the Reliance on Delta Exports:

Enhance Water Supplies:

29.2 - Manage riparian zones to protect water quality
29.3 - Manage land uses to protect water quality

Increase Supply Predictability:

Managing Water Quality:

C42.01 - Implement source control regulations for pollutants - max
C45.01 - Manage discharges from abandoned mines - max
C45.02 - Remediate abandoned mining sites discharging pollutants

Improving System Reliability:

47.1 - Reconstruct levees to higher design standards (to protect economic land uses and freshwater habitat)
47.2 - Reconstruct levees to higher seismic standards
47.3 - Relocate levees to more stable sites
48.1 - Maintain/reconstruct levees around infrastructure

Preliminary Alternative WQ23

Detailed List of Actions Selected:

Because this alternative is limited to protecting and enhancing existing habitat, core habitat actions are included at above core levels of implementation. However, because water quality improvements can be achieved through a variety of methods, the core water quality improvements are not implemented above the core level.

Restore Bay-Delta Habitat

1.4 -Reconstruct levees to include shallow water habitat
1.5 -Fill deep water to produce shallow habitat
2.1 -Reconstruct river banks and shallow areas
2.2 -Restore/preserve channel islands - **above core level**
2.4 -Modify construction practices to include riverine elements
3.1 -Improve and protect degraded riparian habitats
3.4 -Modify levee maintenance practices
3.5 -Protect existing riparian habitat
4.1 -Enhance existing wetlands
4.4 -Protect existing wetland habitat
5.1 -Protect existing upland habitat
5.3 -Preserve the habitat values of agricultural land uses
5.4 -Clean-up sites containing toxic substances - **without converting economic land uses.**
50 -Integrated Habitat Management Programs - **above core level - without converting economic land uses**
6.4 -Restore floodways as habitat corridors
7.1 -Remove or reduce nuisance species in key habitats - **without converting economic land uses**
7.4 -Inspect for invasions of nuisance species
7.5 -Modify habitat to favor native species
8.1 -Manage crops for waterfowl forage production
8.2 -Improve management of public waterfowl areas
8.3 -Implement terrestrial predator control programs
8.4 -Increase sources and availability of wildlife forage - **without converting economic land uses**

Restore Upstream Habitats:

9.1 -Manage flows and temperatures in upstream habitats - **above core level**
C9.2 - Restore and replenish spawning gravels (additional gravel in the stream bed will reduce fined grained sediment erosion from the stream bed)
9.3 - Restore channel configurations (may help lessen stream bank erosion thus reducing sediment load in streams)
9.4 - Restore shoreline habitat conditions (vegetation would help filter runoff before entering

ORIGINAL SUBMITTED BY K.W.

Title: Improve habitat and water quality primarily by watershed land use management without converting existing land use. (**Alternative #1~~WE~~** 23)

Identification of Theme and Subtheme:
Theme: Improve habitat and water quality
Subtheme: without converting existing lands, manage watershed land use

Solution Overview:
Actions were selected which apply towards improving habitat while also improving water quality. Only actions which do not require converting existing land use were chosen in this alternative. Stakeholders who would be affected by implementing these actions would be mainly the owners of land near the Delta headwaters.

Actions Selected:

Restore: Bay-Delta Habitats:

None selected

Restore Upstream Habitats:

A number of actions were chosen to help control erosion and protect riparian vegetation. These actions include restrictions on livestock grazing, modification of gravel mining operations, and protection of riparian corridors. the riparian vegetation would provide for both terestrial and riverine habitat while helping to filter runoff for improved water quality entering the stream.

Reduce Effects of Diversions:

None selected.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

None selected.

Enhance Water Supplies:

None selected.

Increase Supply Predictability:

None selected

12/15/95

Managing Water Quality:

Actions were chosen which prevent poor quality water from discharging into the headwater streams.

Improving System Reliability:

None selected.

Preliminary Assessment:
This alternative is a combination of providing cleaner water at the headlands and increasing habtat quality. This alternative should improve up-stream and ultimately in-Delta water quality which would benefit, the ecosystem, diverters of Delta water, and Delta recreationists. The main burden of this alternative would be on land owners in the upper watersheds. The ecosystem, and especially the fish, would benefit from improved water quality, especially reductions in toxic heavy metals from mine drainage

Detailed List of Actions Selected: Alternative #1WE

Restore: Bay-Delta Habitats:

Restore Upstream Habitats:

C9.2 - Restore and replenish spawning gravels (additional gravel in the stream bed will reduce fined grained sediment erosion from the stream bed)

9.3 - Restore channel configurations (may help lessen stream bank erosion thus reducing sediment load in streams)

9.4 - Restore shoreline habitat conditions (vegetation would help filter runoff before entering stream)

9.5 - Modify gravel mining practices (also for erosion control and habitat protection)

11.1 - Restrict livestock grazing in riparian corridors

11.2 - Revegetate degraded riparian habitats

11.3 - Protect riparian lands through purchase/easements

11.4 - Restore flows to dewatered riparian habitats

Reduce Effects of Diversions:

Enhancement of Anadromous Fish Populations:

Reducing the Reliance on Delta Exports:

Enhance Water Supplies:

Increase Supply Predictability:

Managing Water Quality:

C42.01 - Implement source control regulations for pollutants - max
C45.01 - Manage discharges from abandoned mines - max
C45.02 - Remediate abandoned mining sites discharging pollutants

Improving System Reliability:

Preliminary Alternative WQ124

Group

Water Quality/Land Use

Title

Managing Watersheds and Creating New Habitat

Improve water quality by managing upstream watersheds and create habitat by converting lands currently used for economic purposes into habitat areas.

Key Actions

Delta Shallow Water Habitat - Create new areas of shallow water habitat in the Delta by subjecting existing leveed lands to tidal action and restoring tidal action to existing diked wetlands.

Delta and Upstream Habitats - Create a mosaic of habitat types upstream of the Delta at the minimum level of implementation.

Watershed Management - Protect water quality by managing mine drainage and managing land uses within upstream watersheds.

Levee Upgrades - Improve levees around important economic land uses and restored freshwater habitats.

Supporting Actions

New Delta Habitats - Create a mosaic of habitat types, including shallow water, riverine, riparian, wetland, and terrestrial, in the Delta at the minimum level of implementation.

Natural Flood Protection - Enhance levee flood protection and create new habitat by allowing rivers to meander, relocating levees to create floodways, and modifying floodways to support wetland habitats.

Fund Mine Cleanup - Give urban areas flexibility to fund high-priority mine cleanup.

Core Actions

Bay-Delta Habitat Restoration - Support restoration of Bay-Delta habitats by implementing core actions such as protecting existing shallow water habitat from erosion, restoring riverine habitat on channel islands, enhancing existing riparian and wetland habitats, and improving

efforts to prevent further introduction of undesirable exotic species. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented toward those actions providing both water quality and ecosystem benefits, and involve only the conversion of land currently used for economic purposes into habitat areas.

Upstream Habitat - Support restoration of upstream habitats by implementing core actions including restoring sites for riparian vegetation and improving fish passage at upstream barriers. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented toward those actions providing both water quality and ecosystem benefits, and would involve only the conversion of land currently used for economic purposes into habitat areas.

Reduction in Diversion Effects - Reduce diversion effects by implementing core actions such as installing fish screens, installing fish barriers, improving fish salvage operations, and managing inflow and export using real-time monitoring and adaptive management.

Management of Anadromous Fish - Improve conditions for anadromous fish by improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement.

Reductions in Diversion/Export Reliance - Reduce reliance on Delta diversions and exports by implementing core actions such as educating users about reclamation, conservation, water pricing, and desalination feasibility; and encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement - Implementing core-level actions, such as providing incentives for conjunctive use, would support noncore watershed management actions.

Increasing Water Supply - Increase water supply by implementing core actions such as facilitating water transfers, long-term planning for drought, establishing institutions for water management, and coordinating land use and water supply planning.

Management of Water Quality - Support the key water quality actions by implementing source control regulations for agricultural drainage, retiring lands with drainage problems, and by other cost-effective management of urban, industrial, and mine discharges and runoff. Actions keeping with the theme of watershed management would be implemented at a higher level than actions outside the theme.

Improvement to System Reliability/Vulnerability - Actions in this alternative, such as reconstruction of levees, to improve system reliability would be supplemented with core-level implementation of actions such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be addressed by implementing core actions plus noncore habitat restoration actions that address instream and Delta water quality, creation of a variety of habitats, and water quality improvements. However, because these actions avoid restoration of existing habitat areas, they may not be sufficient to allow current populations to recover or to prevent other species from becoming threatened or endangered. Actions to restore and enhance existing habitats, improve instream flows and temperatures and reduce entrainment impacts are needed to provide greater ecosystem-quality benefits.

Water Supply - No actions, beyond the core actions, to increase the supply or reliability of water are included in this alternative. Therefore, the benefits of this alternative may not be equitable, although all beneficial uses would receive cleaner water. Equity could be achieved by improving the quantity and reliability of the Delta water supply.

Water Quality - This action would make considerable progress in cleaning the water flowing into upstream reservoirs, but would not address downstream water quality sources except at the core level. Providing actions to address downstream water pollutant sources would improve the effectiveness of this alternative in providing improved Delta water quality.

System Reliability - System reliability would be improved by core actions and noncore actions to reconstruct levees, but opportunities to blend flood control with habitat creation would be minimized by the restriction on conversion of economic land uses.

ORIGINAL VERSION
AS SUBMITTED BY K. W.

Title: Improve habitat and water quality primarily by watershed land use management *by converting* existing land use. **(Alternative #124)**

Identification of Theme and Subtheme:
Theme: Improve habitat and water quality
Subtheme: by converting existing lands, manage watershed land use

Solution Overview:
This alternative addresses CALFED's Primary Objectives for water quality and ecosystem quality. This alternative represents a combination of other alternatives: #110 and #111 which focus on improving water quality through watershed land use management, with #115 which focuses on improving habitat by converting existing land use. Actions were selected to benefit water quality and habitat. Specific actions for enhancing fish populations are not included in this alternative because several other alternatives focus on that issue alone, and it seems redundant to add those actions here. Furthermore, only actions which convert existing land use were chosen in this alternative. Alternative #123 addresses the same purposes evaluated in this alternative, without conversion of land uses. Selected actions include management of land use in the upper watersheds, which could apply to either management of existing land use practices, or management by converting existing land uses. Therefore this alternative looks similar to #123. Like #123, stakeholders who would be burdened by implementing the actions included in this alternative, would be mainly the owners and users of land near the Delta headwaters.

Actions Selected:

Restore: Bay-Delta Habitats:

None selected

Restore Upstream Habitats:

A number of actions were chosen to help control erosion and protect riparian vegetation. These actions include restrictions on livestock grazing, modification of gravel mining operations, and protection of riparian corridors. Riparian vegetation is an important part of this alternative because it would provide for both terestrial and riverine habitat while helping to filter runoff for improved water quality entering the stream.

Reduce Effects of Diversions:

None selected.

Enhancement of Anadromous Fish Populations:

None selected.

12/22/95

Reducing the Reliance on Delta Exports:

None selected.

Enhance Water Supplies:

An action was selected to manage land uses to protect water quality. Erosion and sediment loading in the upper watersheds can be reduced by using best land use management practices pertaining to logging, mining, and grazing, and importantly to the design and maintenance of dirt roads and trails in the watershed.

Increase Supply Predictability:

None selected

Managing Water Quality:

Actions were chosen which prevent poor quality water from discharging into the headwater streams.

Improving System Reliability:

None selected.

Preliminary Assessment:
This alternative, similar to #123, is a combination of providing cleaner water at the headlands and increasing haibtat quality in the headlands. This alternative should improve up-stream and ultimately in-Delta water quality, which would benefit the ecosystem, diverters of Delta water, and Delta recreationists. The main burden of this alternative would be on land owners and land users in the upper watersheds. The ecosystem, and delta diverters, would benefit from improved water quality, especially reductions in toxic heavy metals from mine drainage.

Assessment of alternative relative to CALFED Solution Principles. Actions to be implemented in this alternative are relatively *affordable*, however because this alternative is focused on the upper watershed area, it is not *equitable* in solving either the water quality or the habitat quality problems in the Delta. This alternative would be *implementable*, but would not *reduce other conflicts* in the Delta. It is *durable*, but may have some *significant redirected impacts*, depending on the level of implementation.

Detailed List of Actions Selected: Alternative #124

Restore: Bay-Delta Habitats:

Restore Upstream Habitats:

9.3 - Restore channel configurations (may help lessen stream bank erosion thus reducing sediment load in streams)

9.4 - Restore shoreline habitat conditions (vegetation would help filter runoff before entering stream)

9.5 - Modify gravel mining practices (also for erosion control and habitat protection)

11.1 - Restrict livestock grazing in riparian corridors

11.3 - Protect riparian lands through purchase/easements

11.4 - Restore flows to dewatered riparian habitats

12.2 - Reuse agricultural drainage water to create wetland habitats

12.3 - Reuse urban wastewater effluent to create wetlands

12.4 - Manage groundwater recharge for wetland habitat

Reduce Effects of Diversions:

Enhancement of Anadromous Fish Populations:

Reducing the Reliance on Delta Exports:

Enhance Water Supplies:

29.2 - Manage riparian zones to protect water quality

29.3 - Manage land uses to protect water quality

Increase Supply Predictability:

Managing Water Quality:

C42.01 - Implement source control regulations for pollutants - max

C45.01 - Manage discharges from abandoned mines - max

12/22/95

C45.02 - Remediate abandoned mining sites discharging pollutants

Improving System Reliability:

12/22/95

Preliminary Alternative WQ125

Group

Water Quality/Land Use

Title

Managing Watersheds and Restoring Existing and Creating New Habitat

Improve water quality by managing upstream watersheds and create habitat by balancing the preservation and enhancement of existing habitats with the creation of new habitats through the conversion of land currently used for economic purposed into habitat areas.

Key Actions

Delta Shallow Water Habitat - Create new areas of shallow water habitat in the Delta by reconstructing levees, reconstructing riverbanks and shallow areas, restoring and preserving channel islands, and subjecting existing leveed lands to tidal action.

Delta and Upstream Habitats - Create a variety of habitat types upstream of and in the Delta by protecting, enhancing, and creating new instream, wetland, riparian, and terrestrial habitats.

Watershed Management - Protect water quality by managing mine drainage and land uses within upstream watersheds.

Levee Upgrades - Improve levees around important economic land uses and restored freshwater habitats.

Supporting Actions

New Delta Habitats - Create a mosaic of habitat types, including shallow water, riverine, riparian, wetland, and terrestrial, in the Delta at the minimum level of implementation.

Natural Flood Protection - Enhance levee flood protection and create new habitat by allowing rivers to meander, relocating levees to create floodways, and modifying floodways to support wetland habitats.

Fund Mine Cleanup - Give urban areas flexibility to fund high-priority mine cleanup.

Core Actions

Bay-Delta Habitat Restoration - Support restoration of Bay-Delta habitats by implementing core actions such as protecting existing shallow water habitat from erosion, restoring riverine habitat on channel islands, enhancing existing riparian and wetland habitats, and improving efforts to prevent further introduction of undesirable exotic species.

Upstream Habitat - Support restoration of upstream habitats by implementing core actions including restoring sites for riparian vegetation and improving fish passage at upstream barriers.

Reduction in Diversion Effects - Reduce diversion effects by implementing core actions such as installing fish screens, installing fish barriers, improving fish salvage operations, and managing inflow and export using real-time monitoring and adaptive management.

Management of Anadromous Fish - Improve anadromous fish management by improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement.

Reductions in Diversion/Export Reliance - Reduce reliance on Delta diversions and exports by implementing core actions such as educating users about reclamation, conservation, water pricing, and desalination feasibility; and encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement - Support noncore watershed management actions by implementing core actions such as providing incentives for conjunctive use.

Increasing Water Supply - Increase water supply by implementing core actions such as facilitating water transfers, long-term planning for droughts, establishing institutions for water management, and coordination of land use and water supply planning.

Management of Water Quality - Support the key water quality actions by implementing source control regulations for agricultural drainage; retiring lands with drainage problems; and implementing other cost-effective management of urban, industrial, and mine discharges and runoff. Actions keeping with the theme of watershed management would be implemented at a higher level than actions outside the theme.

Improvement to System Reliability/Vulnerability - Actions in this alternative, such as reconstruction of levees, to improve system reliability would be supplemented with core-level implementation of actions such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be addressed by implementing actions to restore existing habitats and create a mosaic of new habitats in both the Delta and upstream. Other actions would improve instream and Delta water quality. This alternative would result in considerable improvement in ecosystem health, but could be improved by adding actions to increase instream flows for fish and for riparian vegetation and actions that reduce the impacts of diversions.

Water Supply - No actions, beyond the core actions, to increase the supply or reliability of water are included in this alternative. Therefore, the benefits of this alternative may not be equitable, although all beneficial uses would receive cleaner water. Equity could be achieved by improving the quantity and reliability of Delta water supply.

Water Quality - This action would make considerable progress in cleaning up water flowing into upstream reservoirs, but would not address downstream water quality sources except at the core level. Providing actions to address downstream water pollutant sources would increase the effectiveness of this alternative in providing improved Delta water quality.

System Reliability - System reliability would be greatly improved by core actions and noncore actions to reconstruct and maintain levees.

ORIGINAL
AS SUBMITTED BY K.W.

Title: Improve habitat and water quality primarily by watershed land use management by using a *balance between* management of *exising* land use and *converting* existing land use. **(Alternative #125)**

Identification of Theme and Subtheme:
Theme: Improve habitat and water quality
Subtheme: by converting or managing existing lands, manage watershed land use

Solution Overview:
This alternative addresses CALFED's Primary Objectives for water quality and ecosystem quality. This alternative represents a combination of other alternatives: #110 and #111 which focus on improving water quality through watershed land use management, with #116 which focuses on improving habitat by a balance of managing or converting existing land use. Actions were selected to benefit water quality and habitat. Specific actions for enhancing fish populations are not included in this alternative because several other alternatives focus on that issue alone, and it seems redundant to add those actions here. Alternative #123 and # 124 address the same purposes evaluated in this alternative, without conversion and with only conversion of land uses, respectively. Selected actions include management of land use in the upper watersheds, which could apply to either management of existing land use practices, or management by converting existing land uses, or both. Therefore this alternative looks similar to #123 and #124. Like #123 and #124, stakeholders who would be burdened by implementing the actions included in this alternative, would be mainly the owners and users of land near the Delta headwaters.

Actions Selected:

Restore: Bay-Delta Habitats:

None selected

Restore Upstream Habitats:

A number of actions were chosen to help control erosion and protect riparian vegetation. These actions include restrictions on livestock grazing, modification of gravel mining operations, and protection of riparian corridors. Riparian vegetation is an important part of this alternative because it would provide for both terestrial and riverine habitat while helping to filter runoff for improved water quality entering the stream. These actions could be implemented by converting some land uses while managing other existing land uses.

Reduce Effects of Diversions:

None selected.

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

None selected.

Enhance Water Supplies:

An action was selected to manage land uses to protect water quality. Erosion and sediment loading in the upper watersheds can be reduced by using best land use management practices pertaining to logging, mining, and grazing, and importantly to the design and maintenance of dirt roads and trails in the watershed. These actions could be implemented by converting some land uses while applying best management practices to other existing land uses.

Increase Supply Predictability:

None selected

Managing Water Quality:

Actions were chosen which prevent poor quality water from discharging into the headwater streams.

Improving System Reliability:

None selected.

Preliminary Assessment:
This alternative, similar to #123 and # 124, is a combination of providing cleaner water at the headlands and increasing haibtat quality in the headlands. This alternative should improve up-stream and ultimately in-Delta water quality, which would benefit the ecosystem, diverters of Delta water, and Delta recreationists. The main burden of this alternative would be on land owners and land users in the upper watersheds. The ecosystem, and delta diverters, would benefit from improved water quality, especially reductions in toxic heavy metals and reductions in sediment loading in the streams.

Assessment of alternative relative to CALFED Solution Principles. Actions to be implemented in this alternative are relatively *affordable*, however because this alternative is focused on the upper watershed area, it is not *equitable* in solving either the water quality or the habitat quality problems in the Delta. This alternative would be *implementable*, but would not *reduce other conflicts* in the Delta. It is *durable*, but may have some *significant redirected impacts*, depending on the level of implementation.

Detailed List of Actions Selected: Alternative #125

Restore: Bay-Delta Habitats:

Restore Upstream Habitats:

9.3 - Restore channel configurations (may help lessen stream bank erosion thus reducing sediment load in streams)

9.4 - Restore shoreline habitat conditions (vegetation would help filter runoff before entering stream)

9.5 - Modify gravel mining practices (also for erosion control and habitat protection)

11.1 - Restrict livestock grazing in riparian corridors

11.3 - Protect riparian lands through purchase/easements

11.4 - Restore flows to dewatered riparian habitats

12.2 - Reuse agricultural drainage water to create wetland habitats

12.3 - Reuse urban wastewater effluent to create wetlands

12.4 - Manage groundwater recharge for wetland habitat

Reduce Effects of Diversions:

Enhancement of Anadromous Fish Populations:

Reducing the Reliance on Delta Exports:

Enhance Water Supplies:

29.2 - Manage riparian zones to protect water quality

29.3 - Manage land uses to protect water quality

Increase Supply Predictability:

Managing Water Quality:

C42.01 - Implement source control regulations for pollutants - max

C45.01 - Manage discharges from abandoned mines - max

12/22/95

C45.02 - Remediate abandoned mining sites discharging pollutants

Improving System Reliability:

12/22/95

Preliminary Alternative WQ126

Group

Water Quality/Land Use

Title

Managing Discharges and Restoring Existing Habitat

Improve water quality through the management of agricultural, municipal, industrial, and mine discharges and create habitat by restoring and enhancing existing habitat areas.

Key Actions

Delta Shallow Water Habitat - Create new areas of shallow water habitat in the Delta by reconstructing levees, riverbanks, and shallow water habitat areas and by restoring/preserving channel islands.

Delta and Upstream Habitats - Restore a variety of Delta and upstream habitats by protecting and enhancing existing aquatic, wetland, and riparian areas.

Reclamation - Reclaim agricultural, municipal, and industrial wastewater to be used for a variety of applications and improve water quality by reducing wastewater discharges.

Levee Upgrades - Improve levees around important economic land uses and restored freshwater habitats.

Supporting Actions

Instream flows - Complement habitat restoration with the acquisition of water for instream flows, the management of reservoirs for flows and temperature, and the restoration of flows to dewatered riparian areas. The restoration and replenishment of spawning gravel also contributes to habitat enhancement.

Floodways- Enhance floodways to restore wetland habitat and to reduce stranding of fish.

Discharge Treatment - Manage agricultural, municipal, and industrial wastewater by treating it through wetlands.

Fund Mine Cleanup - Give urban areas flexibility to fund high-priority mine cleanup.

Core Actions

Bay-Delta Habitat Restoration - Support restoration of Bay-Delta habitats by implementing core-level actions such as protecting existing shallow water habitat from erosion, restoring riverine habitat on channel islands, enhancing existing riparian and wetland habitats, and improving efforts to prevent further introduction of undesirable exotic species. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented to avoid the conversion of existing economic land uses.

Upstream Habitat Restoration - Support restoration of upstream habitats by implementing core actions at higher implementation levels, including managing flows and temperatures and restoring spawning gravels in upstream anadromous fish habitats. Other core actions would be implemented at core levels, including restoring sites for riparian vegetation and improving fish passage at upstream barriers. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented to avoid the conversion of existing economic land uses.

Reduction in Diversion Effects - Reduce diversion effects by implementing core-level actions such as installing fish screens, installing fish barriers, improving fish salvage operations, and managing inflow and export using real-time monitoring and adaptive management.

Management of Anadromous Fish - Improve conditions for anadromous fish by implementing core-level actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement.

Reductions in Diversion/Export Reliance - Reduce reliance on diversions/exports by implementing core-level actions such as educating users about reclamation, conservation, water pricing, and desalination feasibility; and encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement - Enhance available water supplies by implementing core-level actions such as providing incentives for conjunctive use.

Increasing Water Supply Predictability - Improve supply predictability by implementing core-level actions such as improving the ability to implement water transfers, long-term planning for drought, establishing institutions for water management, and coordinating land use and water supply planning.

Management of Water Quality - Improve water quality by implementing key water quality actions and supplementing these with core-level actions to manage Delta water quality. These core actions include implementing source control regulations for agricultural drainage; retiring lands with drainage problems; and other cost-effective actions to manage urban, industrial, and mine discharges and runoff. Core actions keeping with the theme of discharge management would be implemented at a higher level than actions outside the theme.

Improvement to System Reliability/Vulnerability - Supplement key actions in this alternative, such as reconstruction of levees, to improve system reliability by implementing core-level actions such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be addressed by implementing core actions plus noncore habitat restoration actions involving the protection and enhancement of existing habitats. Noncore actions address instream flows, improvements to a variety of habitats, and water quality improvements. However, because the extent of these actions is limited to existing habitat areas, it may not be sufficient to allow current populations to recover or to prevent other species from becoming threatened or endangered. Actions to create additional habitat, to further improve instream flows and temperatures, and to reduce entrainment impacts are needed to provide greater ecosystem-quality benefits.

Water Supply - Few actions, beyond the core actions, to increase the supply or reliability of water are included in this alternative. Therefore, the benefits of this alternative may not be equitable, although all beneficial uses would receive cleaner water. Equity could be achieved by improving the quantity and reliability of the Delta water supply.

Water Quality - Improving water quality is the main focus of this alternative. The benefits of improved water quality would be shared in all beneficial uses, but the costs would be borne mainly by agricultural and urban users.

System Reliability - System reliability would be improved by core and noncore actions to reconstruct levees. This alternative would provide a high degree of improvement to system reliability but opportunities to blend flood control with habitat creation would be minimized by restrictions on land used for economic purposes.

Detailed List of Actions (Alternative 126)

Because this alternative is limited to protecting and enhancing existing habitat, core habitat actions are incluced at above core levels of implementation. However, because water quality improvements can be achieved through a variety of methods, the core water quality improvements are not implemented above the core level.

Restore Bay-Delta Habitat

1.4 -Reconstruct levees to include shallow water habitat
1.5 -Fill deep water to produce shallow habitat
2.1 -Reconstruct river banks and shallow areas
2.2 -Restore/preserve channel islands - **above core level**
2.4 -Modify construction practices to include riverine elements
3.1 -Improve and protect degraded riparian habitats
3.4 -Modify levee maintenance practices
3.5 -Protect existing riparian habitat
4.1 -Enhance existing wetlands
4.4 -Protect existing wetland habitat
5.1 -Protect existing upland habitat
5.3 -Preserve the habitat values of agricultural land uses
5.4 -Clean-up sites containing toxic substances
50 -Integrated Habitat Management Programs - **above core level**
6.4 -Restore floodways as habitat corridors
7.1 -Remove or reduce nuisance species in key habitats
7.4 -Inspect for invasions of nuisance species
7.5 -Modify habitat to favor native species
8.1 -Manage crops for waterfowl forage production
8.2 -Improve management of public waterfowl areas
8.3 -Implement terrestrial predator control programs
8.4 -Increase sources and availability of wildlife forage

Restore Upstream Habitat

9.1 -Manage flows and temperatures in upstream habitats - **above core level**
9.2 -Restore and replenish spawning gravels - **above core level**
9.4 -Restore shoreline habitat conditions [redacted] - where economic uses not taken
~~9.5 -Modify gravel mining practices~~
9.6 -Improve floodway drainage to reduce fish stranding
10.1 -Modify passage at upstream dams/other barriers
10.2 -Modify natural barriers to improve passage
11.2 -Revegetate degraded riparian habitats
11.3 -Protect riparian lands through purchase/easements
11.4 -Restore flows to dewatered riparian habitats
12.1 -Modify floodways to support wetland habitats

12.4 -Manage groundwater recharge for wetland habitat

Reduce Effects of Diversions

17.1 -Acquire water for refuge habitat use (to make up for reduced agricultural drainage water)
17.? -Acquire water for instream flows (to make up for reduced agricultural drainage water)

Enhancement of Anadromous Fish Populations

Reducing the Reliance on Delta Exports

26.1 -Recharge groundwater with reclaimed water
26.2 -Use reclaimed water for agricultural irrigation (to provide farmers with a cleaner source of water and require less cleanup)
26.3 -reclaim saline agricultural drainage water - residual brine not discharged to surface waters
26.4 -Recycle and treat water for potable reuse (from agricultural source/from M&I source)
26.5 - Use reclaimed water for non-potable municipal and industrial uses (from agricultural source/from M&I source)
26.6 - Use reclaimed water to repel salinity intrusion (to repel salinity in groundwater)

Enhance Water Supplies

29.1 -Manage vegetation cover to increase yield
36.1 -Relocate Delta export pumps from key habitats
36.4 -Relocate upstream diversions from key habitats

Increase Supply Predictability

39.18 - Allow urban districts to fund mine cleanup in lieu of urban cleanup.

Managing Water Quality

42.02 - Implement pollutant-load limits in San Joaquin River (from agricultural, municipal, and industrial sources)
42.04 - Modify cropping and irrigation practices - min (should include financial assistance)
42.05 - Export agricultural drainage to other watersheds -max
42.10 - Treat drainage to reduce pollutants
43.2 - Treat discharges to remove problem constituents
43.3 - Construct wetlands to treat wastewater effluent (for agriculture or M&I, to reduce volumes, could be more than 10%)
43.6 - Retain and manage urban wastewater and industrial discharges
44.4 -Remove contaminated sediments in critical habitat

Improving System Reliability

Core actions removed
- habitat core actions not already at 100% were reinstated

Detailed List of Actions (Alternative 126)

Restore Bay-Delta Habitat

~~1.2 -Protect existing shallow habitat from erosion~~ core at 100%
1.4 -Reconstruct levees to include shallow water habitat
1.5 -Fill deep water to produce shallow habitat
2.1 -Reconstruct river banks and shallow areas
~~2.2 -Restore/preserve channel islands~~
~~2.4 -Modify construction practices to include riverine elements~~
~~3.1 -Improve and protect degraded riparian habitats~~
~~3.4 -Modify levee maintenance practices~~
~~3.5 -Protect existing riparian habitat~~
~~4.1 *-Enhance existing wetlands~~
~~4.4 *-Protect existing wetland habitat~~
5.1 -Protect existing upland habitat
5.3 -Preserve the habitat values of agricultural land uses
5.4 -Clean-up sites containing toxic substances
~~50 Integrated Habitat Management Programs~~
6.4 -Restore floodways as habitat corridors
7.1 -Remove or reduce nuisance species in key habitats
~~7.2 *-Improve regulation of ballast-water releases~~ core at 100%
~~7.3 *-Improve border inspection practices~~
7.4 -Inspect for invasions of nuisance species
7.5 -Modify habitat to favor native species
8.1 -Manage crops for waterfowl forage production
8.2 -Improve management of public waterfowl areas
8.3 - Implement terrestrial predator control programs
8.4 -Increase sources and availability of wildlife forage

Restore Upstream Habitat

~~9.1 -Manage flows and temperatures in upstream habitats~~
~~9.2 -Restore and replenish spawning gravels~~
~~9.4 -Restore shoreline habitat conditions~~ - core at 100%
9.5 *-Modify gravel mining practices
9.6 -Improve floodway drainage to reduce fish stranding
~~10.1 -Modify passage at upstream dams/other barriers~~
~~10.2 -Modify natural barriers to improve passage~~
~~11.2 -Revegetate degraded riparian habitats~~
11.3 -Protect riparian lands through purchase/easements
11.4 -Restore flows to dewatered riparian habitats
12.1 -Modify floodways to support wetland habitats
12.4 -Manage groundwater recharge for wetland habitat

Reduce Effects of Diversions

17.1 - Acquire water for refuge habitat use (to make up for reduced agricultural drainage water)

17.? - Acquire water for instream flows (to make up for reduced agricultural drainage water)

Enhancement of Anadromous Fish Populations

Reducing the Reliance on Delta Exports

~~C25.1 - increase agricultural water conservation - (to help farmers reduce cost of treatment~~ by ~~reducing water usage. Should include some financial assistance).~~ Retained at the core level.

~~C25.2 - Increase~~ municipal ~~and industrial water conservation. Retained at the core level.~~

26.1 - Recharge groundwater with reclaimed water

26.2 - Use reclaimed water for agricultural irrigation (to provide farmers with a cleaner source of water and require less cleanup)

26.3 - reclaim saline agricultural drainage water - residual brine not discharged to surface waters

26.4 - Recycle and treat water for potable reuse (from agricultural source/from M&I source)

26.5 - Use reclaimed water for non-potable municipal and industrial uses (from agricultural source/from M&I source)

26.6 - Use reclaimed water to repel salinity intrusion (to repel salinity in groundwater)

~~C27.1 - Encourage land fallowing during drought periods~~

~~C27.2 - Develop incentive programs for land retirement~~

Enhance Water Supplies

29.1 -Manage vegetation cover to increase yield
36.1 -Relocate Delta export pumps from key habitats
36.4 -Relocate upstream diversions from key habitats

Increase Supply Predictability

39.18 - Allow urban districts to fund mine cleanup in lieu of urban cleanup.

~~39.21 - Enforce wastewater discharge requirements (for agricultural drainage water) sites~~ core at 100%

Managing Water Quality

~~C42.01 - Implement source control regulations for pollutants~~

42.02 - Implement pollutant-load limits in San Joaquin River (from agricultural, municipal, and industrial sources)

42.04 - Modify cropping and irrigation practices - min (should include financial assistance)

42.05 - Export agricultural drainage to other watersheds -max

~~C42.06 - Retire lands with drainage and disposal problems~~

~~C42.07 - Improve pest-control practices -max~~

~~C42.08 - Manage irrigation tailwater to reduce pesticides~~

42.10 - Treat drainage to reduce pollutants

~~C43.1 - Retain and manage stormwater runoff~~

43.2 - Treat discharges to remove problem constituents

43.3 - Construct wetlands to treat wastewater effluent (for agriculture or M&I, to reduce volumes, could be more than 10%)

43.6 - Retain and manage urban wastewater and industrial discharges

44.4 -Remove contaminated sediments in critical habitat

~~C45.1 - Manage discharges from abandoned mines~~

~~C45.2 - Remediate abandoned mining sites discharging pollutants~~

Improving System Reliability

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Preliminary Alternative WQ 26

Group
Water Quality/Land Use

Title
Managing Discharges and Restoring Existing Habitat

Improve water quality through the management of both agricultural, municipal, industrial, and mine discharges and create habitat by restoring and enhancing existing habitat areas.

Key Actions

Delta Shallow Water Habitat - create new areas of shallow water habitat in the Delta by reconstructing levees, reconstructing river banks and shallow areas, and by restoring/preserving channel islands.

Delta and Upstream Habitats - restore a variety of Delta and upstream habitats by protecting and enhancing existing wetland, riparian, and wetland areas.

Reclamation - reclaim agricultural, municipal, and industrial wastewater to be used for a variety of uses, to improve water quality by reducing wastewater discharges.

Levee Upgrades - improve levees around important economic land uses and restored freshwater habitats.

Supporting Actions

Instream flows - habitat restoration is complemented with the acquisition of water for instream flows, the management of reservoirs for flows and temperature, and the restoration of flows to dewatered riparian areas. The restoration and replenishment of spawning gravels also contributes to habitat enhancement.

Floodways - floodways are enhanced to restore wetland habitat and to reduce fish stranding.

Discharge Treatment - manage agricultural, municipal, and industrial wastewater through treatment via wetlands.

Fund Mine Cleanup - give urban areas flexibility to fund high-priority mine cleanup.

Core Actions

Bay-Delta Habitat Restoration—Restoration of Bay-Delta habitats would be supported by core-level implementation of actions such as protecting existing shallow water habitat from erosion, restoring riverine habitat on channel islands, enhancing existing riparian and wetland habitats, and improving efforts to prevent further introduction of undesirable exotic species. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented to avoid the conversion of existing economic land uses.

Upstream Habitat Restoration—Restoration of upstream habitats would be supported by implementation of core actions at higher implementation levels, including managing flows and temperatures and restoring spawning gravels in upstream anadromous fish habitats. Other core actions would be implemented at core levels, including restoring sites for riparian vegetation, and improving fish passage at upstream barriers. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented to avoid the conversion of existing economic land uses.

Reduction in Diversion Effects—Diversion effects would be reduced by implementing core-level actions such as installing fish screens, installing fish barriers, improving fish salvage operations, and managing inflow and export using real-time monitoring and adaptive management.

Management of Anadromous Fish—Core-level implementation of actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement would improve conditions for anadromous fish.

Reductions in Diversion/Export Reliance—This alternative would be supported by core-level implementation of actions such as educating users about reclamation, conservation, water pricing and desalination feasibility, as well as encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement—Core-level implementation of actions such as incentives for conjunctive use would enhance available water supplies.

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Preliminary Alternative WQ 26

Increasing Water Supply Predictability—This alternative would rely on the core-level implementation of actions such as improving the ability to implement water transfers, long-term drought planning, institutions for water management, and coordination of land use and water supply planning.

Management of Water Quality—This alternative would support the key water quality actions with core-level implmentation of actions to manage Delta water quality such as implementing source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, industrial, and mine discharges and runoff. Actions keeping with the theme of discharge management would be implemented at a higher level than actions outside the theme.

Improvement to System Reliability/Vulnerability—Actions in this alternative to improve system reliability, such as reconstruction of levees, would be supplemented with core-level implementation of actions such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality—Ecosystem quality would be addressed by implementing core actions plus non-core habitat restoration actions involving the protection and enhancement of existing habitats. Non-core actions address instream flows, improvements to a variety of habitats, and water quality improvements. However, because the extent of these actions is limited to existing habitat areas, it probably would not be sufficient to allow current populations to recover, or to prevent other species from becoming threatened or endangered. Actions to further improve instream flows and temperatures and to reduce entrainment impacts are needed to provide better ecosystem quality benefits.

Water Supply—Few actions to increase the supply or reliability of water, beyond the core actions, are included in this alternative. The benefits of this alternative are, therefore, probably not equitable, although all beneficial uses would receive cleaner water. Equity could be achieve by improving the reliability of Delta water supply.

Water Quality—Water quality in the Delta and upstream would be considerably improved under this alternative, as water quality is one of the focuses of this alternative. The benefits of improved water quality would be shared by all beneficial uses, but the costs would be borne mainly by agricultural and urban users.

System Reliability—System reliability would be improved by core actions and non-core actions to reconstruct levees. This alternative would provide a high degree of improvement to system reliability, but opportunities to blend levee reconstruction with habitat creation would be minimized by the restriction on conversion of economic land uses.

Preliminary Alternative WQ 26

Detailed List of Actions

Because this alternative is limited to protecting and enhancing existing habitat, core habitat actions are included at above core levels of implementation. However, because water quality improvements can be achieved through a variety of methods, the core water quality improvements are not implemented above the core level.

Restore Bay-Delta Habitat

1.4 -Reconstruct levees to include shallow water habitat
1.5 -Fill deep water to produce shallow habitat
2.1 -Reconstruct river banks and shallow areas
2.2 -Restore/preserve channel islands - **above core level**
2.4 -Modify construction practices to include riverine elements
3.1 -Improve and protect degraded riparian habitats
3.4 -Modify levee maintenance practices
3.5 -Protect existing riparian habitat
4.1 -Enhance existing wetlands
4.4 -Protect existing wetland habitat
5.1 -Protect existing upland habitat
5.3 -Preserve the habitat values of agricultural land uses
5.4 -Clean-up sites containing toxic substances - **without converting economic land uses.**
50 -Integrated Habitat Management Programs - **above core level - without converting economic land uses**
6.4 -Restore floodways as habitat corridors
7.1 -Remove or reduce nuisance species in key habitats - **without converting economic land uses**
7.4 -Inspect for invasions of nuisance species
7.5 -Modify habitat to favor native species
8.1 -Manage crops for waterfowl forage production
8.2 -Improve management of public waterfowl areas
8.3 -Implement terrestrial predator control programs
8.4 -Increase sources and availability of wildlife forage - **without converting economic land uses**

Restore Upstream Habitat
9.1 -Manage flows and temperatures in upstream habitats - **above core level**
9.2 -Restore and replenish spawning gravels - **above core level**
9.4 -Restore shoreline habitat conditions - **without converting economic land uses**
9.6 -Improve floodway drainage to reduce fish stranding
10.1 -Modify passage at upstream dams/other barriers - **above core level**
10.2 -Modify natural barriers to improve passage - **above core level**
11.2 -Revegetate degraded riparian habitats - **without converting economic land uses**
11.3 -Protect riparian lands through purchase/easements - **without converting economic land uses**
11.4 -Restore flows to dewatered riparian habitats
12.1 -Modify floodways to support wetland habitats - **without converting economic land uses**
12.4 -Manage groundwater recharge for wetland habitat - **without converting economic land uses**

Reduce Effects of Diversions
17.1 -Acquire water for refuge habitat use (to make up for reduced agricultural drainage water)
17.? -Acquire water for instream flows (to make up for reduced agricultural drainage water)

Enhancement of Anadromous Fish Populations

Reducing the Reliance on Delta Exports
26.1 -Recharge groundwater with reclaimed water
26.2 -Use reclaimed water for agricultural irrigation (to provide farmers with a cleaner source of water and require less cleanup)
26.3 -reclaim saline agricultural drainage water - residual brine not discharged to surface waters
26.4 -Recycle and treat water for potable reuse (from agricultural source/from M&I source)
26.5 - Use reclaimed water for non-potable municipal and industrial uses (from agricultural source/from M&I source)
26.6 - Use reclaimed water to repel salinity intrusion (to repel salinity in groundwater)

Enhance Water Supplies
29.1 -Manage vegetation cover to increase yield - **without converting economic land uses**
36.1 -Relocate Delta export pumps from key habitats
36.4 -Relocate upstream diversions from key habitats

Increase Supply Predictability
39.18 - Allow urban districts to fund mine cleanup in lieu of urban cleanup.

Managing Water Quality
42.02 - Implement pollutant-load limits in San Joaquin River (from agricultural, municipal, and industrial sources)
42.04 - Modify cropping and irrigation practices - min (should include financial assistance)

Preliminary Alternative WQ 26

42.05 - Export agricultural drainage to other watersheds -max
42.10 - Treat drainage to reduce pollutants
43.2 - Treat discharges to remove problem constituents
43.3 - Construct wetlands to treat wastewater effluent (for agriculture or M&I, to reduce volumes, could be more than 10%)
43.6 - Retain and manage urban wastewater and industrial discharges
44.4 -Remove contaminated sediments in critical habitat

Improving System Reliability

47.1 - Reconstruct levees to higher design standards (to protect economic land uses and freshwater habitat)
47.2 - Reconstruct levees to higher seismic standards
47.3 - Relocate levees to more stable sites
48.1 - Maintain/reconstruct levees around infrastructure

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Preliminary Alternative 126
(Land Use/Habitat and Water Quality Group)

TITLE: **Improve Water Quality by Managing Discharges and Create Habitat by Preserving and Enhancing Existing Habitat Areas**

SOLUTION OVERVIEW

Theme. This alternative is designed to improve water quality through the management of both agricultural, municipal, industrial, and mine discharges. This would be accomplished through the treatment of discharges, the reclamation and reuse of discharges, and through agricultural best management practices. In addition, the quality of existing Bay-Delta and upstream habitat would be enhanced.

Key Actions. The unique character of this alternative is represented by these features:

- the combination of treatment, reclamation, and modification of land use practices to improve water quality
- Reconstruct levees to include shallow water habitat

ACTIONS SELECTED FOR THE ALTERNATIVE

Bay-Delta Habitat Restoration. Restoration of Bay-Delta habitats would rely on core actions, such as protecting existing shallow water habitat from erosion,, and restoring flows to dewatered riparian habitats. Core habitat actions not involving the conversion of economic land uses are implemented above the core level, and non-core actions such as reconstructing levees to include shallow water habitat and restoring floodways as habitat corridors (where not serving economic land uses) are included.

Upstream Habitat Restoration. This alternative includes core actions, that may involve conversion of economic land uses, such as restoring high-priority sites for riparian vegetation and restricting grazing in high-priority riparian corridors are implemented at the core level. Core actions not involving conversion of economic uses, such as managing flows and temperatures in upstream habitats and restoring and replenishing spawning gravels are included above the core level of implementation. These actions are supplemented by non-core actions not involving the conversion of economic land uses, such as improving floodway drainage to reduce fish stranding, and protecting riparian lands through easements.

Reduction in Diversion Effects. In addition to core actions, this alternative would include the purchase of water for refuges and instream flows to replace the water lost due to the actions in this alternative to reduce agricultural drainage.

Management of Anadromous Fish. This alternative would rely on core actions to benefit the management of anadromous fish include improvements to fish hatchery operations and improvements in the management and enforcement of commercial and recreational fish harvesting. Actions beyond the core actions were not included.

Reduction in Diversion/Export Reliance. The core actions included in this alternative include increasing agricultural, municipal and industrial water conservation, and programs for temporary land fallowing and permanent land retirement. In addition, non-core actions to use reclaimed agricultural, municipal and industrial wastewater for irrigation, potable and non-potable urban uses, and to repel salinity intrusion are included.

Water Supply Enhancement. In addition to such core actions as managing watersheds to protect water quality, and implementing conjunctive use programs, this alternative includes non-core actions such as managing vegetation in watersheds to increase yield, and relocating diversions from key habitats.

Increasing Water Supply Predictability. In addition to core actions such as programs to facilitate water transfers and long-term water planning, this alternative includes an action to allow urban districts to fund mine cleanup in lieu of further cleanup of urban discharges.

Management of Water Quality. This alternative includes core actions to improve Delta water quality. In addition, actions to control agricultural, municipal, industrial and mine drainage, such as implementing pollutant-load limits on the San Joaquin River, modifying land use and cropping practices, and using wetlands to treat wastewater are included.

Improvement to System Reliability/Vulnerability. This alternative would rely on core actions to improve system reliability, such as managing the highest priority levees, modifying agricultural practices to reduce subsidence in the most cost effective sites, and establishing an emergency levee management plan. Actions beyond the core actions were not included.

PRELIMINARY ASSESSMENT

Ecosystem Quality. Ecosystem quality would be addressed by implementing core actions plus habitat restoration actions not involving the conversion of economic land uses. Non-core actions address instream flows, fish entrainment, improvements to a variety of habitats, and water quality improvement. However, because the extent of these actions is somewhat limited, it may not be sufficient to allow current populations to recover, or to prevent other species from becoming threatened or endangered.

Water Supply. Few actions to increase the supply or reliability of water, beyond the core actions, are included in this alternative. The benefits of this alternative are probably not equitable, although all beneficial uses would receive cleaner water.

Water Quality. Water quality in the Delta and upstream would be considerably improved under this alternative, as water quality is one of the focuses of this alternative. The benefits of improved water quality would be shared by all beneficial uses, but the costs would be borne mainly by agricultural and urban users.

Reliability of Delta Functions. System reliability would be improved only to the core level of implementation. This alternative, therefore, may not achieve equity with regard to this program objective.

Preliminary Alternative WQ127

Group

Water Quality/Land Use

Title

Managing Discharges and Creating New Habitat

Improve water quality by managing discharges and create habitat by converting land used for economic purposed into habitat areas .

Key Actions

New Shallow Water Habitat Areas - Create new areas of shallow water habitat in the Delta by subjecting existing leveed lands to tidal action and restoring tidal action to existing diked wetlands.

New Upstream Habitats - Create a mosaic of habitat types upstream of the Delta at the minimum level of implementation.

Reclamation - Reclaim agricultural, municipal, and industrial wastewater to be used for a variety of applications and improve water quality by reducing wastewater discharges.

Levee Upgrades - Improve levees around important economic land uses and restored freshwater habitats.

Supporting Actions

New Delta Habitats - Create a mosaic of habitat types in the Delta, including shallow water, riverine, riparian, wetland, and terrestrial, at the minimum level of implementation.

Natural Flood Protection - Enhance levee flood protection and create new habitat by allowing rivers to meander, relocating levees to create floodways, and modifying floodways to support wetland habitats.

Discharge Treatment - Manage agricultural, municipal, and industrial wastewater by treating it through wetlands.

Fund Mine Cleanup - Give urban areas flexibility to fund high-priority mine cleanup.

Core Actions

Bay-Delta Habitat Restoration - Support restoration of Bay-Delta habitats by implementing core-level actions such as protecting existing shallow water habitat from erosion, restoring riverine habitat on channel islands, enhancing existing riparian and wetland habitats, and improving efforts to prevent further introduction of undesirable exotic species. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented toward the conversion of land uses to habitat areas.

Upstream Habitat Restoration - Support restoration of upstream habitats by implementing core-level actions, such as managing flows and temperatures and restoring spawning gravel in upstream anadromous fish habitats, restoring sites for riparian vegetation, and improving fish passage at upstream barriers, in high priority areas. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented toward the conversion of land uses to habitat areas.

Reduction in Diversion Effects - Reduce diversion effects by implementing core-level actions such as installing fish screens, installing fish barriers, improving fish salvage operations, and managing inflow and export using real-time monitoring and adaptive management.

Management of Anadromous Fish - Improve conditions for anadromous fish by implementing core-level actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement.

Reductions in Diversion/Export Reliance - Reduce reliance on diversions/exports by implementing core-level actions such as educating users about reclamation, conservation, water pricing, and desalination feasibility; and encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement - Enhance available water supplies by implementing core-level actions such as providing incentives for conjunctive use.

Increasing Water Supply Predictability - Improve supply predictability by implementing core-level actions such as improving the ability to implement water transfers, long-term planning for drought, establishing institutions for water management, and coordinating land use and water supply planning.

Management of Water Quality - Improve water quality by implementing key water quality actions and core-level actions, such as implementing source control regulations for agricultural drainage and retiring lands with drainage problems, to manage Delta water quality and implementing other cost-effective actions to manage urban, industrial, and mine discharges and runoff. Actions keeping with the theme of discharge management would be implemented at a higher level than actions outside the theme.

Improvement to System Reliability/Vulnerability - Supplement key actions in this alternative, such as reconstruction of levees, to improve system reliability by implementing core-level actions such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be addressed by implementing core actions plus habitat restoration involving only the conversion of economic land uses. Noncore actions address instream flows, fish entrainment, improvements to a variety of habitats, and water quality improvement. However, because the extent of these actions is somewhat limited, it may not be sufficient to allow current populations to recover or to prevent other species from becoming threatened or endangered. Actions to restore existing habitats, improve instream flows, and further reduce entrainment impacts are needed to provide greater ecosystem-quality benefits.

Water Supply - No actions, beyond the core actions, to increase the supply or reliability of water are included in this alternative. Therefore, the benefits of this alternative may not be equitable, although all beneficial uses would receive cleaner water. Equity could be achieved by improving the quantity and reliability of the Delta water supply.

Water Quality - Improving water quality is the main focus of this alternative. The benefits of improved water quality would be shared in all beneficial uses, but the costs would be borne mainly by agricultural and urban users.

System Reliability - System reliability would be improved by core actions, by natural flood protection actions, and by actions to improve the stability of levees.

Preliminary Alternative WQ 27

Detailed List of Actions

All actions implemented at the minimum level, since a variety of actions are included.

Restore Bay-Delta Habitat

1.1 -Convert existing leveed lands to tidal action
1.3 -Restore tidal action to existing diked wetlands
2.3 -Restore natural channel configurations
3.2 -Establish new areas of riparian habitat
3.3 -Reestablish historic riparian areas
4.2 -Expand wetland acquisition programs
4.3 -Convert agricultural lands to wetlands
5.2 -Establish upland habitat
5.4 -Clean-up sites containing toxic substances - by converting existing economic uses
50 -Integrated Habitat Management Programs - for areas with existing economic uses
6.1 -Relocate levees to widen floodways
6.2 -Allow river channels to meander
6.3 -Acquire Delta islands as overflow areas
6.4 -Restore floodways as habitat corridors
7.1 -Remove or reduce nuisance species in key habitats - by converting existing economic uses
7.2 -Improve regulation of ballast-water releases
7.3 -Improve border inspection practices
7.4 -Inspect for invasions of nuisance species
7.5 -Modify habitat to favor native species
8.4 -Increase sources and availability of wildlife forage - by converting existing economic uses

Restore Upstream Habitat

9.3 -Restore channel configurations
9.4 -Restore shoreline habitat conditions - by converting existing economic uses
10.1 -Modify passage at upstream dams/other barriers
10.2 -Modify natural barriers to improve passage
11.1 -Restrict livestock grazing in riparian corridors
11.2 -Revegetate degraded riparian habitats - ~~without~~ by converting existing economic uses
11.3 -Protect riparian lands through purchase/easements - by converting existing economic uses
12.1 -Modify floodways to support wetland habitats - by converting existing economic uses
12.2 -Reuse agricultural drainage to create wetlands - by converting existing economic uses
12.3 -Reuse urban wastewater effluent to create wetlands
12.4 -Manage groundwater recharge for wetland habitat - by converting existing economic uses

Reduce Effects of Diversions

17.1 - Acquire water for refuge habitat use (to make up for reduced agricultural drainage water)

17.? - Acquire water for instream flows (to make up for reduced agricultural drainage water)

Preliminary Alternative WQ 27

Enhancement of Anadromous Fish Populations

Reducing the Reliance on Delta Exports

26.1 - Recharge groundwater with reclaimed water
26.2 - Use reclaimed water for agricultural irrigation (to provide farmers with a cleaner source of water and require less cleanup)
26.3 - reclaim saline agricultural drainage water - residual brine not discharged to surface waters
26.4 - Recycle and treat water for potable reuse (from agricultural source/from M&I source)
26.5 - Use reclaimed water for non-potable municipal and industrial uses (from agricultural source/from M&I source)
26.6 - Use reclaimed water to repel salinity intrusion (to repel salinity in groundwater)
27.1 - Encourage land fallowing during drought periods
27.2 - Develop incentive programs for land retirement
27.3 - Purchase lands or easements

Enhance Water Supplies

29.1 -Manage vegetation cover to increase yield - by converting existing economic uses

Increase Supply Predictability

39.18 - Allow urban districts to fund mine cleanup in lieu of urban cleanup.
39.21 - Enforce wastewater discharge requirements (for agricultural drainage water)

Managing Water Quality

42.02 - Implement pollutant-load limits in San Joaquin River (from agricultural, municipal, and industrial sources)
42.04 - Modify cropping and irrigation practices - min (should include financial assistance)
42.05 - Export agricultural drainage to other watersheds -max
42.10 - Treat drainage to reduce pollutants
43.2 - Treat discharges to remove problem constituents
43.3 - Construct wetlands to treat wastewater effluent (for agriculture or M&I, to reduce volumes, could be more than 10%)
43.6 - Retain and manage urban wastewater and industrial discharges

Improving System Reliability

47.1 - Reconstruct levees to higher design standards (to protect economic land uses and freshwater habitat)
47.2 - Reconstruct levees to higher seismic standards
47.3 - Relocate levees to more stable sites
48.1 - Maintain/reconstruct levees around infrastructure

Preliminary Alternative WQ128

Group	*Title*
Water Quality/Land Use	**Managing Discharges, Restoring Existing and Creating New Habitat**

Improve water quality by managing discharges and create habitat by balancing the preservation and enhancement of existing habitats with the creation of new habitats by converting land used for economic purposes.

Key Actions

Delta Shallow Water Habitat - Create new areas of shallow water habitat in the Delta by reconstructing levees, reconstructing riverbanks and shallow water habitat areas, restoring/preserving channel islands, and subjecting existing leveed lands to tidal action.

Delta and Upstream Habitats - Create a variety of habitat types upstream of and in the Delta by protecting, enhancing, and creating new instream, wetland, riparian, and terrestrial habitats.

Reclamation - Reclaim agricultural, municipal, and industrial wastewater to be used for a variety of applications and improve water quality by reducing wastewater discharges.

Levee Upgrades - Improve levees around important economic land uses and restored freshwater habitats.

Supporting Actions

Instream flows - Complement habitat restoration with the acquisition of water for instream flows, the management of reservoirs for flows and temperature, and the restoration of flows to dewatered riparian areas.

Natural Flood Protection - Enhance levee flood protection and create new habitat by allowing rivers to meander, relocating levees to create floodways, and modifying floodways to support wetlands and reduce stranding of fish.

Discharge Treatment - Manage agricultural, municipal, and industrial wastewater by treating it through wetlands.

Fund Mine Cleanup - Give urban areas flexibility to fund high-priority mine cleanup.

Core Actions

Bay-Delta Habitat Restoration - Support restoration of Bay-Delta habitats by implementing core-level actions such as protecting existing shallow water habitat from erosion, restoring riverine habitat on channel islands, enhancing existing riparian and wetland habitats, and improving efforts to prevent further introduction of undesirable exotic species.

Upstream Habitat Restoration - Support restoration of upstream habitats by implementing core-level actions, such as managing flows and temperatures and restoring spawning gravel in upstream anadromous fish habitats, restoring sites for riparian vegetation, and improving fish passage at upstream barriers, in high-priority areas.

Reduction in Diversion Effects - Reduce diversion effects by implementing core-level actions such as installing fish screens, installing fish barriers, improving fish salvage operations, and managing inflow and export using real-time monitoring and adaptive management.

Management of Anadromous Fish - Improve conditions for anadromous fish by implementing core-level actions such as improving hatchery operations, reducing hatchery effects on wild populations, restoring and replenishing spawning gravel, and improving fish harvest regulations and their enforcement.

Reductions in Diversion/Export Reliance - Reduce reliance on diversions/exports by implementing core-level actions such as educating users about reclamation, conservation, water pricing and desalination feasibility, and encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement - Enhance available water supplies by implementing core-level actions such as providing incentives for conjunctive use.

Increasing Water Supply Predictability - Improve supply predictability by implementing core-level actions such as improving the ability to implement water transfers, long-term planning for drought, establishing institutions for water management, and coordinating land use and water supply planning.

Management of Water Quality - Improve water quality by implementing key water quality actions and core-level actions, such as implementing source control regulations for agricultural drainage and retiring lands with drainage problems, to manage Delta water quality and implementing other cost-effective actions to manage urban, industrial, and mine discharges and runoff. Actions keeping with the theme of discharge management would be implemented at a higher level than actions outside the theme.

Improvement to System Reliability/Vulnerability - Supplement key actions in this alternative, such as reconstruction of levees, to improve system reliability by implementing core-level actions such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be addressed by supplementing core actions with the creation of a mosaic of habitats in both the Delta and upstream. Other actions address instream flows, fish entrainment, improvements to a variety of habitats, and water quality improvement. This alternative should result in substantial improvements to the Delta ecosystem; however, it could be improved by adding actions to further reduce entrainment impacts.

Water Supply - Few actions, beyond the core actions, to increase the supply or reliability of water are included in this alternative. Therefore, the benefits of this alternative may not be equitable, although all beneficial uses would receive cleaner water. Equity could be achieved by improving the quantity and reliability of the Delta water supply.

Water Quality - Improving water quality is the main focus of this alternative. The benefits of improved water quality would be shared in all beneficial uses, but the costs would be borne mainly by agricultural and urban users.

System Reliability - System reliability would be greatly improved by core actions, by natural flood protection actions, and by actions to improve the stability of levees through reconstruction.

maintain land uses.

Increase Supply Predictability:

Core actions were included that would provide additional dilution flow in the Delta.

Managing Water Quality:

Core actions were added to treat and avoid introduction of poor quality water into the rivers by modifying land use practices.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative would improve water quality by adding water to the Delta and changing land uses that could contribute pollutants. It would benefit the ecosystem by providing new habitat. Restoration of existing wetlands and creation of new wetlands could place additional demands on water supply. Some form of compensation would be needed to mitigate the impacts on land owners. Actions for this compensation are not specifically identified.

Detailed List of Actions Selected (Alternative #118):

Restore Bay-Delta Habitats:

3.2 - Establish new areas of riparian habitat

3.3 - Reestablish historic riparian areas

C4.2 - Expand wetland acquisition program.

4.3 - Convert agricultural land to wetlands.

5.2 - Establish upland habitat.

5.4 - Clean up sites containing toxic substances.

Restore Upstream Habitats:

C11.1 - Restrict livestock grazing in riparian corridors - max (to prevent pollutant entry into streams)

C11.2 - Revegetate degraded riparian habitats - max (to prevent pollutant entry into streams)

11.3 - Protect riparian lands through purchase/easements.

Reduce Effects of Diversions:

C13.4 - Provide instream pulse flows for fish passage - max (would not be considered if it restricts use of water for water quality)

C13.5 - Provide instream pulse flows for fish attraction - max (would not be considered if it restricts use of water for water quality)

C14.1 - Modify central Delta channel operations - (to allow control of additional flows for water quality)

C14.2 - Modify export operations criteria - (to allow increased Delta outflow and in-Delta flows when needed for water quality)

C14.3 - Use real-time monitoring and adaptive management - max (to be used to monitor water quality and time reservoir releases accordingly)

Enhancement of Anadromous Fish Populations:

None selected.

Reducing the Reliance on Delta Exports:

24.1 - Expand desalination of Southern California supplies (to reduce the water quality impacts of exports)

24.2 - Expand desalination of San Joaquin Valley supplies (to reduce the water quality impacts of exports)

C25.1 - Increase agricultural water conservation - max (to provide additional water supply for water quality)

C25.2 - Increase municipal and industrial water conservation - max (to provide additional water supply for water quality)

C27.1 - Encourage land fallowing during drought periods - max

C27.2 - Develop incentive programs for land retirement - max

27.3 - Purchase lands or easements

Enhance Water Supplies:

28.1 - Establish incentives for pricing to reduce demand (to provide additional water supply for water quality)

29.1 - Manage vegetation cover to increase yield

C29.2 - Manage riparian zones to protect water quality - max

C29.3 - Manage land uses to protect water quality - max

Increase Supply Predictability:

C37.1 - Coordinate diversion and conveyance of transfers - max (timed to provide water quality benefits)

C37.2 - Establish brokerage for water transfers - max (to provide control mechanism for timing transfers)

C39.04 - Coordinate groundwater/surface water management - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.15 - Modify California Water Code to encourage conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

C39.22 - Water resources data amd information management - max (to provide information for timing of releases for water quality)

C39.24 - Establish incentives for conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

Managing Water Quality:

42.04 - Modify cropping and irrigation practices

42.05 - Export agricultural drainage to other watersheds

C42.06 - Retire lands with agricultural drainage problems - max

C42.07 - Improve pest control practices - max

C42.08 - Manage irrigation tailwater to reduce pesticides - max

42.11 - Dilute pollutants in Delta inflows from SJR using stored water - max

C43.1 - Retain and manage stormwater runoff - max

C44.2 - Use techniques to localize sediment movement - max (to minimize water quality impacts of dredging)

C44.3 - Dispose dredge materials at nonaquatic habitat sites - max (to minimize water quality impacts of dredging)

Improving System Reliability:

None selected

Preliminary Alternative WQ119

Group	*Title*
Water Quality/Land Use	**Diluting Pollutants, Restoring Existing and Creating New Habitat**

Improve water quality by diluting pollutants with stored water and water from reduced diversions and create habitat by balancing the preservation and enhancement of existing habitats with the creation of new habitats by converting land used for economic purposes into habitat areas.

Key Actions

Delta Shallow Water Habitat - Create new areas of shallow water habitat in the Delta by reconstructing levees, reconstructing riverbanks and shallow areas, restoring/preserving channel islands, and subjecting existing leveed lands to tidal action.

Delta and Upstream Habitats - Create a variety of habitat types upstream of and in the Delta, by protecting, enhancing, and creating new instream, wetland, riparian, and terrestrial habitats.

Dilution Flows - Use a variety of actions, including land fallowing and retirement, acquisition of water for instream flows, timing of water transfers, and expand use of desalination in San Joaquin Valley and southern California, to reallocate water supplies to be used for dilution.

Levee Upgrades - Improve levees around important economic land uses and restored freshwater habitats.

Supporting Actions

Instream Flows - Habitat restoration is complemented with the acquisition of water for instream flows, the management of reservoirs for flows and temperature, and the restoration of flows to dewatered riparian areas. The restoration and replenishment of spawning gravel also contributes to habitat enhancement. The timing of flows would be balanced to provide instream habitat and water quality benefits.

Habitat Restoration - Restoration of upstream and Delta riparian and wetland habitat would be undertaken to provide better water quality and greater ecosystem benefits.

Conservation and Reclamation - Increasing water conservation and reclamation would allow water to be reallocated from use in agricultural, municipal, and industrial purposes to use instream for water quality purposes.

Fund Mine Cleanup - Give urban areas flexibility to fund high-priority mine cleanup.

Core Actions

Bay-Delta Habitat Restoration - Support restoration of Bay-Delta habitats by implementing core-level actions such as protecting existing shallow water habitat from erosion, restoring riverine habitat on channel islands, enhancing existing riparian and wetland habitats, and improving efforts to prevent further introduction of undesirable exotic species. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented toward those actions providing both water quality and ecosystem benefits.

Upstream Habitat Restoration - Support restoration of upstream habitats by implementing core actions at higher implementation levels including modifying upstream reservoir operations and providing instream pulse flows. Other core actions would be implemented at core levels including restoring sites for riparian vegetation and improving fish passage at upstream barriers. In keeping with the theme of this alternative, these habitat restoration efforts would be oriented toward those actions providing both water quality and ecosystem benefits.

Reduction in Diversion Effects - Reduce diversion effects by supplementing noncore actions with core-level actions, such as decreasing upstream diversions and modifying central Delta channel operations, implemented at above-core levels.

Management of Anadromous Fish - No actions beyond implementing core-level actions, such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement, are included in this alternative.

Reductions in Diversion/Export Reliance - Supplement noncore actions to reduce reliance on Delta diversions and exports by increasing the implementation of core actions such as increasing agricultural, municipal, and industrial water conservation and encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement - Support noncore watershed management actions by implementing core-level actions such as providing incentives for conjunctive use.

Increasing Water Supply Predictability - Increase water supply predictability by implementing core-level actions such as improving the ability to implement water transfers, long-term planning for drought, establishing institutions for water management, and coordinating land use and water supply planning.

Management of Water Quality - Support key water quality actions by implementing core-level actions, such as implementing source control regulations for agricultural drainage and retiring lands with drainage problems, to manage Delta water quality and implementing other cost-effective management of urban, industrial, and mine discharges and runoff. Actions keeping with the theme of dilution flows would be implemented at a higher level than actions outside the theme.

Improvement to System Reliability/Vulnerability - Supplement noncore actions, such as reconstruction of levees, to improve system reliability by implementing core-level actions such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be addressed by supplementing core actions with the creation of a mosaic of habitats in both the Delta and upstream. Other actions address instream flows, fish entrainment, improvements to a variety of habitats, and improvements in water quality. This alternative should result in substantial improvements to the Delta ecosystem; however, it could be improved by adding actions to further reduce entrainment impacts.

Water Supply - Actions to increase the supply or reliability of water are included in this alternative, but this water is used in instream flows to dilute pollutants. Although some of this extra water could be diverted from the Delta, most probably could not. Therefore, the benefits of this alternative may not equitable, although all beneficial uses would receive cleaner water. Equity could be achieved by improving the quantity and reliability of Delta water supply.

Water Quality - Instream and Delta water quality would be improved by this alternative, but the ability of dilution to solve water quality is limited by the accumulation of pollutants in the ecosystem. Further, dilution of pollutants occurs at a high water cost. Inclusion of other water quality strategies, such as discharge and watershed management, would improve the water quality benefits of this alternative. Physical improvements in the Delta (e.g., changing the location of diversions) would also provide greater water quality benefits.

System Reliability - System reliability would be greatly improved by core actions, by natural flood protection actions, and by actions to improve the stability of levees through reconstruction.

OLD VERSION
AS SUBMITTED BY P.W.

Title: Improve habitat and water quality by maintaining or converting existing land uses and providing sufficient water for dilution. **(Alternative #119)**

Identification of Theme, Subtheme, and Approach:
Theme: Improve habitat and water quality
Subtheme: Preserve or modify existing land uses and provide additional water to rivers.

Solution Overview:
This alternative includes the maximum of all core actions to improve habitat through maintaining or converting land uses. The actions would also provide instream water quality benefits by adding water to the stream.

Major Actions:

Because land use can be altered or remain the same under this alternative, the actions that differentiate this alternative focus on improving water quality through dilution rather than source control.

Actions Selected:

Restore Bay-Delta Habitats:

A number of actions were selected to preserve and restore existing wetlands and riparian areas and add new areas to help improve water quality.

Restore Upstream Habitats:

A number of actions were selected to maintain instream water quality by protecting habitat.

Reduce Effects of Diversions:

Core actions were included that would provide additional dilution flow in the Delta.

Enhancement of Anadromous Fish Populations:

None Selected

Reducing the Reliance on Delta Exports:

Core actions were included that would conserve water to provide additional dilution flow in the Delta.

Enhance Water Supplies:

Actions were selected that would increase yield and therefore dilution flow.

Increase Supply Predictability:

Core actions were included that would provide additional dilution flow in the Delta.

Managing Water Quality:

Core actions were added to treat and avoid introduction of poor quality water into the rivers by maintaining or modifying land use practices.

Improving System Reliability:

None selected.

Preliminary Assessment:

This alternative would improve water quality by applying best management practices to watershed land uses without changing those uses. It would benefit the ecosystem by providing new habitat. Because of the constraint of maintaining existing land uses, this alternative may not substantially benefit habitat. Restoration of existing wetlands and creation of new wetlands could place additional demands on water supply. Some form of compensation would be needed to mitigate the impacts on land owners. Actions for this compensation are not specifically identified.

Preliminary Alternative WQ119

Detailed List of Actions Selected:

All actions implemented at the minimum level, since a variety of actions are included.

Restore Bay-Delta Habitat

1.1 -Convert existing leveed lands to tidal action
1.3 -Restore tidal action to existing diked wetlands
1.4 -Reconstruct levees to include shallow water habitat
1.5 -Fill deep water to produce shallow habitat
2.1 -Reconstruct river banks and shallow areas
2.3 -Restore natural channel configurations
3.1 -Improve and protect degraded riparian habitats
3.2 -Establish new areas of riparian habitat
3.3 -Reestablish historic riparian areas
4.3 -Convert agricultural lands to wetlands
5.1 -Protect existing upland habitat
5.2 -Establish upland habitat
5.3 -Preserve the habitat values of agricultural land uses
5.4 -Clean-up sites containing toxic substances
6.1 -Relocate levees to widen floodways
6.2 -Allow river channels to meander
6.3 -Acquire Delta islands as overflow areas
6.4 -Restore floodways as habitat corridors
7.1 -Remove or reduce nuisance species in key habitats
7.4 -Inspect for invasions of nuisance species
7.5 -Modify habitat to favor native species
8.1 -Manage crops for waterfowl forage production
8.2 -Improve management of public waterfowl areas
8.4 -Increase sources and availability of wildlife forage

Restore Upstream Habitats:

9.3 -Restore channel configurations
9.4 -Restore shoreline habitat conditions
9.6 -Improve floodway drainage to reduce fish stranding
11.3 -Protect riparian lands through purchase/easements
11.4 -Restore flows to dewatered riparian habitats
12.1 -Modify floodways to support wetland habitats
12.2 -Reuse agricultural drainage to create wetlands
12.3 -Reuse urban wastewater effluent to create wetlands
12.4 -Manage groundwater recharge for wetland habitat

Preliminary Alternative WQ119

Reduce Effects of Diversions:

13.1 - Decrease upstream diversions - max (to increase instream flows when needed for water quality purposes)

13.2 - Modify upstream reservoir operations - max (to provide the water for dilution flows)

13.3 - Modify Delta inflow timing pattern - max (to provide flows to dilute pollutants in the Delta)

C13.4 - Provide instream pulse flows for fish passage - max (would not be considered if it restricts use of water for water quality)

C13.5 - Provide instream pulse flows for fish attraction - max (would not be considered if it restricts use of water for water quality)

C14.1 - Modify central Delta channel operations - (to allow control of additional flows for water quality)

C14.2 - Modify export operations criteria - (to allow increased Delta outflow and in-Delta flows when needed for water quality)

C14.3 - Use real-time monitoring and adaptive management - max (to be used to monitor water quality and time reservoir releases accordingly)

C17.1 - Acquire water for refuge habitat use - (water would actually be acquired for water quality purposes)

Enhancement of Anadromous Fish Populations:

Reducing the Reliance on Delta Exports:

24.1 - Expand desalination of Southern California supplies (to reduce the water quality impacts of exports)

24.2 - Expand desalination of San Joaquin Valley supplies (to reduce the water quality impacts of exports)

C25.1 - Increase agricultural water conservation - max (to provide additional water supply for water quality)

C25.2 - Increase municipal and industrial water conservation - max (to provide additional water supply for water quality)

26.1 - Recharge groundwater with reclaimed water

26.2 - Use reclaimed water for agricultural irrigation

26.3 - Reclaim saline agricultural drainage water

26.4 - Recycle and treat water for potable use

26.5 - Use reclaimed water for non-potable M&I uses

26.6 - Use reclaimed water to repel salinity intrusion (both in the Delta and in groundwater basins)

C27.1 - Encourage land fallowing during drought periods - max

C27.2 - Develop incentive programs for land retirement - max

27.3 - Purchase lands or easements

Preliminary Alternative WQ119

Enhance Water Supplies:

28.1 - Establish incentives for pricing to reduce demand (to provide additional water supply for water quality)
C29.1 - Manage vegetation cover to increase yield
C29.2 - Manage riparian zones to protect water quality - max
C29.3 - Manage land uses to protect water quality - max

Increase Supply Predictability:

C37.1 - Coordinate diversion and conveyance of transfers - max (timed to provide water quality benefits)
C37.2 - Establish brokerage for water transfers - max (to provide control mechanism for timing transfers)
C39.04 - Coordinate groundwater/surface water management - max (to provide an alternative source of water supply during periods when flows needed for water quality)
C39.14 - Establish incentives for conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)
C39.15 - Modify California Water Code to encourage conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)
C39.22 - Water resources data and information management - max (to provide information for timing of releases for water quality)
C39.24 - Establish incentives for conjunctive use - max (to provide an alternative source of water supply during periods when flows needed for water quality)

Managing Water Quality:

C42.03 - Reduce or control volume of agricultural discharges - max
42.04 - Modify cropping and irrigation practices
42.05 - Export agricultural drainage to other watersheds
C42.06 - Retire lands with agricultural drainage problems - max
C42.07 - Improve pest control practices - max
C42.08 - Manage irrigation tailwater to reduce pesticides - max
42.11 - Dilute pollutants in Delta inflows from SJR using stored water - max
C43.1 - Retain and manage stormwater runoff - max
C44.2 - Use techniques to localize sediment movement - max (to minimize water quality impacts of dredging)
C44.3 - Dispose dredge materials at nonaquatic habitat sites - max (to minimize water quality impacts of dredging)

Improving System Reliability:

47.1 - Reconstruct levees to higher design standards (to protect economic land uses and

Preliminary Alternative WQ119

freshwater habitat)
47.2 - Reconstruct levees to higher seismic standards
47.3 - Relocate levees to more stable sites
48.1 - Maintain/reconstruct levees around infrastructure

Preliminary Alternative WQ120

Group

Water Quality/Land Use

Title

Construct Delta Water Quality Facilities and Restore Existing Habitat

Improve Delta water quality primarily by modifying or constructing Delta physical facilities, and create habitat by restoring and enhancing existing habitat areas.

Key Actions

Delta Shallow Water Habitat Areas - Create new shallow water habitat by adding submerged berms to existing levees, filling selected deep areas, and reconstructing riverbanks to resemble their natural cross-sections.

Delta Upstream Habitats - Restore wetlands and other habitat elements in floodways to form ecological corridors. Protect and improve existing riparian lands for habitat and water quality, utilizing easements and purchase options.

Reduce Effects of Diversions - Reduce effects of diversions on Bay-Delta aquatic habitat quantity and quality by reducing and relocating in-Delta diversions, altering their timing to increase the quantities of instream flow available for habitat and dilution of contaminants, and improving fish screens. This affords flexibility to manage Delta inflows and exports to improve water quality for ecosystem and export needs.

Managing Water Quality - In-Delta and export water quality is improved by the construction of a through-Delta conveyance system. South Delta water quality is improved by the installation of tide gates, barriers, and salinity control structures (e.g., sills or weirs). Selected agricultural water quality management measures, such as those directed at drainage volume control, can reduce agricultural demands and increase in-Delta flows. Exporting agricultural drainage from the San Joaquin Valley to the least sensitive locations in the ocean or salt sinks will greatly reduce water quality problems in the San Joaquin River and southern Delta while minimizing impairment of agricultural lands and resultant losses in production.

Supporting Actions

Enhance Water Supplies - Expanding conjunctive use programs and expanding existing reservoir storage will increase water supplies and increase flexibility in the timing of diversions and exports.

Island and Levee Maintenance and Stabilization - Islands are stabilized primarily by large-scale infilling of the lowest areas with a suitable blend of inorganic soil and compost or clean dredged materials to restore interior elevations to near mean sea level. The protection of Delta levees will be oriented toward protecting the through-Delta conveyance system.

Core Actions

Bay-Delta Habitat Restoration - Support restoration of Bay-Delta habitat by implementing core actions including protecting existing shallow water habitat, restoring riverine habitat on channel islands, and implementing measures to curb further introductions of potentially harmful exotic species. Emphasis is on core actions that do not alter existing land uses.

Upstream Habitat Restoration - Support Restoration of upstream habitats by implementing core-level actions in high-priority areas such as managing flows and temperatures and restoring spawning gravel in upstream anadromous fish habitats, restoring sites for riparian vegetation, and improving fish passage at upstream barriers.

Reduction in Diversion Effects - Reduce diversion effects by implementing core actions such as installing fish barriers, improving salvage operations, and managing inflows and exports using real-time monitoring and adaptive management.

Management of Anadromous Fish - Improvements to the management of anadromous fish would be supported by core actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement.

Reductions in Diversion/Export Reliance - Support of key actions to reduce reliance on Delta diversions and exports would be provided by core actions such as educating users about reclamation, conservation, water pricing, and desalination feasibility; and by encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement - Support for key actions to enhance water supplies are provided by core actions to manage watersheds to protect water quality.

Increasing Water Supply Predictability - Increasing the predictability of water supplies would be achieved by implementing core actions such as facilitating water transfers, long-term planning for drought, establishing institutions for water management, and coordinating land use and water supply planning.

Management of Water Quality - Support key actions to improve water quality through core actions such as implementing source control regulations for agricultural drainage; retiring lands with drainage problems; and implementing other cost-effective actions to manage urban, industrial, and mine discharges and runoff.

Improvement to System Reliability/Vulnerability - Supplement key actions to improve the reliability of Delta levees by implementing core actions such as modifying agricultural practices to reduce subsidence and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be improved by actions that create and improve habitat, primarily in the existing channels, floodways, and other areas not currently used for economic purposes. Improvements are therefore limited in scope and may not produce all of the desired benefits. Modifying Delta and export diversions and increasing export capacities may reduce diversion-related impacts, maintain higher instream flows where and when needed for aquatic biota, and meet water quality requirements.

Water Supply and Conveyance - The ability to minimize ecological impacts is impaired by reliance on increased through-Delta conveyance. Equity actions are included to reduce adverse impacts where possible. Increased storage and reclamation will augment service-area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available. The overall improvement in the quality of diverted and delivered water supplies is in itself a benefit that helps to achieve equity. In addition, higher exports can be made when the flows are not needed for water quality.

Water Quality - Core and noncore actions would increase the quantity and quality of water available in the Delta for dependent economic and ecological needs, and change the timing of diversions to avoid periods of poorer water quality. Facilities and/or operations to modify Delta channel flows provide capabilities to change the flow split between the Sacramento and Mokelumne systems, flows toward the pumps, and inflows into the San Joaquin River distributaries to dilute contaminants and displace water of poor quality. Specifically, the actions would 1) serve to increase the quality and quantity of water available in the Delta thereby decreasing the concentrations of contaminants, 2) alter the distribution and timing of flows in the Delta making more water available in the system for dilution of contaminants and beneficial use, and 3) change the locations and timing of diversions to avoid periods of poor water quality and reduce entrainment of high numbers of fish.

System Reliability - Implementation of island infilling will allow existing agricultural land uses to continue while relieving a significant amount of hydrostatic pressure on the levee system. Maximum core-level levee maintenance actions will provide some additional protection against flood- and seismically induced levee failures, and reduce the risks of system-failure-induced shutdowns and export curtailments.

As submitted by Peter 12/20/95

Preliminary Alternative WQ 22

Group	*Title*
Water Quality/Land Use	**Construct Delta Water Quality Facilities and Maintain/Improve Resources Use**

Improve habitat and water quality, primarily by modifying or constructing Delta physical facilities, while maintaining existing land uses and minimizing impacts.

Key Actions

New shallow water habitat areas - create new shallow water habitat by adding submerged berms to existing levees, filling selected deep areas, and reconstructing riverbanks to resemble their natural cross-sections.

New and improved upstream habitats - restore wetlands and other habitat elements in floodways to form ecological corridors. Protect and improve existing riparian lands for habitat and water quality, utilizing easements and purchase options.

Reduce Effects of Diversions - reduce effects of diversions on Bay-Delta aquatic habitat quantity and quality by reducing and relocating in-Delta diversions, altering their timing to increase the quantities of instream flow available for habitat and dilution of contaminants, and improving fish screens. This affords flexibility to manage Delta inflows and exports to improve water quality for ecosystem and export needs. Facilities and/or operations to modify Delta channel flows provide capabilities to change the flow split between the Sacramento and Mokelumne systems, flows toward the pumps, and inflows into the San Joaquin River distributaries to dilute contaminants and displace water of poor quality. Modification of Delta and export diversions and increasing export capacities also improve capability to maintain higher instream flows where and when needed for aquatic biota and to meet water quality requirements. Equity is achieved because higher exports can be made when the flows are not needed for dilution.

Managing Water Quality - in-Delta and export water quality is improved by through-Delta conveyance. South Delta water quality is improved by tide gates, barriers and salinity control structures (such as sills or weirs). Some agricultural water quality management measures such as those directed at drainage volume control can reduce agricultural demands thereby increasing in-Delta flows. Exporting agricultural drainage from the San Joaquin Valley to the least sensitive locations in the ocean or salt sinks will greatly reduce water quality problems in the San Joaquin River and southern Delta while minimizing impairment of agricultural lands and resultant losses in production.

Island and Levee Maintenance and Stabilization - islands are stabilized primarily by large scale in filling of the lowest areas with a suitable blend of inorganic soil and compost, or clean dredged materials, to restore interior elevations to near MSL.

Supporting Actions

Enhance Water Supplies - conjunctive use and expanded existing reservoir storage actions selected to increase water supplies and maximize flexibility of diversion and export timing.

Increase Supply Predictability - supply predictability is improved for equity by increasing the capacity of North and South Delta channels, expanding Clifton Court Forebay to the north, and adding a northern intake. South Delta water stages and pumping capabilities are improved by tide gates. Export diversion capacity is also increased.

Core Actions

Bay-Delta Habitat Restoration - maximum level core actions include protecting existing shallow water habitat, restoring riverine habitat on channel islands, and implementing measures to curb further introductions of potentially-harmful exotic species. Emphasis is on core actions that do not alter existing land uses.

Existing upstream habitat areas - implement all remaining minimum impact, habitat-related core actions at maximum levels in targeted areas of potentially-high value to Delta species. Examples include managing flows and temperatures, restoring spawning gravels, improving existing degraded riparian habitats, and improving fish passage at upstream barriers.

Manage Contaminant Discharges and Maintain Adequate Dilution Flows - core actions maximized to reduce the quantities of contaminants entering the aquatic system thereby improving water quality in Bay-Delta receiving waters and associated aquatic habitats. Examples include implementing source controls for agricultural drainage, mine and industrial discharges, urban runoff, limited enlargements to existing reservoirs, and numerous demand reduction measures such as water conservation, temporary land fallowing, retirement incentives, free market pricing and water reclamation (the latter because it reduces the demand for Delta exports by providing substitute supplies). Water transfer core actions also can be timed and maximized so that the increased flows in upstream channels and the Delta dilute contaminants of concern. The overall improvement in the quality of diverted and delivered water supplies is a significant benefit.

Improving System Reliability - core actions to increase supply reliability in the service areas through implementation of integrated long term water management measures can reduce the need for upstream and Delta diversions and increase quantities of instream flow available for dilution.

Levee Maintenance and Stabilization - core actions that improve reliability of the existing levee system (notably levee stabilization actions and maintenance practices) are implemented at maximum levels. These actions can also improve water supply

predictability, as well as water quality (by reducing contaminant and sediment discharges), while still protecting existing land uses.

Preliminary Assessment

Ecosystem Quality - This would be addressed by actions and core measures that create and improve habitat with minimal land use impacts or conversions, primarily in the existing channels, floodways, and other areas not currently used for economic purposes. Improvements are therefore limited in scope and may not produce all of the desired benefits.

Water Supply and Conveyance - The ability to minimize ecological impacts is impaired by reliance on increased through-Delta conveyance. Equity actions are included to reduce adverse impacts where possible. Increased storage and reclamation will augment service area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available. The overall improvement in the quality of diverted and delivered water supplies is in itself a benefit that helps to achieve equity.

Water Quality - Core and non-core actions are maximized to improve water quantity and quality in Bay-Delta receiving and exported waters, and improve habitats, with minimal impacts on existing land uses. These actions would increase the quantity and quality of water available in the Delta for dependent economic and ecological needs, and change the timing of diversions to avoid periods of poorer water quality. Specifically, the actions would 1) serve to increase the quality and quantity of water available in the Delta thereby decreasing the concentrations of contaminants; 2) alter the distribution and timing of flows in the Delta making more water available in the system for dilution of contaminants and beneficial use; and 3) change the locations and timing of diversions to avoid periods of poor water quality and reduce entrainment of high fish populations. Overall quantities of contaminants entering the aquatic system are also reduced.

System Reliability - Implementation of the island in filling process will allow existing agricultural land uses to continue, while relieving a significant amount of hydrostatic pressure on the levee system. Maximum core levee maintenance actions will provide some additional protection against flood- and seismically-induced levee failures, and reduce the risks of system-failure-induced shutdowns and export curtailments.

ORIGINAL VERSION SUBMITTED BY P.S.L.

ELU:NEWG.WPG
120

Title: Improve habitat and improve in-Delta and export water quality, primarily with physical facilities in the Delta, while maintaining existing land uses to the maximum degree possible

Theme: Combine the themes of improving habitat quality and water quality
Subtheme: Modify physical facilities in the Delta and maintain existing land uses
Approach/primary purpose: Improve water quality to meet ecosystem and export requirements with minimal impacts on existing land uses

Solution overview: This alternative improves water quality for in-Delta economic and ecological needs by utilizing three types of actions that 1) serve to increase the quality and quantity of water available in the Delta thereby decreasing the concentrations of contaminants; 2) alter the distribution and timing of flows in the Delta making more water available in the system for dilution of contaminants and beneficial use; and 3) change the locations and timing of diversions to avoid periods of poor water quality and reduce entrainment of high fish populations. All core measures that reduce the quantities of contaminants entering the aquatic system are included because those actions support the main theme. Equity actions are included to reduce overall impacts, however Delta ecological impacts are difficult to mitigate. The overall improvement in the quality of diverted and delivered water supplies is a significant benefit.

Actions Selected:

Restore Bay-Delta Habitats:
Core and non-core actions maximized to improve water quantity and quality in Bay-Delta receiving and exported waters and improve habitats with minimal impacts on existing land uses.

Restore Upstream Habitats:
Core actions selected that improve water quality in Bay-Delta receiving waters and associated aquatic habitats.

Reduce Effects of Diversions:
Core and non-core actions selected to reduce effects of diversions on aquatic habitat quality in Bay-Delta waters by reducing and re-locating in-Delta diversions and altering their timing to increase the quantities of instream flow available for habitat and dilution of contaminants. This afforded some flexibility to manage Delta inflows and exports to improve water quality for ecosystem and export needs. Facilities and/or operations to modify Delta channel flows provide capabilities to change the flow split between the Sacramento and Mokelumne systems, flows toward the pumps, and inflows into the San Joaquin River distributaries to dilute contaminants and displace water of poor quality. Modification of Delta and export diversions and increasing export capacity also provide capability to maintain higher instream flows when needed to maintain water quality requirements where needed for aquatic biota. Equity is achieved because higher exports can be made when the flows are not needed for dilution.

Enhancement of Anadromous Fish Populations:
Core actions selected (this theme emphasized in other alts)

Reduce Reliance on Delta Exports:
Core actions selected to reduce reliance on Delta exports by implementing demand reducing actions such as water conservation, temporary land fallowing, retirement incentives, free market pricing and water reclamation (the latter because it reduces the demand for Delta exports by providing substitute supplies).

Enhance Water Supplies:
Conjunctive use and expanded existing reservoir storage actions selected to increase water supplies and maximize flexibility of diversion and export timing. Water transfer core actions also can be timed and maximized so that the increased flows in upstream channels and the Delta dilute contaminants of concern.

Increase Supply Predictability:
Supply predictability is improved by increasing the capacity of North and South Delta channels, expanding Clifton Court Forebay to the north, and adding a northern intake. South Delta water stages are improved by tide gates. Export diversion capacity is also increased. Core actions to increase supply reliability in the service areas through implementation of integrated long term water management measures can reduce the need for upstream and Delta diversions and increase quantities of instream flow available for dilution.

Managing Water Quality:
In-Delta and export water quality is improved by through Delta conveyance. South Delta water quality is improved by tide gates, barriers and salinity control structures (such as sills). Some agricultural water quality management measures such as those directed at drainage volume control can reduce agricultural demands. Exporting agricultural drainage to the least sensitive location in the ocean, or to a non-sensitive salt sink will greatly reduce water quality problems in the Delta and San Joaquin while minimizing losses and impairment of agricultural lands.

Improving System Reliability:
Some core actions that improve system reliability (notably levee stabilization actions and maintenance practices) can also improve water quality by reducing contaminant and sediment discharges, and protect existing land uses.

Preliminary Assessment:
This alternative would improve in-Delta and export water quality for ecological and service area needs by increasing the quantity and quality of water available in the Delta and changing the timing of diversions to avoid periods of poorer water quality. Overall quantities of contaminants entering the aquatic system are also reduced. The ability to minimize ecological impacts is impaired by reliance on increased through-Delta conveyance. Equity actions are included to reduce impacts where possible. Increased storage and reclamation will augment service area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available. The overall improvement in the quality of diverted and delivered water supplies is in itself a benefit that helps to achieve equity.

Preliminary Alternative WQ121

Group

Water Quality/Land Use

Title

Construct Delta Water Quality Facilities, Create New Habitat

Enhance water quality, primarily by modifying or constructing Delta physical facilities, and create new habitat by converting land currently used for economic purposes to habitat areas.

Key Actions

New Shallow Water Habitat Areas - Create new shallow water habitat by converting western Delta islands and diked wetlands into tidal wetlands (while improving or protecting existing levees). Aquatic habitat would also be constructed as part of the Delta water conveyance facilities.

New and Improved Upstream and Riparian Habitats - Restore Delta wetlands and riparian habitats by acquiring lands or easements, ensuring adequate water availability (including treated wastewaters), and replanting native species.

Construction and Improvement of Conveyance Facilities - Delta islands would be converted to a storage and conveyance system (the "chain-of-lakes alternative") extending from the northern diversion to the export pumps. The flooded islands would be connected by a series of inverted siphons with pump stations added where additional hydraulic head is needed.

Reduce Effects of Diversions - Reduce effects on Bay-Delta aquatic habitat quantity and quality by relocating and reducing in-Delta diversions, altering their timing and improving or constructing fish screens. The major benefit is achieved by relocating the export diversion from the current south-Delta site, which is subject to reversal of flows directly toward the pumps, to the north Delta or Sacramento River. Here diversions can be better timed to avoid fish migration periods, and bypass flows can be maintained past optimally designed fish screens.

Managing Water Quality - Improve export and in-Delta water quality by diverting higher quality Sacramento River water and making releases back into channels at selected Delta locations. Limited releases could be made to rapidly respond to water quality degradation in the Delta (e.g., from saltwater intrusion) at times when there would be no interference with anadromous fish migrations. South-Delta water quality would be improved by releases and by constructing tide gates, barriers, and salinity control structures (e.g., sills or weirs).

Island and Levee Maintenance and Stabilization - Reconstruct selected high-value levees and those protecting the island transfer system to protect against erosion, seepage, overtopping, and seismic failures. Use levee setbacks wherever needed and feasible.

Stabilize other islands with smaller scale levee improvements or large scale infilling of the lowest areas with suitable blends of inorganic soil and compost or clean dredged materials to restore interior elevations to near mean sea level.

Supporting Actions

Bay-Delta and Upstream Habitat Restoration - Core actions implemented at the maximum level to support key habitat restoration actions include protecting existing shallow water habitat, managing flows and temperatures, restoring channel configurations and spawning gravel, improving existing degraded riparian habitats, improving fish passage at upstream barriers, restoring riverine habitat on channel islands, and implementing measures to curb further introductions of potentially harmful exotic species.

Enhance Water Supplies - Conjunctive use and expanded existing reservoir storage actions were selected to increase water supplies and maximize flexibility of diversion and export timing.

Core Actions

Bay-Delta Habitat Restoration - All core actions are implemented at the maximum level in this alternative as described above under "Supporting Actions".

Existing Upstream Habitat Areas - All core actions are implemented at the maximum level in this alternative as described above under "Supporting Actions".

Reduction in Diversion Effects - Support key actions that reduce diversions with core actions such as installing fish barriers, improving salvage operations, and managing inflows and exports using real-time monitoring and adaptive management.

Management of Anadromous Fish - Improvements to the management of anadromous fish would be supported by core actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement.

Reductions in Diversion/Export Reliance - Support of key actions to reduce reliance on Delta diversions and exports would be provided by core actions such as educating users about reclamation, conservation, water pricing, and desalination feasibility; and by encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement - Support for key actions to enhance water supply are provided by core actions to encourage conjunctive use and manage watersheds to protect water quality.

Increasing Water Supply Predictability - Increasing the predictability of water supplies would be achieved by implementing core actions such as facilitating water transfers, long-

term planning for drought, establishing institutions for water management, and coordinating land use and water supply planning.

Management of Water Quality -Support key actions to improve water quality through core actions such as implementing source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective actions to manage urban, industrial, and mine discharges and runoff.

Improving System Reliability - Support for key actions to increase supply reliability in the service areas is provided by implementing core actions, such as integrated long-term water management measures, to reduce the need for upstream and Delta diversions and increase quantities of instream flow available for dilution.

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be greatly improved by actions that create new habitat and improve existing habitat, by the modification of the export diversion location, increasing export capacity, increased capability to make in-Delta releases of Sacramento River water, and by providing capabilities to release Delta channel flows when needed to maintain water quality requirements for in-Delta uses and aquatic biota. The major benefit is achieved by relocating the export diversion from the current South-Delta location to the north Delta or Sacramento River where diversions can be better timed to avoid fish migration periods and bypass flows can be maintained past new fish screens.

Water Supply and Conveyance - Supply predictability is greatly improved with this alternative because threatened and endangered species constraints on exports will be far less in magnitude and frequency. Increased storage and reclamation and increased availability of water transfers will augment service-area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available when needed.

Water Quality - This alternative would improve in-Delta and export water quality for ecological and service area needs by increasing the quantity and quality of water available in the Delta and by changing the timing of diversions to avoid periods of poorer water quality. Quantities of contaminants entering the aquatic system from upstream are also reduced, however some contaminants derived from Delta soils could enter the drinking water supply (particularly trihalomethanes). Overall in-Delta and export water quality is improved by direct access to, and releases of, higher quality Sacramento River water. Core actions are maximized to further improve water quantity and quality in Bay-Delta receiving and exported waters, and improve habitats. Specifically, the actions would 1) serve to increase the quality and quantity of water available in the Delta thereby decreasing the concentrations of contaminants, 2) alter the distribution and timing of flows in the Delta making more water available in the system for dilution of contaminants and beneficial use, and 3) change the locations and timing of diversions to avoid periods of poor water quality and reduce

entrainment of large numbers of fish. This affords flexibility to manage Delta inflows and exports to improve water quality for ecosystem and export needs.

System Reliability - The upgraded levees will greatly reduce flood overtopping and levee failure risks and associated water quality degradation potential. The probability of a prolonged shutdown of the water projects and local diversions will be greatly reduced. Implementation of the island infilling process will allow remaining agricultural, recreational, and associated land uses to continue, while relieving a significant amount of hydrostatic pressure on the levee system. Maximum core-level levee maintenance actions will provide additional protection against flood- and seismically induced levee failures and reduce future risks of system-failure-induced shutdowns and export curtailments.

As submitted by Peter
12/21/95

Preliminary Alternative WQ 21

Group	*Title*
Water Quality/Land Use	**Water Quality and Habitat Enhancement with Facilities and Land Use Conversions**

Enhance habitat and water quality, primarily by modifying or constructing Delta physical facilities and converting existing land uses, while minimizing adverse impacts.

Key Actions

New shallow water habitat areas - create new shallow water habitat by converting western Delta islands and diked wetlands into tidal wetlands (while improving or protecting existing levees), adding submerged berms to existing levees, filling selected deep areas, and reconstructing riverbanks to restore their natural cross-sectional profiles. Aquatic habitat also would be constructed as part of the Delta water conveyance facilities.

New and improved upstream and riparian habitats - restore wetlands and riparian habitats in floodways to form ecological corridors. Restore Delta wetlands and riparian habitats by acquiring lands or easements, ensuring adequate water availability (including treated wastewaters), and replanting native species.

Construction and Improvement of Conveyance Facilities - Delta islands would be converted to a storage and conveyance system (the "chain-of-lakes alternative") extending from the northern diversion to the export pumps. The flooded islands would be connected by a series of inverted siphons with pump stations added where additional head is needed.

Reduce Effects of Diversions - reduce effects on Bay-Delta aquatic habitat quantity and quality by relocating and reducing in-Delta diversions, altering their timing and improving or constructing fish screens. The major benefit is achieved by relocating the export diversion from the current South-Delta site, which is subject to reversal of flows directly toward the pumps, to the north Delta or Sacramento River, where diversions can be better timed to avoid fish migration periods and bypass flows can be maintained past optimally-designed fish screens. Modify facilities and/or operations to vary remaining Delta channel flows, particularly the flow split between the Sacramento and Mokelumne systems, flows toward the pumps, and inflows into the San Joaquin River distributaries, for the purposes avoiding entrainment, improving aquatic habitat, diluting contaminants, and displacing waters of poor quality. Modify Delta and export diversions and increase export capacities to improve capabilities to maintain higher instream flows where and when needed for aquatic biota and to meet water quality requirements. Achieve equity by permitting higher export rates when the flows are not needed for dilution.

Managing Water Quality - improve export and in-Delta water quality by diverting higher quality Sacramento River water and making releases back into channels at selected Delta

locations. Limited releases could be made to rapidly respond to water quality degradation in the Delta (e.g. from saltwater intrusion) at times when there would be no interference with anadromous fish migrations. South Delta water quality is improved by releases, tide gates, barriers and salinity control structures (such as sills). South Delta water quality is improved by tide gates, barriers and salinity control structures (such as sills or weirs). Retire agricultural lands with drainage problems to eliminate large volumes and sources of salt loads reaching the Delta. Utilize existing evaporation ponds for storage of agricultural drainage and release it only during periods of high instream flows.

Island and Levee Maintenance and Stabilization - reconstruct selected high value levees and those protecting the island transfer system to protect against erosion, seepage, overtopping and seismic failures. Use levee setbacks wherever needed and feasible. Stabilize other islands with smaller scale levee improvements or large scale in-filling of the lowest areas with suitable blends of inorganic soil and compost, or clean dredged materials, to restore interior elevations to near MSL.

Supporting Actions

Bay-Delta Habitat Restoration - maximum level core actions include protecting existing shallow water habitat, restoring riverine habitat on channel islands, and implementing measures to curb further introductions of potentially-harmful exotic species.

Enhance Water Supplies - conjunctive use and expanded existing reservoir storage actions selected to increase water supplies and maximize flexibility of diversion and export timing.

Increase Supply Predictability - supply predictability is improved for equity by increasing the capacity of North and South Delta channels, expanding Clifton Court Forebay to the north, and adding a northern intake. South Delta water stages and pumping capabilities are improved by tide gates. Export diversion capacity is also increased.

Core Actions

Existing upstream habitat areas - implement all remaining complementary, habitat-related core actions at maximum levels in targeted areas of potentially-high value to Delta species. Examples include managing flows and temperatures, restoring channel configurations and spawning gravels, improving existing degraded riparian habitats, and improving fish passage at upstream barriers.

Manage Contaminant Discharges and Maintain Adequate Dilution Flows - core actions maximized to reduce the quantities of contaminants entering the aquatic system thereby improving water quality in Bay-Delta receiving waters and associated aquatic habitats. Examples include implementing source controls for agricultural drainage constituents, mine and industrial discharges, urban runoff, limited enlargements to existing

reservoirs, and numerous demand reduction measures such as water conservation, temporary land fallowing, retirement incentives, free market pricing and water reclamation (the latter because it reduces the demand for Delta exports by providing substitute supplies). Water transfer core actions also can be timed and maximized so that the increased flows in upstream channels and the Delta dilute contaminants of concern. The overall improvement in the quality of diverted and delivered water supplies is a significant benefit.

Manage Agricultural Drainage - Agricultural water quality management measures directed at subsurface drainage volume control will reduce agricultural demands thereby increasing in-Delta flows and inflows, and reduce drainage. Other measures, such as those directed at the elimination of pesticides from tailwaters, also can reduce agricultural water supply demands on the Delta and improve the quality of Delta inflows.

Improving System Reliability - core actions to increase supply reliability in the service areas through implementation of integrated long term water management measures can reduce the need for upstream and Delta diversions and increase quantities of instream flow available for dilution.

Preliminary Assessment.

Equity actions are included to reduce or eliminate impacts where possible, however in-Delta losses of economic land uses can only be mitigated by payments or land trades. Increased storage (including in-Delta) and reclamation will augment service area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available. The overall improvement in the quality of diverted and delivered water supplies is in itself a benefit that helps to achieve equity. The volume and salt load in agricultural drainage will be greatly reduced due to the improved quality of irrigation water. A "Chain-of-Lakes" system is more vulnerable to failure than a peripheral isolated facility located on stable soils, but a major improvement over the existing system.

Ecosystem Quality - This would be addressed by actions and core measures that create and improve habitat. Modification of export diversion location and increasing export capacity coupled with the capability to make in-Delta releases of Sacramento River water, provide capabilities to release Delta channel flows when needed to maintain water quality requirements for in-Delta uses and aquatic biota. The major benefit is achieved by relocating the export diversion from the current South-Delta location to the north Delta or Sacramento River, where diversions can be better timed to avoid fish migration periods and bypass flows can be maintained past new fish screens.

Water Supply and Conveyance - Supply predictability is greatly improved with this alternative because threatened and endangered species constraints on exports will be far less in magnitude and frequency. Increased storage and reclamation will augment service

area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available when needed.

Water Quality - This alternative would improve in-Delta and export water quality for ecological and service area needs by increasing the quantity and quality of water available in the Delta and changing the timing of diversions to avoid periods of poorer water quality. Quantities of contaminants entering the aquatic system from upstream are also reduced, however some contaminants derived from Delta soils could enter the drinking water supply (particularly THMs). Overall in-Delta and export water quality is improved by direct access to, and releases of, higher quality Sacramento River water. Core actions are maximized to further improve water quantity and quality in Bay-Delta receiving and exported waters, and improve habitats. Specifically, the actions would 1) serve to increase the quality and quantity of water available in the Delta thereby decreasing the concentrations of contaminants; 2) alter the distribution and timing of flows in the Delta making more water available in the system for dilution of contaminants and beneficial use; and 3) change the locations and timing of diversions to avoid periods of poor water quality and reduce entrainment of high fish populations. This affords flexibility to manage Delta inflows and exports to improve water quality for ecosystem and export needs.

System Reliability - The upgraded levees will greatly reduce flood overtopping and levee failure risks and associated water quality degradation potential. The probability of a prolonged shutdown of the water projects and local diversions will be greatly reduced. Implementation of the island in filling process will allow remaining agricultural, recreational and associated land uses to continue, while relieving a significant amount of hydrostatic pressure on the levee system. Maximum core levee maintenance actions will provide additional protection against flood- and seismically-induced levee failures, and reduce future risks of system-failure-induced shutdowns and export curtailments.

ORIGINAL
SUBMITTED BY P.S.L

CLAIMS NO.
121

Title: Improve habitat and improve in-Delta and export water quality, primarily with physical facilities in the Delta, while allowing the conversion of existing land uses if beneficial.

Theme: Combine the themes of improving habitat quality and water quality
Subtheme: Modify in-Delta physical facilities and preserve or enhance beneficial water uses
Approach/primary purpose: Improve water quality to meet ecosystem and export requirements, allowing some conversion of existing land uses if beneficial, imposing minimum adverse impacts

Solution overview: This alternative improves water quality for in-Delta economic and ecological needs by utilizing three types of actions that 1) serve to increase the quality and quantity of water available in the Delta thereby decreasing the concentrations of contaminants; 2) alter the distribution and timing of flows in the Delta making more water available in the system for dilution of contaminants and beneficial use; and 3) change the locations and timing of diversions to avoid periods of poor water quality and generally avoid entrainment of fish populations. Core measures that reduce the quantities of contaminants entering the aquatic system are included because those actions support the main theme. Equity actions are included to reduce overall impacts and Delta ecological impacts are mitigated by moving the diversion location toward the North Delta or Sacramento River. Overall improvement in the quality of diverted and delivered water supplies is near the maximum level short of a Valley conveyance such as the East-Valley Canal.

Actions Selected:

Restore Bay-Delta Habitats:
Core and non-core actions maximized to improve water quantity and quality in Bay-Delta receiving and exported waters and improve habitats, allowing conversion of existing land uses with minimal impacts. Agricultural lands would be returned to open water aquatic habitat usable by fish and waterfowl, and there would be a major opportunity to include other types of wetland habitat in an comprehensive alternative. Large segments of the Delta would look more like their original condition.

Restore Upstream Habitats:
Core actions selected that improve water quality in Bay-Delta receiving waters and associated aquatic habitats.

Reduce Effects of Diversions:
Modification of export diversion location and increasing export capacity, while providing capability to make in-Delta releases of Sacramento River water, provide capability to release Delta channel flows into the central Delta (north-south axis) when needed to maintain water quality requirements for in-Delta uses and aquatic biota. The major benefit is achieved by relocating the export diversion from the current South-Delta location which is subject to reversal of flows directly toward the pumps, to the north, where diversions can be better timed to avoid fish migration periods and bypass flows can be maintained past new fish screens. Core and non-

core actions also selected to reduce effects of diversions on aquatic habitat quality in Bay-Delta waters by reducing and re-locating in-Delta diversions and altering their timing to increase the quantities of instream flow available for habitat and dilution of contaminants. Maximum flexibility is achieved to manage Delta inflows and exports to improve water quality for both ecosystem and export needs. Facilities and/or operations to modify in-Delta channel flows provide capabilities to change the flow split between the Sacramento and Mokelumne systems, and inflows into the San Joaquin River distributaries, to dilute contaminants and displace water of poor quality. Equity is achieved because higher exports can be made when the flows are not needed for dilution.

Enhancement of Anadromous Fish Populations:
Core actions selected (this theme emphasized in other alts)

Reduce Reliance on Delta Exports:
Core actions selected to reduce reliance on Delta exports by implementing demand reducing actions such as water conservation, temporary land fallowing, retirement incentives, free market pricing and water reclamation (the latter because it reduces the demand for Delta exports by providing substitute supplies).

Enhance Water Supplies:
Conjunctive use and expanded existing reservoir storage actions selected to increase water supplies and maximize flexibility of diversion and export timing. Water transfer core actions also can be timed and maximized so that the increased flows in upstream channels and the Delta dilute contaminants of concern.

Increase Supply Predictability:
Supply predictability is improved by location of the northern intake where threatened and endangered species constraints are far less in magnitude and frequency. Export diversion capacity is also increased. South Delta water stages are improved by tide gates and/or releases from Delta storage islands. Core actions to increase supply reliability in the service areas through implementation of integrated long term water management measures can reduce the need for upstream and Delta diversions and increase quantities of instream flow available for dilution.

Managing Water Quality:
In-Delta and export water quality is improved by direct access to, and releases of, higher quality Sacramento River water. Limited releases could be made to rapidly respond to water quality degradation in the Delta (e.g. from saltwater intrusion). South Delta water quality is improved by releases, tide gates, barriers and salinity control structures (such as sills). Some agricultural water quality management measures such as those directed at drainage volume control can reduce agricultural demands. Exporting agricultural drainage to the least sensitive location in the ocean, or to a non-sensitive salt sink will greatly reduce water quality problems in the Delta and San Joaquin while minimizing losses and impairment of agricultural lands. The volume and salt load will be greatly reduced due to the improved quality of irrigation water.

Improving System Reliability:

Some core actions that improve system reliability (notably levee stabilization actions and maintenance practices) can also improve water quality by reducing contaminant and sediment discharges, and protect existing land uses. The reliability of the system as far as vulnerability to catastrophic levee failure is much less, because of hydrostatic equilibrium and the filling of voids into which salt water would otherwise rush. However, a "Chain-of-Lakes" system is more vulnerable to failure than a peripheral isolated facility located on stable soils.

Preliminary Assessment:
Modification of export diversion location and increasing export capacity coupled with the capability to make in-Delta releases of Sacramento River water, provide capabilities to release Delta channel flows when needed to maintain water quality requirements for in-Delta uses and aquatic biota. The major benefit is achieved by relocating the export diversion from the current South-Delta location to the north Delta or Sacramento River, where diversions can be better timed to avoid fish migration periods and bypass flows can be maintained past new fish screens. Supply predictability is improved at this location because threatened and endangered species constraints are far less in magnitude and frequency. This alternative would improve in-Delta and export water quality for ecological and service area needs by increasing the quantity and quality of water available in the Delta and changing the timing of diversions to avoid periods of poorer water quality. Quantities of contaminants entering the aquatic system from upstream are also reduced, however some contaminants derived from Delta soils could enter the drinking water supply (particularly THMs). Overall in-Delta and export water quality is improved by direct access to, and releases of, higher quality Sacramento River water. Equity actions are included to reduce or eliminate impacts where possible, however in-Delta losses of economic land uses can only be mitigated by payments or land trades. Increased storage (including in-Delta) and reclamation will augment service area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available. The overall improvement in the quality of diverted and delivered water supplies is in itself a benefit that helps to achieve equity. The volume and salt load in agricultural drainage will be greatly reduced due to the improved quality of irrigation water. A "Chain-of-Lakes" system is more vulnerable to failure than a peripheral isolated facility located on stable soils, but a major improvement over the existing system.

Preliminary Alternative WQ122

Group	*Title*
Water Quality/Land Use	**Constructing Delta Water Quality Facilities, Restoring Existing and Creating New Habitat**

Enhance water quality primarily by modifying or constructing Delta physical facilities, and create habitat by balancing the preservation and enhancement of existing habitats with the creation of new habitats by converting land currently used for economic purposes into habitat areas.

Key Actions

New Shallow Water Habitat Areas - Create new shallow water habitat by returning one or two of the most vulnerable western Delta islands to tidal wetlands. Add submerged berms to existing levees, fill selected deep areas, and reconstruct riverbanks to restore their natural cross-sectional profiles. Aquatic habitat would also be constructed as part of the Delta water conveyance facilities.

New and Improved Upstream and Riparian Habitats - restore wetlands and riparian habitats in floodways to form ecological corridors. Restore Delta wetlands and riparian habitats by acquiring lands or easements, ensuring adequate water availability (including treated wastewaters), and replanting native species.

Construction and Improvement of Conveyance Facilities - Construct a small-, medium-, or large-capacity isolated transfer facility on stable mineral soils around the eastern and southeastern edges of the Delta to serve the State Water Project or combined State Water Project/Central Valley Project. Canal releases to Delta channels would require a large intake size and channel capacity. The canal segments would be connected by a series of inverted siphons beneath points of significant Delta inflows with pump stations located where additional hydraulic head is needed.

Reduce Effects of Diversions - Reduce effects on Bay-Delta aquatic habitat quantity and quality by relocating and reducing in-Delta diversions, altering their timing, and improving or constructing fish screens. The major benefit is achieved by relocating the project export diversions from the current south-Delta site, which is subject to reversal of flows directly toward the pumps, to the north Delta or Sacramento River, where diversions can be better timed to avoid fish migration periods and bypass flows can be maintained past optimally designed fish screens. Modify facilities and/or operations to vary remaining Delta channel flows, particularly the flow split between the Sacramento and Mokelumne systems, flows toward the pumps, and inflows into the San Joaquin River distributaries, for the purposes of avoiding entrainment, improving aquatic habitat, diluting contaminants, and displacing waters of poor quality. Modify Delta and export diversions and increase export capacities

to improve capabilities to maintain higher instream flows where and when needed for aquatic biota and to meet water quality requirements. Achieve equity by permitting higher export rates when the flows are not needed for dilution.

Managing Water Quality - Improve export and in-Delta water quality by diverting higher quality Sacramento River water and making releases back into channels at selected Delta locations. Releases could be made to rapidly respond to water quality degradation in the Delta (e.g., from saltwater intrusion) at times and locations when and where there would be no interference with anadromous fish migrations. South Delta water quality is improved by releases from the conveyance facility, tide gates, barriers, and salinity control structures (e.g., sills or weirs).

Conjunctive Use and Additional Storage - Utilize expanded groundwater storage actions and conjuctive use to increase water supplies and maximize flexibility of diversion and export timing. Expand existing reservoir storage to accommodate additional Delta diversions and provide additional water supplies for use during dry and critical periods.

Supporting Actions

Bay-Delta Habitat Restoration - Core actions implemented at the maximum level include protecting existing shallow water habitat, restoring riverine habitat on channel islands, and implementing measures to curb further introductions of potentially harmful exotic species.

Existing Upstream Habitat Areas - All complementary habitat-related core actions will be implemented at maximum levels in targeted areas of potentially high value to Delta species. Examples include managing flows and temperatures, restoring channel configurations and spawning gravel, improving existing degraded riparian habitats, and improving fish passage at upstream barriers.

Island and Levee Maintenance and Stabilization - Construct levees built to U.S. Army Corps of Engineers standards to protect the isolated facility. Reconstruct selected high-value levees and those protecting the western Delta wetlands to protect against erosion, seepage, overtopping, and seismic failures. Minimize use of levee setbacks to avoid preemption of existing land uses. Stabilize other islands with smaller scale levee improvements or large scale infilling of the lowest areas with suitable blends of inorganic soil and compost, or clean dredged materials, to restore interior elevations to near mean sea level.

Core Actions

Bay-Delta Habitat Restoration - All core actions are implemented at the maximum level in this alternative as described above under "Supporting Actions".

Existing Upstream Habitat Areas - Restoration of upstream habitats would be supported implementing core-level actions in high-priority areas, such as managing flows and

temperatures and restoring spawning gravel in upstream anadromous fish habitats, restoring sites for riparian vegetation, and improving fish passage at upstream barriers.

Reduction in Diversion Effects - Support key actions that reduce diversions with core actions such as installing fish barriers, improving salvage operations, and managing inflows and exports using real-time monitoring and adaptive management.

Management of Anadromous Fish - Improvements to the management of anadromous fish would be supported by core actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement.

Reductions in Diversion/Export Reliance - Support of key actions to reduce reliance on Delta diversions and exports would be provided by core actions such as educating users about reclamation, conservation, water pricing, and desalination feasibility; and by encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement - Support for key actions to enhance water supply are provided by core actions to encourage conjunctive use and manage watersheds to protect water quality.

Increasing Water Supply Predictability - Increasing the predictability of water supplies would be achieved by implementing core actions such as facilitating water transfers, long-term planning for drought, establishing institutions for water management, and coordinating land use and water supply planning.

Management of Water Quality - Support key actions to improve water quality through core actions such as implementing source control regulations for agricultural drainage; retiring lands with drainage problems; and implementing other cost-effective actions to manage urban, industrial, and mine discharges and runoff.

Improving System Reliability - Support for key actions to increase supply reliability in the service areas is provided by implementing core actions such as integrated long-term water management measures can reduce the need for upstream and Delta diversions and increase quantities of instream flow available for dilution.

Preliminary Assessment

Ecosystem Quality - Ecosystem quality would be greatly improved by this alternative. The major benefit is achieved by relocating the export diversion from the current south-Delta location to the Sacramento River, where diversions can be better timed to avoid fish migration periods and bypass flows can be maintained past new fish screens. This alternative would improve in-Delta and export water quality for ecological and out-of-stream needs by increasing the quantity and quality of water available in the Delta and changing the timing of diversions to avoid periods of poorer water quality. Modifying export diversion locations and increasing export capacity coupled with the capability to make in-Delta releases of Sacramento River water (when there would be no interference with anadromous fish

migrations) provide capabilities to release Delta channel flows when needed to maintain water quality requirements for in-Delta uses and aquatic biota.

Water Supply and Conveyance - Supply predictability is greatly improved with this alternative because there will be virtually no threat of interruption as a result of Delta levee failures, and threatened and endangered species constraints on exports will be far less in magnitude and frequency. Increased storage and reclamation will augment service-area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available when needed.

Water Quality - Modification of export diversion locations and increasing export capacity coupled with the ability to make peripheral Delta releases of Sacramento River water, provide capabilities to release Delta channel flows where and when needed to maintain water quality requirements for in-Delta uses and aquatic biota. This alternative would improve in-Delta and export water quality for ecological and service area needs by increasing the quantity and quality of water available in the Delta and changing the timing of diversions to avoid periods of poorer water quality. Quantities of contaminants entering the aquatic system from upstream are also reduced.

System Reliability - The probability of a prolonged shutdown of the water projects and local diversions will be greatly reduced. Implementation of selected island infilling will allow remaining agricultural, recreational, and associated land uses to continue, while relieving a significant amount of hydrostatic pressure on the levee system. Maximum core-level levee maintenance actions will provide additional protection against flood- and seismically induced levee failures, and reduce future risks of system-failure-induced shutdowns and export curtailments.

As submitted by Pete
12/21/95

Preliminary Alternative WQ 22

Group
Water Quality/Land Use

Title
Water Quality and Habitat Enhancement with Facilities and Balanced Conversions

Enhance habitat and water quality, primarily by modifying or constructing Delta physical facilities and balancing the maintenance and conversion of existing land uses, while minimizing adverse impacts.

Key Actions

New shallow water habitat areas - create new shallow water habitat by returning one or two of the most vulnerable western Delta islands to tidal wetlands. Add submerged berms to existing levees, fill selected deep areas, and reconstruct river banks to restore their natural cross-sectional profiles. Aquatic habitat also would be constructed as part of the Delta water conveyance facilities.

New and improved upstream and riparian habitats - restore wetlands and riparian habitats in floodways to form ecological corridors. Restore Delta wetlands and riparian habitats by acquiring lands or easements, ensuring adequate water availability (including treated wastewaters), and replanting native species.

Construction and Improvement of Conveyance Facilities - construct a small, medium or large capacity peripheral canal on stable mineral soils around the eastern and south-eastern edges of the Delta to serve the SWP or combined SWP/CVP. Canal releases to Delta channels would be an optional feature requiring enlarged intake size and channel capacity. The canal segments would be connected by a series of inverted siphons beneath points of significant Delta inflows with pump stations located where additional head is needed.

Reduce Effects of Diversions - reduce effects on Bay-Delta aquatic habitat quantity and quality by relocating and reducing in-Delta diversions, altering their timing and improving or constructing fish screens. The major benefit is achieved by relocating the project export diversions from the current South-Delta site, which is subject to reversal of flows directly toward the pumps, to the north Delta or Sacramento River, where diversions can be better timed to avoid fish migration periods and bypass flows can be maintained past optimally-designed fish screens. Modify facilities and/or operations to vary remaining Delta channel flows, particularly the flow split between the Sacramento and Mokelumne systems, flows toward the pumps, and inflows into the San Joaquin River distributaries, for the purposes avoiding entrainment, improving aquatic habitat, diluting contaminants, and displacing waters of poor quality. Modify Delta and export diversions and increase export capacities to improve capabilities to maintain higher instream flows where and when needed for aquatic biota and to meet water quality requirements. Achieve equity by

permitting higher export rates when the flows are not needed for dilution.

Managing Water Quality - improve export and in-Delta water quality by diverting higher quality Sacramento River water and making releases back into channels at selected Delta locations. Releases could be made to rapidly respond to water quality degradation in the Delta (e.g. from saltwater intrusion) at times and locations when and where there would be no interference with anadromous fish migrations. South Delta water quality is improved by releases, tide gates, barriers and salinity control structures (such as sills or weirs).

Conjunctive Use and Additional Storage - Utilize expanded groundwater storage actions and conjuctive use to increase water supplies and maximize flexibility of diversion and export timing. Expand existing reservoir storage to accommodate additional Delta diversions and provide additional water supplies for use during dry and critical periods.

Managing Agricultural Drainage - Exporting agricultural drainage from the San Joaquin Valley to the least sensitive locations in the ocean or salt sinks will greatly reduce water quality problems in the San Joaquin River and southern Delta while minimizing impairment of agricultural lands and resultant losses in production. Fallow, or provide incentives to retire agricultural lands with drainage problems to reduce volumes and sources of salt loads requiring export or reaching the Delta. Utilize existing evaporation ponds for storage of agricultural drainage and release it only during periods of high instream flows.

Island and Levee Maintenance and Stabilization - Project levees will protect the isolated facility. Reconstruct selected high value levees and those protecting the western Delta wetlands to protect against erosion, seepage, overtopping and seismic failures. Minimize use of levee setbacks to avoid pre-emption of existing land uses. Stabilize other islands with smaller scale levee improvements or large scale in-filling of the lowest areas with suitable blends of inorganic soil and compost, or clean dredged materials, to restore interior elevations to near MSL.

Supporting Actions

Bay-Delta Habitat Restoration - maximum level core actions include protecting existing shallow water habitat, restoring riverine habitat on channel islands, and implementing measures to curb further introductions of potentially-harmful exotic species.

Existing upstream habitat areas - implement all complementary, habitat-related core actions at maximum levels in targeted areas of potentially-high value to Delta species. Examples include managing flows and temperatures, restoring channel configurations and spawning gravels, improving existing degraded riparian habitats, and improving fish passage at upstream barriers.

Enhance Water Supplies - water transfer core actions also can be timed and maximized so that the increased flows in upstream channels and the Delta dilute contaminants of concern.

Section 3. Alternatives from Water Supply Team

B–E

Bookman-Edmonston Engineering, Inc.

FAX TRANSMITTAL SHEET

DATE: December 14, 1995	TIME: 4:45 pm
TO: Peter Mangerella ~~Dean Ruiz~~ Russ Brown ~~cc: Jordan Lang~~	RECEIVING FAX NO. (510) 874-3268 (916) 924-9102 (916) 737-3030

MESSAGE:

Enclosed is a list of the alternatives our group is in the process of developing. Note the new numbering system. This might be slightly different than what we discussed yesterday. If so, adjust accordingly. I have sent a copy to Ron, at his request.

I have not received a revised format so proceed with our existing format until we hear otherwise.

Please bring electronic copies of your alternatives to the Monday meeting.

Call me if you have any questions, at 852-8050.

FROM: Larry J. Rodriguez	WORK ORDER #: 7500.04
OPERATOR NAME: Sharon R. Parr	
NUMBER OF PAGES (including cover sheet):	

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Please contact the operator listed above at 916/852-5080 if you have problems with this transmittal.

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n = 30

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✓=rec'd from Larry R. 12-19-95

WATER SUPPLY ALTERNATIVES

THEME: Reduce Competition for Water During Critical Periods by Reducing Demands.

Sub-themes:

✓ 201) Reduce demands in the Export Area (conservation/reclamation).
✓ 202) Reduce demands upstream and in the Delta (conservation/reclamation including actions to improve the facilitation of transfers).
✓ 203) Reduce Demands in all areas (conservation/reclamation and transfers).

✓ 204) Reduce demands for Delta outflow.
✓ 205) Reduce instream flow requirements.
✓ 206) Reduce demands for Delta outflow and instream flow requirements.

THEME: Reduce Competition for Water During Critical Periods by Increasing Supply Availability.

Sub-themes:

JSA 201 ✓ 207) Increase storage in the export area (off-stream and groundwater). ?
✓ 208) Increase storage in areas upstream of the Delta (off-stream and on-stream). ✓
✓ 209) Increase storage within the Delta (island storage for export and environmental water).
✓ 210) Increase ground and surface water conjunctive use storage.
✓ 211) Increase storage in all areas.

✓ 212) Relocate diversions to increase supplies.
✓ 213) Develop an isolated transfer/conveyance facility. ✓
✓ 214) Develop a combination storage/conveyance facility through the Delta (chain-of-lakes idea) ✓
✓ 215) Increase pumping/conveyance capacities of export facilities. ✓
✓ 216) Reoperate existing reservoirs to increase yield.

Combinations of Sub-Themes to Reduce Demand and Increase Supply.

217). Reduce demands in all areas (203) and develop an isolated transfer facility (213).
- Increase ability to convey conserved water through the Delta. Additional supplies created through conservation and reclamation.

✓ 218) Reduce demands in all areas (203) and develop an in-Delta storage facility (209).
- Water developed through conservation would be managed for export and Delta needs with an in-Delta storage facility.

✓ 219) Reduce demands in all areas (203) and increase storage upstream of the Delta (208).
- Water developed through conservation would be managed for export and Delta needs with upstream storage facilities.

220) Reduce demands for Delta outflow and instream flow requirements (206) and increase storage within the Delta (209).
- Additional supplies developed from reduced environmental demands would be partially regulated with an in-Delta storage facility (emphasizes adaptive management practices for in-Delta storage facility).

221) Reduce demands for Delta outflow and instream flow requirements (206) and develop an isolated transfer/conveyance facility (213 or 212).
- Additional supplies developed from reduced environmental demands would be partially managed through the isolated transfer/conveyance facility (emphasizes adaptive management practices).

222) Reduce demands for Delta outflow and instream flow requirements (206) and develop an isolated transfer facility plus an in-Delta storage facility (213 and 209, or 212).
- Additional supplies developed from reduced environmental demands would be managed with an in-Delta storage facility and isolated transfer/conveyance facility (emphasizes adaptive management practices).

223) Increase storage capacity in the export areas (207) and develop an isolated transfer/conveyance facility (213 or 212).
- Increase efficiency of water movement through the Delta and increase the capacity to store flows that are currently bypassed due to lack of storage capacity.

224) Increase storage capacity in the export areas (207) and increase pumping and conveyance capacities of export facilities (214).
- Increase the ability to capture flood/winter flows in the Delta.

225) Increase storage capacity in the export areas (207) and increase in-Delta storage capacity (209 or 212).
- Increase the ability to capture flood/winter flows in the Delta and manage the export of that water.

226) Increase the storage in the areas upstream of the Delta (209) and develop an isolated transfer/conveyance facility (213 or 212).
- Allow for greater management of watershed runoff (increase yield / reduce flood control losses) and provide an efficient means to convey water through the Delta.

227) Increase the **off-stream** storage capacity in the areas upstream of the Delta (209) and develop an isolated eastside transfer/conveyance facility (variation of 213).
- Large westside storage/conveyance idea.

228) Increase storage in all areas (211) and develop an isolated transfer/conveyance facility (213 or 212).
- Increase yield and storage management capabilities as well as improve the efficiency of water movement through the Delta.

229) Increase storage in all areas (211) and increase the pumping/conveyance capacity of export facilities (215).
- Increase yield and storage management capabilities and the ability to move water out of the Delta.

Note: ***All of the above alternatives are primarily Sacramento Valley projects, the only alternative which is distinctly San Joaquin Valley is shown below.***

230) Increase storage (variation of 208) and conveyance (variation of 213) along the eastside San Joaquin Valley (on & off-stream storage with an isolated conveyance facility).
- Increase ability to capture, manage. and convey water along the east side of the San Joaquin Valley to provide increased supplies for supply and environmental water.

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY REDUCING DEMAND (Alternative 201)

Theme: Demand reduction
Sub theme: In export area only
Approach: Conservation/reclamation, water marketing, land use planning

SOLUTION OVERVIEW

Future increases in water needs in the export area are envisioned in response to anticipated population increases. This alternative is intended minimize future water needs in the export area to the maximum extent practicable by aggressive demand management, water marketing, and water pricing in the export area. It is felt that the combination of demand management actions and more efficient water marketing actions are synergistic and will lead to a more efficient utilization of the existing resource. This alternative therefore emphasizes actions such as conservation, reclamation, pricing, water transfers, and land use planning and conversion. This alternative is considered a default alternative that would likely be required as part of the NEPA/CEQA requirements.

ACTIONS SELECTED

Bay-Delta Habitat Restoration
no actions above core actions were selected in this category

Upstream Habitat Restoration
no actions above core actions were selected in this category

Reduction in Diversion Effects
no actions above core actions were selected in this category

Management of Anadramous Fish
no actions above core actions were selected in this category

Reduction in Export Reliance
The principal thrust of this alternative is to reduce export reliance by improved utilization and reuse of water in the export area. Many of the actions in this alternative are core actions which would be implemented at the maximum level. Conservation would be implemented by agricultural, undustrial, and municipal users. Reclamation of municipal waste water and agricultural drainage water would supplement supplies for potable and nonpotable uses, including irrigation. To increase the options to water users, this alternative would encourage actions to facilitate water marketing and a market-driven pricing structure. Improved land use

planning based on water availability and actions that would encourage land retirement and fallowing during drought periods would be undertaken under this option.

Water Supply Enhancement Predictability
This alternative will enhance water supply predicability in export areas by providing multiple water supply options and relying less on delta exports.

Management of Water Quality
no actions above core actions were selected in this category

Improvements to System Reliability/Vulnerability
no actions above core actions were selected in this category

PRELIMINARY ASSESSMENT

Ecosystem Quality
Indirect benefits to ecosystem quality will be achieved by limiting future increases in delta exports.

Water Supply Reliability
This alternative would enhance water supply reliability by encouraging reuse of existing Delta and non-Delta supplies and facilitating water transfers.

Water Quality
Indirect benefits to water quality will be achieved by limiting future increases in delta exports.

System Vulnerability
This alternative would not yield direct benefits to system vulnerability.

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY REDUCING DEMAND (alternative 202)

Theme: Demand reduction
Sub theme: In and upstream of Delta only
Approach: Conservation/reclamation and water marketing

SOLUTION OVERVIEW

This alternative is intended to increase the supply and reliability of Delta exports by reducing agricultural and urban demand in and upstream of the Delta. This alternative combines demand management actions and more efficient water marketing actions as these are synergistic and will lead to a more efficient utilization of the existing resource. This alternative therefore emphasizes actions such as conservation, reclamation, pricing, water transfers, and land use planning and conversion. This alternative may lead to reduced diversions in and upstream of the Delta and, in response, may necessitate reoperational actions for upstream reservoirs. Indirect environmental benifits should accrue from this alternative because of reduced diversions.

ACTIONS SELECTED

Bay-Delta Habitat Restoration
no actions above core actions were selected in this category

Upstream Habitat Restoration
no actions above core actions were selected in this category

Reduction in Diversion Effects
no actions above core actions were selected in this category

Management of Anadramous Fish
no actions above core actions were selected in this category

Reduction in Export Reliance
no actions above core actions were selected in this category

Water Supply Enhancement Predictability

The principal thrust of this alternative is to enhance water supply predictability by improved utilization and reuse of water in and upstream of the Delta. Many of the actions in this alternative are core actions which would be implemented at the maximum level. Conservation would be implemented by agricultural, undustrial, and municipal users. Reclamation of

municipal waste water and agricultural drainage water would supplement supplies for potable and nonpotable uses, including irrigation. To increase the options to water users, this alternative would encourage actions to facilitate water marketing and a market-driven pricing structure. Improved land use planning based on water availability and actions that would encourage land retirement and fallowing during drought periods would be undertaken under this option.

Management of Water Quality
no actions above core actions were selected in this category

Improvements to System Reliability/Vulnerability
no actions above core actions were selected in this category

PRELIMINARY ASSESSMENT

Ecosystem Quality
Enhanced by virtue of reduced diversions upstream and in Delta; benefits possibly offset by increased exports.

Water Supply Reliability
This alternative would increase water supply reliablity by reducing demand in and upstream of Delta. In order to capitalize on achieved demand reduction, may need to reoperate existing upstream reservoirs to provide more supply during critical periods, and/or to provide for additional upstream storage.

Water Quality
Modest water quality benefits may accrue from reduced agricultural drainage.

System Vulnerability
No additional benefits beyond those provided by core actions.

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY REDUCING DEMAND (alternative 203)

Theme: Demand reduction
Sub-theme: In export area and in and upstream of Delta
Approach: Conservation/reclamation, water marketing, land use planning

SOLUTION OVERVIEW

This alternative is intended to increase the supply and reliability of Delta exports by reducing agricultural, industrial, and municipal demand in the export area and in and upstream of the Delta. This alternative combines demand management actions, water marketing actions, and land use planning actions as these are synergistic and will lead to a more efficient utilization of the existing resource. This alternative therefore emphasizes actions such as conservation, reclamation, pricing, water transfers, and land use planning and conversion. This alternative recognizes that currently there are institutional and regulatory impediments that would have to be overcome to achieve reliable transfers between willing sellers in and upstream of the Delta and willing buyers in the export area. This alternative is based on aggressive implementation of actions that tend toward better utilization of existing supplies and therefore may represent a default alternative for the NEPA/CEQA process.

ACTIONS SELECTED

Bay-Delta Habitat Restoration
no actions above core actions were selected in this category

Upstream Habitat Restoration
no actions above core actions were selected in this category

Reduction in Diversion Effects
no actions above core actions were selected in this category

Management of Anadramous Fish
no actions above core actions were selected in this category

Reduction in Export Reliance
One thrust of this alternative is to reduce export reliance by improved utilization and reuse of water in the export area. Many of the actions in this alternative are core actions which would be implemented at the maximum level. Conservation would be implemented by agricultural, undustrial, and municipal users. Reclamation of municipal waste water and agricultural drainage water would supplement supplies for potable and nonpotable uses, including irrigation. To increase the options to water users, this alternative would encourage actions to

ADAPTIVE MANAGEMENT OF DELTA OUTFLOW FOR TRANSPORT AND ESTUARINE HABITAT CONDITIONS (Alternative 204) .

Theme: Reduce water requirements for transport and estuarine habitat management.
Sub-theme: Minimize surplus Delta outflows beyond transport and habitat needs.
Approach: Adaptive management with real-time salinity and fish monitoring.

HIGHLIGHTS

Habitat restoration and adaptive water management for pulse flows and estuarine salinity control will minimize the needs for Delta outflow. Restoration of shallow and wetland habitat in the vicinity of the confluence of the Sacramento and San Joaquin Rivers (some agricultural land conversion) would be use to improve the estuarine habitat. Substantial habitat protection is achieved with PGE cooling towers.

SOLUTION OVERVIEW

This alternative is intended to achieve substantial improvement in transport and estuarine habitat conditions and the survival of juvenile fish species feeding and rearing in the estuarine habitat. Restoration of shallow and wetland habitat in the vicinity of the confluence of the Sacramento and San Joaquin Rivers (some agricultural land conversion) would be use to improve the estuarine habitat. This alternative emphasizes actions which will improve the suitable estuarine habitat conditions (salinity, transport and entrainment reductions) with reduced Delta outflow requirements. These savings in releases from storage and outflow requirements would then become available for export during times when entrainment effects would be minimized. Cooling towers for the PGE Delta power plants should be constructed to reduce the entrainment effects in the expanded estuarine habitat. Fish barriers at DCC, Georgiana Slough, and Threemile Slough should be included to reduce the mortality of migrating salmon and other anadromous species. Pulse flows would be used to transport riverine and Delta spawning larvae into the estuarine entrapment zone used for rearing.

ACTIONS SELECTED (in addition to core actions)

Bay-Delta Habitat Restoration- restoration of estuarine habitat in the vicinity of the confluence; conversion of some agricultural land (e.g. Sherman Island) to shallow water and wetland habitats; conversion of some non-tidal wetlands (e.g. Suisun Marsh) to tidal wetlands to increase estuarine fish habitat benefits.

Upstream Habitat Restoration-

Reduction in Diversion Effects- construct cooling towers to eliminate PGE power plant cooling water entrainment.

Management of Anadromous Fish- fish barriers to direct migrating salmon down the Sacramento and San Joaquin Rivers towards the estuarine habitat area.

Reduction in Demands for Exports and Diversions-

Water Supply Enhancement and Predictability- adaptive management of pulse flows and Delta outflows to reduce existing Delta outflow requirements and thereby allow more water to be exported.

Management of Water Quality-

Improvement to System Reliability/Vulnerability-

PRELIMINARY ASSESSMENT

Ecosystem Quality- Substantial improvement in estuarine habitat and fishery benefits.

Water Supply Reliability- Increased water supply reliability from reduced Delta outflow requirements. The portion of the water savings from reduced outflow that can be exported will depend on diversion opportunities and storage capacities.

Water Quality-

System Vulnerability-

ADAPTIVE MANAGEMENT OF RELEASES FOR RIVERINE HABITAT AND FISH TRANSPORT CONDITIONS (Alternative 205).

Theme: Reduce water requirements for instream flow and transport management.
Sub-theme: Minimize releases beyond riverine habitat and transport needs.
Approach: Adaptive management with real-time temperature and fish monitoring.

HIGHLIGHTS

Habitat restoration and adaptive water management for instream flows will minimize the needs for reservoir releases. Substantial riverine habitat protection is achieved by relocation of all major river diversions to upstream of the anadromous fish habitat. However, these upstream water savings may not be exportable if there are no additional diversion opportunities.

SOLUTION OVERVIEW

This alternative is intended to achieve substantial improvement in riverine habitat conditions and the survival of spawning and rearing juvenile fish by restoring channel and riparian habitat below the major tributary storage reservoirs. This alternative emphasizes actions which will improve the suitable habitat conditions (temperature, gravel, transport, entrainment reductions) with reduced reservoir release requirements. These savings in releases from storage would then become available for export during times when pumping capacity was available and when entrainment effects would be minimized. Major river diversions should be relocated to upstream of the anadromous habitat area (i.e. canal from Keswick to replace Tehama-Colusa and Glenn-Colusa ID intakes). Channel and riparian restoration activities would be used to improve the riverine habitat.

ACTIONS SELECTED (in addition to core actions)

Bay-Delta Habitat Restoration-

Upstream Habitat Restoration-restoration of riverine and riparian habitat below all major reservoirs.

Reduction in Diversion Effects- relocate major river diversions to upstream of the spawning rearing habitats.

Management of Anadromous Fish-

Reduction in Demands for Exports and Diversions-

Water Supply Enhancement and Predictability- adaptive management of instream flows and transport flows to reduce existing release requirements and thereby allow more water to be

diverted or exported.

Management of Water Quality-

Improvement to System Reliability/Vulnerability-

PRELIMINARY ASSESSMENT

Ecosystem Quality- Substantial improvement in riverine habitat and fishery benefits.

Water Supply Reliability- Increased water supply reliability from reduced instream flow requirements. However, these upstream water savings may not be exportable if there are no additional diversion opportunities.

Water Quality-

System Vulnerability-

ADAPTIVE MANAGEMENT OF DELTA OUTFLOW AND INSTREAM FLOW RELEASES (Alternative 206).

Theme: Reduce water requirements for riverine and estuarine habitat management.
Sub-theme: Minimize reservoir releases and Delta outflows beyond habitat needs.
Approach: Adaptive management with real-time temperature, salinity and fish monitoring.

HIGHLIGHTS

Habitat restoration and adaptive water management for instream flows and estuarine habitat will minimize the needs for Delta outflow. Substantial habitat protection is achieved by PGE cooling towers and relocation of all major river diversions to upstream of the anadromous fish habitat.

SOLUTION OVERVIEW

This alternative is intended to achieve substantial improvement in both riverine and estuarine habitat conditions and increase the survival of fish spawning and rearing in the riverine and estuarine habitats. Channel and riparian restoration activities would be used to improve the riverine habitat. Restoration of shallow and wetland habitat in the vicinity of the confluence of the Sacramento and San Joaquin Rivers (some agricultural land conversion) would be use to improve the estuarine habitat. This alternative emphasizes actions which will improve the suitable riverine habitat conditions (temperature, gravel, transport, entrainment reductions) with reduced reservoir release requirements. This alternative emphasizes actions which will improve the suitable estuarine habitat conditions (salinity, transport and entrainment reductions) with reduced Delta outflow requirements. These savings in releases from storage and outflow requirements would then become available for export during times when entrainment effects would be minimized. Major river diversions should be relocated to upstream of the riverine habitat area. Cooling towers for the PGE Delta power plants should be constructed to reduce the entrainment effects in the expanded estuarine habitat. Fish barriers at DCC, Georgiana Slough, and Threemile Slough should be included to reduce the mortality of migrating salmon and other anadromous species. Pulse flows would be used to transport riverine and Delta spawning larvae into the estuarine entrapment zone used for rearing.

ACTIONS SELECTED (in addition to core actions)

Bay-Delta Habitat Restoration- restoration of estuarine habitat in the vicinity of the confluence; conversion of some agricultural land (e.g. Sherman Island) to shallow water and wetland habitats; conversion of some non-tidal wetlands (e.g. Suisun Marsh) to tidal wetlands to increase estuarine fish habitat benefits.

Upstream Habitat Restoration-

Reduction in Diversion Effects- construct cooling towers to eliminate PGE power plant cooling water entrainment; relocate diversions to upstream of riverine habitat used by anadromous fish.

Management of Anadromous Fish- fish barriers to direct migrating salmon down the Sacramento and San Joaquin Rivers towards the estuarine habitat area.

Reduction in Demands for Exports and Diversions-

Water Supply Enhancement and Predictability- adaptive management of instream flows, transport flows and Delta outflows to reduce existing instream flow and Delta outflow requirements and thereby allow more water to be exported.

Management of Water Quality-

Improvement to System Reliability/Vulnerability-

PRELIMINARY ASSESSMENT

Ecosystem Quality- Substantial improvement in both riverine and estuarine habitat conditions and associated fishery benefits.

Water Supply Reliability- Increased water supply reliability from reduced instream flow releases and reduced Delta outflow requirements.

Water Quality-

System Vulnerability-

ALTERNATIVE 207: REDUCE COMPETITION FOR DELTA SUPPLIES BY EXPANDING OFF-STREAM STORAGE IN EXPORT AREAS.

Theme: Reduce competition for water during critical periods by increasing supply availability.

Sub-theme: Increase storage in the export areas.

Approach: Develop new off-stream storage facilities.

SOLUTION OVERVIEW

This alternative is intended to reduce the competition of water supplies during critical periods by increasing the amount of available storage in the export areas. The availability of additional off-stream storage would be integrated with SWP/CVP diversion patterns to capture a greater portion of flood/winter flows. Captured flows would be stored for release during periods of high competition for water in the Delta, thereby reducing the demand from the Delta during these periods.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion Effects

In addition to core actions, additional actions included in this alternative are:

- Delta export management actions to modify export criteria.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance
No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports would remain unchanged.

Water Supply Enhancement and Predictability
Beyond the core actions in this category, actions would be selected to:

- Increase off-stream storage in the export areas (on the order of 500 TAF).
- Implement long-term planning for drought contingencies above core level implementation.

Management of Water Quality
No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports would remain unchanged.

Improvement to System Reliability/Vulnerability
No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports would remain unchanged.

PRELIMINARY ASSESSMENT

Ecosystem Quality
Ecosystem quality is addressed only to the level of core actions.

Water Supply Reliability
Water supply reliability is the focus of this alternative. The reliability is improved through the development of additional off-stream storage which would enable the capture of flood/winter flows which currently are currently not diverted from the Delta due to a lack of storage availability.

Water Quality
Water quality is addressed only at the core level.

System Vulnerability

System vulnerability is addressed only at the core level.

ALTERNATIVE 208: REDUCE COMPETITION FOR DELTA SUPPLIES BY INCREASING ON-STREAM STORAGE CAPACITIES UPSTREAM OF THE DELTA.

Theme: Reduce competition for water during critical periods by increasing supply availability.

Sub-theme: Increase storage upstream of the Delta.

Approach: Develop additional on-stream storage capacity.

SOLUTION OVERVIEW

This alternative is intended to reduce the competition of water supplies during critical periods by increasing the amount of storage and supply in the area upstream of the Delta. The development of additional on-stream storage capacity coupled with reoperation of existing storage facilities would capture a greater portion of flood/winter flows and reduces the losses associated with flood control releases. Flows stored in new or expanded on-stream reservoirs upstream of the Delta would be release during periods of high competition for water in the Delta, thereby increasing the available supply and reducing competition during these periods.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion Effects

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta

exports and other diversions would remain unchanged.

Water Supply Enhancement and Predictability
Beyond the core actions in this category, actions would be selected to:

- Expand on-stream storage capacity in areas upstream of the Delta.
- Modify operations of reservoirs upstream of the Delta.

The effect of these actions would be to increase the yield of watersheds upstream of the Delta. Core actions related to long-term planning for drought contingencies and improved coordination of water management would be would be implemented at a higher level than that proposed at the core level.

Management of Water Quality
No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Improvement to System Reliability/Vulnerability
No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

PRELIMINARY ASSESSMENT

Ecosystem Quality
Ecosystem quality is addressed only to the level of core actions.

Water Supply Reliability
Water supply reliability is the focus of this alternative. Reliability is improved through the development of additional on-stream storage upstream of the Delta. The increase in upstream storage would enable the capture of currently unregulated flows and a reduction in the loss of water released for flood control measures. The yield generated from such storage would be available for release during periods of high competition in the Delta, thereby reducing competition during these critical periods.

Water Quality
Water quality is addressed only at the core level.

System Vulnerability

System vulnerability is generally addressed at the core level. Secondary benefits (specific to the approach of this alternative) would be increased flood control storage and management opportunities.

ALTERNATIVE 209: REDUCE COMPETITION FOR DELTA SUPPLIES BY CONVERTING SELECT DELTA ISLANDS TO STORAGE FACILITIES.

Theme: Reduce competition for water during critical periods by increasing supply availability.

Sub-theme: Increase storage within the Delta.

Approach: Convert select Delta islands to storage facilities.

SOLUTION OVERVIEW

This alternative is intended to reduce the competition for water supplies during critical periods by developing storage within the Delta through conversion of selected islands to storage facilities. These island storage facilities would capture excess flows in the Delta and release them for environmental or supply needs during periods when competition is high for other Delta sources. An in-Delta storage facility operated in such a manner would reduce the competition of Delta water supplies and ensure a greater level of reliability for export water.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. However, to mitigate habitat losses from conversion of Delta islands to storage facilities the level of implementation of core actions would be increased by this alternative.

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion Effects

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance

No actions above those identified as core actions were selected in this category. The

implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports and other diversions would remain unchanged.

Water Supply Enhancement and Predictability
Beyond the core actions in this category, actions would be selected to:

- Develop storage capacity within the Delta.
- Modify operations of reservoirs upstream of the Delta.

The effect of these actions would be to capture excess flows in the Delta. Upstream reservoir operations would be altered to coordinate with releases from Delta storage facilities for export. Core actions related to long-term planning for drought contingencies and improved coordination of water management would be would be implemented at a higher level than that proposed at the core level.

Management of Water Quality
No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Improvement to System Reliability/Vulnerability
No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

PRELIMINARY ASSESSMENT

Ecosystem Quality
Only core actions related to ecosystem quality are included in this alternative. However, core actions aimed a Delta habitat are to be implemented at a higher level to mitigate losses of habitat associated with conversion of Delta islands to storage facilities. Higher implementation levels of theses actions is intended to maintain ecosystem quality at the core level and to improve ecosystem quality.

Water Supply Reliability
Water supply reliability is the focus of this alternative. Reliability is improved through the development in-Delta storage. In-Delta storage would be operated to capture excess Delta flows and generate new supplies to ensure the reliability of export and environmental water in the Delta. The focus of this in-Delta facility is to reduce competition for water during critical

periods.

Water Quality

Water quality is addressed only at the core level.

System Vulnerability

Water quality is addressed only at the core level.

Alternative 210:

Title: Reduce Competition for Water Supplies Through Enhanced Utilization of Conjunctive Use Programs

Theme: Reduce competition for water during critical periods by increasing supply availability.

Sub-Theme: Increase ground and surface water conjunctive use storage.

Approach: Increase groundwater storage north of the Delta for use during periods of high competition.

Solution Overview

This alternative is intended to reduce the competition for Delta water supplies during critical periods by increasing the conjunctive use of groundwater and surface water supplies. This alternative would require increased diversion capacities at selected locations .to divert surplus and flood flows into groundwater storage. The stored groundwater would be pumped during high competition periods and an equal amount of water would not be diverted from north of the Delta streams, thus increasing overall available Delta supply. The additional volume of water available to the Delta would increase the reliability of overall Delta water supply during critical periods.

Actions Selected

Bay-Delta Habitat Restoration
No actions above the those identified as core actions were selected for this category.

Upstream Habitat Restoration
No actions above the those identified as core actions were selected for this category.

Reduction in Diversion Effects
No actions above the those identified as core actions were selected for this category.

Management of Anadromous Fish
No actions above the those identified as core actions were selected for this category.

Reduction in Diversion/Export Reliance
No core actions exist for this category. Non-core actions selected for this alternative include:

- Enlarged pumping and conveyance facilities
- Implement techniques to increase groundwater recharge

Water Supply Enhancement and Predictability
In addition to the core actions, the following actions have been included:
- Implement techniques to increase groundwater recharge

Management of Water Quality
No actions above the those identified as core actions were selected for this category.

Improvement to System Reliability/Vulnerability
In addition to the core actions, the following actions have been included:
- Increase downstream flood protection by coordinating conjunctive use storage of flood flows with operation of existing facilities.

Preliminary Assessment

Ecosystem Quality
Ecosystem quality is addressed to the level of core actions.

Water Supply Reliability
Water supply reliability is the primary objective of this alternative. Reliability is improved through the development of expanded conjunctive use programs, whereby surplus and flood flows are diverted and stored in north of Delta groundwater basins for use during periods of high competition for Delta water supply. Surface water volumes equal to the amount of stored groundwater would not be diverted during critical periods resulting in increased Delta supply.

Water Quality
Water Quality is addressed only at the core level.

System Vulnerability
Vulnerability to the system from downstream flooding would be decreased as periodic flood flows would be partially diverted to groundwater storage before entering the Delta.

ALTERNATIVE 211: REDUCE COMPETITION FOR DELTA SUPPLIES BY INCREASING STORAGE CAPACITIES THROUGHOUT THE SYSTEM.

Theme: Reduce competition for water during critical periods by increasing supply availability.

Sub-theme: Increase storage in upstream and export areas and within the Delta.

Approach: Develop off-stream storage in the export area, on-stream storage upstream of the Delta, and Delta island storage within the Delta.

SOLUTION OVERVIEW

This alternative is intended to reduce the competition for water supplies during critical periods as well as increase the reliability of water supplies. Storage facilities would be developed in the export and upstream areas and within the Delta. These facilities would be operated to maximize supply reliability for Delta exports. While these facilities could provide water for environmental purposes, those benefits are not considered as part of this alternative.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. However, to mitigate habitat losses from conversion of Delta islands to storage facilities the level of implementation of core actions would be increased by this alternative.

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. However, to mitigate habitat losses associated with the development of additional on-stream storage the level of implementation of core actions would be increased by this alternative.

Reduction in Diversion Effects

In addition to core actions, additional actions included in this alternative are:

- Delta export management actions to modify export criteria.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports and other diversions would remain unchanged.

Water Supply Enhancement and Predictability

Beyond the core actions in this category, actions would be selected to:

- Develop new or expanded off-stream storage capacity in export areas.
- Expand on-stream storage capacity upstream of the Delta.
- Develop storage capacity within the Delta.
- Modify operations of reservoirs upstream of the Delta.

The effect of these actions would be to capture unregulated flows in the Delta and upstream watersheds. Upstream reservoir operations would be altered to coordinate with releases from Delta storage facilities for export. Core actions related to long-term planning for drought contingencies and improved coordination of water management would be implemented at their maximum levels.

Management of Water Quality

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Improvement to System Reliability/Vulnerability

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

PRELIMINARY ASSESSMENT

Ecosystem Quality

Only core actions related to ecosystem quality are included in this alternative. However, core actions aimed at Delta habitat are to be implemented at a higher level to mitigate losses of habitat associated with conversion of Delta islands to storage facilities. Core actions associated with upstream habitat will also be implemented at a higher level to mitigate for habitat losses due to increases in on-stream storage facilities. Higher implementation levels of theses actions is intended to maintain ecosystem quality at the core level and to improve ecosystem quality.

Water Supply Reliability

Water supply reliability is the focus of this alternative. Reliability is improved through the development of additional storage throughout the system. Additional storage would be operated to capture excess Delta flows and generate new supplies to ensure the reliability of export and environmental water in the Delta.

Water Quality

Water quality is addressed only at the core level.

System Vulnerability

Water quality is addressed only at the core level.

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY INCREASING SUPPLY AVAILABILITY (alternative 212)

Theme: Increase supply
Sub-theme: Increase efficiency of water movement through and/or around the Delta
Approach: Relocate and redesign export facilities.

SOLUTION OVERVIEW

Currently, the diversions at the existing SWP and CVP export facilities are significantly constrained by environmental considerations such that the regulated diversions are often well below the physical capacities of the export pumps. This alternative is intended to relocate and/or redesign the export facilites in order to relax the current environmental restrictions on diversion magnitude and timing. By taking advantage of this "diversion opportunity", additional supplies would be made available for export.

ACTIONS SELECTED

Bay-Delta Habitat Restoration
no actions above core actions were selected in this category

Upstream Habitat Restoration
No actions above core actions were selected in this category.

Reduction in Diversion Effects
Actions in this alternative include relocating and redesigning the export diversion facilites such that diversion impacts in water transport, water quality, and fisheries are significantly reduced. Actions to accomplish this reduction in diversion effects would include relocating the diversions to less sensitive locations (e.g., Old River), increasing the size of the forebays, and installing state-of-the-art fish screens and barriers.

Management of Anadramous Fish
No actions above core actions were selected in this category.

Reduction in Export Reliance
No actions above core actions were selected in this category.

Water Supply Enhancement Predictability
The principal thrust of this alternative is to enhance water supply reliability and water quality by relocating and redesigning the export facilities such that entrainment and "reverse flow" effects would be substantially mitigated.

Management of Water Quality

Relocation and redesign of the export diversion facilities should enhance the quality of exported water and generally improve the quality of water in the south Delta.

Improvements to System Reliability/Vulnerability
no actions above core actions were selected in this category

PRELIMINARY ASSESSMENT

Ecosystem Quality
Diversion effects associated with the current export facilities would be mitigated with the construction of new diversion facilities in the south Delta.

Water Supply Reliability
This alternative would increase water supply reliability and water supply quality by relocating and redesigning the export facilites in order to relax the current restrictions on export diversion magnitude and timing.

Water Quality
This alternative should improve the quality of exported water.

System Vulnerability
No additional benefits beyond those provided by core actions.

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY INCREASING SUPPLY AVAILABILITY (alternative 213)

Theme: Increase supply
Sub-theme: Increase efficiency of water movement through and/or around the Delta
Approach: Develop eastside isolated transfer/conveyance facility

SOLUTION OVERVIEW

This alternative is intended to increase the reliability and water quality of Delta exports by constructing an eastside isolated transfer facility between the Sacramanto River in the north Delta and Clifton Court Forebay. It is assumed that by moving the diversion from the south Delta to the Sacramento River, the current regulatory export pumping restrictions will be significantly relaxed such that the full physical capacity of the export pumps will be available to be utilized. In this alternative, the capacity of the transfer facility is designed to be consistent with the pumping capacities of the SWP and CVP export facilities.

ACTIONS SELECTED

Bay-Delta Habitat Restoration
no actions above core actions were selected in this category

Upstream Habitat Restoration
No actions above core actions were selected in this category.

Reduction in Diversion Effects
Actions in this alternative include moving the current location of the diversion facilites to locations on the Sacramento River.

Management of Anadramous Fish
No actions above core actions were selected in this category.

Reduction in Export Reliance
No actions above core actions were selected in this category.

Water Supply Enhancement Predictability
The principal thrust of this alternative is to enhance water supply reliability by constructing a dedicated isolated transfer facility that would convey water around the Delta from the Sacramento River.

Management of Water Quality
No actions above core actions were selected in this category to improve water quality in the Delta. However, relocation of the export diversion facilities should significantly enhance the quality of the exported water.

Improvements to System Reliability/Vulnerability
no actions above core actions were selected in this category

PRELIMINARY ASSESSMENT

Ecosystem Quality
Diversion effects associated with the current export facilities would be significantly mitigated with the construction of new diversion facilities on the Sacramento River.

Water Supply Reliability
This alternative would increase water supply reliablity and water supply quality by constructing an isolated transfer facility that would convey water directly from the Sacramento River.

Water Quality
This alternative should significantly improve the quality of exported water.

System Vulnerability
No additional benefits beyond those provided by core actions.

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY INCREASING SUPPLY AVAILABILITY (alternative 214)

Theme: Increase supply
Sub-theme: Develop a combination storage/conveyance facility through the Delta
Approach: "chain of lakes" concept

SOLUTION OVERVIEW

This alternative is intended to increase the supply and reliability of Delta exports by developing a water supply storage/conveyance system in the Delta. The system would consist of a series of flooded Delta islands linked by siphons, existing channels, or new channels (constructed across existing islands) leading from the Sacramento River to Clifton Court Forebay. The conveyance capacity of the system would be consistent with the present physical pumping capacities of the CVP and SWP export pumping facilities. The storage capacity of the system would be driven by which islands are chosen to be flooded and levee stability considerations. By moving the diversion facilities, this alternative would likely relax the current diversion restrictions, and provide more flexibility in the magnitude and timing of diversions. The additional storage would also facilitate high flow diversions during specific storm events which then could be utilized for export diversions (or environmental outflow) during critical environmental periods.

ACTIONS SELECTED

Bay-Delta Habitat Restoration
no actions above core actions were selected in this category

Upstream Habitat Restoration
No actions above core actions were selected in this category.

Reduction in Diversion Effects
This alternative includes actions that will likely decrease diversion effects by moving the diversions from Clifton Court Forebay to the Sacramento River.

Management of Anadramous Fish
No actions above core actions were selected in this category.

Reduction in Export Reliance
No actions above core actions were selected in this category.

Water Supply Enhancement Predictability
The principal thrust of this alternative is to enhance water supply reliability by constructing an in-Delta storage/conveyance system whose primary purpose would be water supply.

Management of Water Quality
No actions above core actions were selected in this category to improve water quality in the Delta.

Improvements to System Reliability/Vulnerability
no actions above core actions were selected in this category

PRELIMINARY ASSESSMENT

Ecosystem Quality
This alternative, by moving the export diversions from the south Delta to the Sacramento River, would result in less adverse effects of the diversion on the fisheries.

Water Supply Reliability
This alternative would increase water supply reliablity and water supply quality by relaxing the current diversion limitations on the magnitude and timing of diversions.

Water Quality
This alternative should improve the quality of exported water. Water quality in the south Delta may improve by eliminating the "reverse flow" caused by the current export pumping, and by the possiblity of using the storage/conveyance system for water quality releases.

System Vulnerability
System vulnerability would be reduced as levee construction and modification to develop the system would also address system vulnerability.

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY INCREASING SUPPLY AVAILABILITY (alternative 215)

Theme: Increase supply
Sub-theme: Increase efficiency of water movement through or around the Delta
Approach: Increase export pumping capacity

SOLUTION OVERVIEW

This alternative is intended to increase the reliability of Delta exports by increasing the through-Delta conveyance capacity, including channel capacity, forebay capacity, and export pumping capacity. Such additional capacity would provide the opportunity for increasing exports during high flow periods when entrainment effects would be minimized and water quality would be relatively good. This alternative would also likely include additional storage south of the Delta in order to take full advantage of the increased conveyance capacity.

ACTIONS SELECTED

Bay-Delta Habitat Restoration
no actions above core actions were selected in this category

Upstream Habitat Restoration
No actions above core actions were selected in this category.

Reduction in Diversion Effects
This alternative includes actions that will potentially decrease diversion effects at the export facilites by enlarging the forebay and by being able to pump during more selective periods (high tide periods and high Delta-outflow periods).

Management of Anadramous Fish
No actions above core actions were selected in this category.

Reduction in Export Reliance
No actions above core actions were selected in this category.

Water Supply Enhancement Predictability
The principal thrust of this alternative is to enhance water supply reliability and improve water quality by increasing the capacity of the Delta channel system and export facilities. This will resultsin the ability to export additional (and possibly higher quality) water during high flow events and/or during high tide; which then could be stored south of the Delta for critical and other periods.

Management of Water Quality

No actions above core actions were selected in this category to improve water quality in the Delta. However, this alternative will facilitate diversion at the export facilities during period when there is the potential for improved export water quality.

Improvements to System Reliability/Vulnerability
no actions above core actions were selected in this category

PRELIMINARY ASSESSMENT

Ecosystem Quality
This alternative would improve the opportunity to export during periods when entrainment effects and adverse water quality effects would be minimized; thereby enhancing ecosystem quality.

Water Supply Reliability
This alternative would increase water supply reliablity and water supply quality by providing the capability of increased export pumping during periods when adverse water quality and entrainment effects are minimized.

Water Quality
This alternative should improve the quality of exported water.

System Vulnerability
System vulnerability would be reduced as levee modification to increase capacity would also address system vulnerability.

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY INCREASING SUPPLY AVAILABILITY (alternative 216)

Theme: Increase supply
Sub-theme: Reoperate existing reservoirs to increase yield
Approach: Provide additional downstream flood protection, thereby relaxing flood protection constraints on reservoir operations

SOLUTION OVERVIEW

This alternative is intended to increase the supply and reliability of Delta exports by developing additional flood protection downstream of on-line reservoirs that would facilitate reoperation of the reservoirs with more emphasis on water supply. The premise of this alternative is that currently the threat of downstream flooding constrains reservoir operators in terms of managing release flows and storage. Relaxing of such constraints could benefit water supply by providing more reservoir storage dedicated to water supply. This alternative therefore requires the construction of additional downstream flood mitigation features, such as floodways, larger channel capacities, and/or set-back levees.

ACTIONS SELECTED

Bay-Delta Habitat Restoration
no actions above core actions were selected in this category

Upstream Habitat Restoration
No actions above core actions were selected in this category.

Reduction in Diversion Effects
No actions above core actions were selected in this category.

Management of Anadramous Fish
No actions above core actions were selected in this category.

Reduction in Export Reliance
No actions above core actions were selected in this category.

Water Supply Enhancement Predictability
The principal thrust of this alternative is to enhance water supply reliability by constructing additional downstream flood protection facilities that would allow reservoirs to be operated with less flood control constraints and more emphasis on water supply.

Management of Water Quality
No actions above core actions were selected in this category.

Improvements to System Reliability/Vulnerability
no actions above core actions were selected in this category

PRELIMINARY ASSESSMENT

Ecosystem Quality
This alternative would potentially provide for additional or enhanced habitat as part of constructing additional flood control facilities.

Water Supply Reliability
This alternative would increase water supply reliability relaxing the current flood control constraints on reservoir operations.

Water Quality
This alternative would not necessarily result in improved water quality in the Delta.

System Vulnerability
System vulnerability would be reduced as levee construction and modification for flood control would also address system vulnerability.

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY REDUCING DEMAND (alternative 217)

Theme:

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY REDUCING DEMAND (alternative 218)

Theme: Reduce competition during critical periods through demand reduction
Sub-theme: Reduce demand north and south of the Delta and provide for storage in the Delta
Approach: Conservation/reclamation, water marketing, land use planning and convert Delta islands for storage

SOLUTION OVERVIEW

This alternative is intended to increase the supply and reliability of Delta exports by demand reduction actions in the export area that translate into reduced future demands on Delta supplies, and demand reduction measures in and upstream of the Delta that translate into increased future supplies to the Delta. This alternative combines demand management actions, water marketing actions, and land use planning actions as these are synergistic and will lead to a more efficient utilization of the existing resource. This alternative therefore emphasizes actions such as conservation, reclamation, pricing, water transfers, and land use planning and conversion. This alternative recognizes that current regulatory restriction on export pumping are a major impediment to conducting reliable water marketing and transfers between willing sellers north of the Delta and willing buyers in the export area. In order to facilitate such transfers, this alternative includes converting selected Delta Islands for water supply storage and constructing an isolated conveyance facility between these islands and the export facilites, thereby avoiding the current environmental restrictions on export diversions. Such storage would also be utilized for conserved water.

ACTIONS SELECTED

Bay-Delta Habitat Restoration
no actions above core actions were selected in this category

Upstream Habitat Restoration
no actions above core actions were selected in this category

Reduction in Diversion Effects
In Delta storage combined with an isolated transfer facility between the storage islands and the export facilities will mitigate diversion impacts associated with the export facilities. Reduced demand in the Delta may also lead to reduced future diversions.

Management of Anadramous Fish
no actions above core actions were selected in this category

Reduction in Export Reliance
One thrust of this alternative is to reduce export reliance by improved utilization and reuse of water in the export area. Many of the actions in this alternative are core actions which would be implemented at the maximum level. Conservation would be implemented by agricultural, undustrial, and municipal users. Reclamation of municipal waste water and agricultural drainage water would supplement supplies for potable and nonpotable uses, including irrigation. To increase the options to water users, this alternative would encourage actions to facilitate water marketing and a market-driven pricing structure. Improved land use planning based on water availability and actions that would encourage land retirement and fallowing during drought periods would be undertaken under this option.

Water Supply Enhancement Predictability

The second thrust of this alternative is to enhance water supply predictability by improved utilization and reuse of water in and upstream of the Delta and the facilitation of water transfers between north and south users through the construction of in-Delta storage and an isolated conveyance facility between this storage and the export facilities. Water saved by conservation and water available for transfers could be stored in the Delta and exported reliably without the current environmental restrictions on export diversions.

Management of Water Quality
no actions above core actions were selected in this category

Improvements to System Reliability/Vulnerability
Improvements to system reliability would indirectly accrue from the construction of the isolated transfer facility.

PRELIMINARY ASSESSMENT

Ecosystem Quality
Some improvement of ecosystem quality could accrue through the operation of in-Delta storage for environmental as well as water supply needs.

Water Supply Reliability
This alternative would increase water supply reliability by reducing demand in the export area and increasing supply in the Delta by demand reduction in and upstream of the Delta. Water conserved and water available for north-to-south transfers would be stored in-Delta and pumped to the export facilities in an isolated conveyance system that would not fall under the current export diversions caps.

Water Quality
Water quality benefits will accrue from conservation and reclamation that would lead to reduced discharges (e.g., agricultural irrigation return flows).

System Vulnerability
System vulnerability would be incidntally enhanced by construction of levees associated with the isolated transfer facility.

REDUCE COMPETITION FOR WATER DURING CRITICAL PERIODS BY REDUCING DEMAND (alternative 219)

Theme: Demand reduction
Sub-theme: Reduce demand in export area and in and upstream of Delta and increase storage upstream of Delta
Approach: Water developed through conservation in the Delta would be available for direct export. Water developed upstream of the Delta would be stored in surface and/or groundwater storage to faciliate export during critical periods.

SOLUTION OVERVIEW

This alternative is intended to increase the supply and reliability of Delta exports by reducing Delta demand in the export area and by increasing Delta supplies by demand reduction in and upstream of the Delta. Increases in Delta supplies through conservation would be managed for exports and could include surface and groundwater storage to maximize the conservation and reclamation potential. This alternative emphasizes actions such as conservation, reclamation, pricing, water transfers, land use planning and conversion, and storage upstream of the Delta.

ACTIONS SELECTED

Bay-Delta Habitat Restoration
no actions above core actions were selected in this category

Upstream Habitat Restoration
no actions above core actions were selected in this category

Reduction in Diversion Effects
no actions above core actions were selected in this category

Management of Anadramous Fish
no actions above core actions were selected in this category

Reduction in Export Reliance
One thrust of this alternative is to reduce export reliance by improved utilization and reuse of water in the export area. Many of the actions in this alternative are core actions which would be implemented at the maximum level. Conservation would be implemented by agricultural, undustrial, and municipal users. Reclamation of municipal waste water and agricultural

drainage water would supplement supplies for potable and nonpotable uses, including irrigation. To increase the options to water users, this alternative would encourage actions to facilitate water marketing and a market-driven pricing structure. Improved land use planning based on water availability and actions that would encourage land retirement and fallowing during drought periods would be undertaken under this option.

Water Supply Enhancement Predictability
A second thrust of this alternative is to enhance water supply predictability by improved conservation and reclamation of water in and upstream of the Delta, supplemented by storage to maximize the conservation and reclamation potential. Storage could include surface or groundwater storage and thereby could take advantage of land application reclamation actions. Storage would improve the reliability of exporting supplies generated by conservation and reclamation or avialable as water transfers.

Management of Water Quality
no actions above core actions were selected in this category

Improvements to System Reliability/Vulnerability
no actions above core actions were selected in this category

PRELIMINARY ASSESSMENT

Ecosystem Quality
No additional benefits beyond those provided by core actions.

Water Supply Reliability
This alternative would increase water supply reliablity by reducing demand in the export area and increasing supplies by demand reduction in and upstream of the Delta. In order to maximize conservation and reclamation benefits, upstream storage would be provided. Release from storage could be timed to critical periods when other supplies are highly regulated.

Water Quality
Water quality benefits will accrue from conservation and reclamation actions that would lead to reduced discharges (e.g., reduced agricultural irrigation return flows).

System Vulnerability
No additional benefits beyond those provided by core actions.

planning based on water availability and actions that would encourage land retirement and fallowing during drought periods would be undertaken under this option.

Water Supply Enhancement Predictability
This alternative will enhance water supply predicability in export areas by providing multiple water supply options and relying less on delta exports.

Management of Water Quality
no actions above core actions were selected in this category

Improvements to System Reliability/Vulnerability
no actions above core actions were selected in this category

PRELIMINARY ASSESSMENT

Ecosystem Quality
Indirect benefits to ecosystem quality will be achieved by limiting future increases in delta exports.

Water Supply Reliability
This alternative would enhance water supply reliability by encouraging reuse of existing Delta and non-Delta supplies and facilitating water transfers.

Water Quality
Indirect benefits to water quality will be achieved by limiting future increases in delta exports.

System Vulnerability
This alternative would not yield direct benefits to system vulnerability.

DELTA OUTFLOW AND INSTREAM FLOW MANAGEMENT WITH DELTA STORAGE (Alternative 220).

Theme: Reduce water requirements for riverine and estuarine habitat management.
Sub-theme: Minimize reservoir releases and Delta outflows beyond habitat needs.
Approach: Adaptive management of reservoir releases, outflow, exports, and in-Delta storage based on real-time salinity and fish monitoring.

HIGHLIGHTS

Habitat restoration and adaptive water management for instream flows and estuarine habitat will minimize the needs for Delta outflow. In-Delta storage is used to capture high Delta inflows (including instream flow releases) for later use to increase exports or provide Delta outflow augmentation. Substantial habitat protection is achieved by PGE cooling towers and relocation of all major river diversions to upstream of the anadromous fish habitat.

SOLUTION OVERVIEW

This alternative is intended to achieve substantial improvement in both riverine and estuarine habitat conditions and increase the survival of fish spawning and rearing in the riverine and estuarine habitats. Channel and riparian restoration activities would be used to improve the riverine habitat. Restoration of shallow and wetland habitat in the vicinity of the confluence of the Sacramento and San Joaquin Rivers (some agricultural land conversion) would be use to improve the estuarine habitat. This alternative emphasizes actions which will improve the suitable riverine habitat conditions (temperature, gravel, transport, entrainment reductions) with reduced reservoir release requirements. This alternative also emphasizes actions which will improve the suitable estuarine habitat conditions (salinity, transport and entrainment reductions) with reduced Delta outflow requirements. These savings in releases from storage and outflow requirements would then become available for export during times when entrainment effects would be minimized. Major river diversions should be relocated to upstream of the riverine habitat area. Cooling towers for the PGE Delta power plants should be constructed to reduce the entrainment effects in the expanded estuarine habitat. Fish barriers at DCC, Georgiana Slough, and Threemile Slough should be included to reduce the mortality of migrating salmon and other anadromous species. Pulse flows would be used to transport riverine and Delta spawning larvae into the estuarine entrapment zone used for rearing. In-Delta storage is used to capture high Delta inflows (greater than export capacity and Delta outflow requirements). Delta storage could then be released for subsequent adaptive management of Delta outflow or for increased exports during periods with reduced entrainment risks.

ACTIONS SELECTED (in addition to core actions)

Bay-Delta Habitat Restoration- restoration of estuarine habitat in the vicinity of the confluence; conversion of some agricultural land (e.g. Sherman Island) to shallow water and wetland habitats; conversion of some non-tidal wetlands (e.g. Suisun Marsh) to tidal wetlands to increase estuarine fish habitat benefits. Conversion of some agricultural land to in-Delta storage will require some

mitigation for waterfowl and other types of wetland and terrestrial habitats.

Upstream Habitat Restoration-restoration of riverine and riparian habitat below all major reservoirs.

Reduction in Diversion Effects- construct cooling towers to eliminate PGE power plant cooling water entrainment; relocate diversions to upstream of riverine habitat used by anadromous fish.

Management of Anadromous Fish- fish barriers to direct migrating salmon down the Sacramento and San Joaquin Rivers towards the estuarine habitat area.

Reduction in Demands for Exports and Diversions-

Water Supply Enhancement and Predictability- adaptive management of instream flows, transport flows and Delta outflows to reduce existing instream flow and Delta outflow requirements; in-Delta storage to capture excess Delta inflows for subsequent Delta outflow or increased Delta exports.

Management of Water Quality-

Improvement to System Reliability/Vulnerability-

PRELIMINARY ASSESSMENT

Ecosystem Quality- Substantial improvement in both riverine and estuarine habitat conditions and associated fishery benefits.

Water Supply Reliability- Increased water supply reliability from reduced instream flow releases and reduced Delta outflow requirements; in-Delta storage provides increased flexibility for adaptive outflow and export management.

Water Quality-

System Vulnerability-

DELTA OUTFLOW AND INSTREAM FLOW MANAGEMENT WITH RELOCATED EXPORT INTAKES (Alternative 221).

Theme: Reduce water requirements for riverine and estuarine habitat management.
Sub-theme: Minimize reservoir releases and Delta outflows beyond habitat needs.
Approach: Adaptive management of reservoir releases, outflow, and exports based on real-time salinity and fish monitoring with relocated export intakes.

HIGHLIGHTS

Habitat restoration and adaptive water management for instream flows and estuarine habitat will minimize the needs for Delta outflow. Substantial habitat protection is achieved by PGE cooling towers and relocation of all major river diversions to upstream of the anadromous fish habitat. The Delta export intakes are relocated to greatly reduce entrainment losses of Delta fish and thereby increase export diversion opportunities.

SOLUTION OVERVIEW

This alternative is intended to achieve substantial improvement in both riverine and estuarine habitat conditions and increase the survival of fish spawning and rearing in the riverine and estuarine habitats. Channel and riparian restoration activities would be used to improve the riverine habitat. Restoration of shallow and wetland habitat in the vicinity of the confluence of the Sacramento and San Joaquin Rivers (some agricultural land conversion) would be used to improve the estuarine habitat. This alternative emphasizes actions which will improve the suitable riverine habitat conditions (temperature, gravel, transport, entrainment reductions) with reduced reservoir release requirements. This alternative also emphasizes actions which will improve the suitable estuarine habitat conditions (salinity, transport and entrainment reductions) with reduced Delta outflow requirements. These savings in releases from storage and outflow requirements would then become available for export during times when entrainment effects would be minimized. Relocated Delta export intakes with best available screening facilities will substantially increase the opportunities for diversion of Sacramento River inflows that are not required for estuarine habitat and salinity control. Major river diversions should be relocated to upstream of the riverine habitat area. Cooling towers for the PGE Delta power plants should be constructed to reduce the entrainment effects in the expanded estuarine habitat. Pulse flows with export curtailment would be used to transport riverine larvae into the estuarine entrapment zone used for rearing and to help protect vulnerable anadromous life stages during migration periods.

ACTIONS SELECTED (in addition to core actions)

Bay-Delta Habitat Restoration- restoration of estuarine habitat in the vicinity of the confluence; conversion of some agricultural land (e.g. Sherman Island) to shallow water and wetland habitats; conversion of some non-tidal wetlands (e.g. Suisun Marsh) to tidal wetlands to increase estuarine fish habitat benefits.

Upstream Habitat Restoration-restoration of riverine and riparian habitat below all major

reservoirs.

Reduction in Diversion Effects- construct cooling towers to eliminate PGE power plant cooling water entrainment; relocate diversions to upstream of riverine habitat used by anadromous fish; relocate Delta export intakes and provide best available screening facilities on Sacramento River.

Management of Anadromous Fish- real-time monitoring of anadromous fish migration with adaptive management of pulse flows and export curtailment to protect vulnerable fish during migration periods.

Reduction in Demands for Exports and Diversions-

Water Supply Enhancement and Predictability- adaptive management of instream flows, transport flows and Delta outflows to reduce existing instream flow and Delta outflow requirements; relocated Delta export intakes will substantially increase diversion opportunities.

Management of Water Quality- export water quality will be significantly improved because of the relocated export intakes on the Sacramento River.

Improvement to System Reliability/Vulnerability- water supply reliability will be substantially improved because of increased diversion opportunities; vulnerability may be improved because levee failure will not disrupt export water quality.

PRELIMINARY ASSESSMENT

Ecosystem Quality- Substantial improvement in both riverine and estuarine habitat conditions and associated fishery benefits; entrainment effects will be almost completely eliminated.

Water Supply Reliability- Increased water supply reliability from reduced instream flow releases and reduced Delta outflow requirements; relocated export intakes will allow increased diversion opportunities while maintaining estuarine habitat and fish transport conditions.

Water Quality- Substantial improvement in export water quality will be achieved with the relocated export intakes to the Sacramento River.

System Vulnerability- Improved water supply reliability will be achieved with the relocated intakes because diversion opportunities will be increased.

DELTA OUTFLOW AND INSTREAM FLOW MANAGEMENT WITH DELTA STORAGE AND RELOCATED EXPORT INTAKES (Alternative 222).

Theme: Reduce water requirements for riverine and estuarine habitat management.
Sub-theme: Minimize reservoir releases and Delta outflows beyond habitat needs.
Approach: Adaptive management of reservoir releases, outflow, Delta storage, and exports based on real-time salinity and fish monitoring with relocated export intakes.

HIGHLIGHTS

Habitat restoration and adaptive water management for instream flows and estuarine habitat will minimize the needs for Delta outflow. In-Delta storage is used to capture high Delta inflows for later use to provide pulse flows or Delta outflow augmentation. Substantial habitat protection is achieved by PGE cooling towers and relocation of all major river diversions to upstream of the anadromous fish habitat. The Delta export intakes are relocated to greatly reduce entrainment losses of Delta fish and thereby increase export diversion opportunities.

SOLUTION OVERVIEW

This alternative is intended to achieve substantial improvement in both riverine and estuarine habitat conditions and increase the survival of fish spawning and rearing in the riverine and estuarine habitats. Channel and riparian restoration activities would be used to improve the riverine habitat. Restoration of shallow and wetland habitat in the vicinity of the confluence of the Sacramento and San Joaquin Rivers (some agricultural land conversion) would be used to improve the estuarine habitat. This alternative emphasizes actions which will improve the suitable riverine habitat conditions (temperature, gravel, transport, entrainment reductions) with reduced reservoir release requirements. This alternative also emphasizes actions which will improve the suitable estuarine habitat conditions (salinity, transport and entrainment reductions) with reduced Delta outflow requirements. These savings in releases from storage and outflow requirements would then become available for export. Relocated Delta export intakes with best available screening facilities will substantially increase the opportunities for diversion of Sacramento River inflows that are not required for estuarine habitat and salinity control. Major river diversions should be relocated to upstream of the riverine habitat area. Cooling towers for the PGE Delta power plants should be constructed to reduce the entrainment effects in the expanded estuarine habitat. Pulse flows with export curtailment would be used to transport riverine larvae into the estuarine entrapment zone used for rearing and to help protect vulnerable anadromous life stages during migration periods. In-Delta storage is used to capture high Delta inflows (greater than export capacity and Delta outflow requirements). Delta storage could then be released for subsequent adaptive management of Delta outflow for estuarine habitat management and salinity control.

ACTIONS SELECTED (in addition to core actions)

Bay-Delta Habitat Restoration- restoration of estuarine habitat in the vicinity of the confluence; conversion of some agricultural land (e.g. Sherman Island) to shallow water and wetland habitats;

conversion of some non-tidal wetlands (e.g. Suisun Marsh) to tidal wetlands to increase estuarine fish habitat benefits.

Upstream Habitat Restoration-restoration of riverine and riparian habitat below all major reservoirs.

Reduction in Diversion Effects- construct cooling towers to eliminate PGE power plant cooling water entrainment; relocate diversions to upstream of riverine habitat used by anadromous fish; relocate Delta export intakes and provide best available screening facilities on Sacramento River.

Management of Anadromous Fish- real-time monitoring of anadromous fish migration with adaptive management of pulse flows and export curtailment to protect vulnerable fish during migration periods.

Reduction in Demands for Exports and Diversions-

Water Supply Enhancement and Predictability- adaptive management of instream flows, transport flows and Delta outflows to reduce existing instream flow and Delta outflow requirements; relocated Delta export intakes will substantially increase diversion opportunities.

Management of Water Quality- export water quality will be significantly improved because of the relocated export intakes on the Sacramento River; in-Delta storage will provide additional flexibility for salinity control.

Improvement to System Reliability/Vulnerability- water supply reliability will be substantially improved because of increased diversion opportunities; vulnerability may be improved because levee failure will not disrupt export water quality.

PRELIMINARY ASSESSMENT

Ecosystem Quality- Substantial improvement in both riverine and estuarine habitat conditions and associated fishery benefits; entrainment effects will be almost completely eliminated; in-Delta storage will be adaptively managed to provide pulse flows and estuarine habitat management..

Water Supply Reliability- Increased water supply reliability from reduced instream flow releases and reduced Delta outflow requirements; relocated export intakes will allow increased diversion opportunities while maintaining estuarine habitat and fish transport conditions.

Water Quality- Substantial improvement in export water quality will be achieved with the relocated export intakes to the Sacramento River; in-Delta storage will provide additional water for short-term flushing of central Delta and salinity control.

System Vulnerability- Improved water supply reliability will be achieved with the relocated intakes because diversion opportunities will be increased.

ALTERNATIVE 223: REDUCE COMPETITION FOR DELTA SUPPLIES BY EXPANDING OFF-STREAM STORAGE AND IMPROVING THROUGH DELTA CONVEYANCE.

Theme:	Reduce competition for water during critical periods by increasing supply availability.
Sub-theme:	Increase storage in the export area and develop an isolated conveyance facility.
Approach:	Develop new off-stream storage on the west side of San Joaquin Valley. Develop an east side Delta conveyance facility for export water.

SOLUTION OVERVIEW

This alternative is intended to reduce the competition of water supplies during critical periods by increasing the amount of available storage and increasing the ability to convey water to export facilities. Additional off-stream storage along the west side of the San Joaquin Valley and increased opportunities to deliver water to the export facilities would allow greater opportunities to capture a larger portion of flood/winter flows and manage captured flows for delivery to exporters. The isolated conveyance facility would be developed with the capacity to provide export water and environmental releases.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion Effects

In addition to core actions, additional actions included in this alternative include:

- Delta export management actions to modify export criteria.
- Relocate and consolidate pumping facilities away from key habitats.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports would remain unchanged.

Water Supply Enhancement and Predictability

Beyond the core actions in this category, actions would be selected to:

- Increase off-stream storage in the export areas (+500 TAF).
- Implement long-term planning for drought contingencies above core level implementation.
- Construct an isolated conveyance facility including siphons between Delta channels.

Management of Water Quality

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Improvement to System Reliability/Vulnerability

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

PRELIMINARY ASSESSMENT

Ecosystem Quality

Ecosystem quality is addressed only to the level of core actions.

Water Supply Reliability

Water supply reliability is the focus of this alternative. The reliability is improved through the development of additional off-stream storage which would enable the capture of flood/winter flows which are currently not diverted from the Delta due to a lack of storage availability. The additional storage would provide greater flexibility in managing export diversions and deliveries. In addition, opportunities to export water from the Delta will be increased with the development

of an isolated transfer facility.

Water Quality

Water quality is addressed only at the core level. However, the water quality of M&I and agricultural export supplies would be increased due to intake of the isolated conveyance facility's location on the Sacramento River.

System Vulnerability

System vulnerability is addressed only at the core level.

ALTERNATIVE 224: REDUCE COMPETITION FOR DELTA SUPPLIES BY EXPANDING OFF-STREAM STORAGE AND INCREASING THE DELTA EXPORT CAPACITY

Theme: Reduce competition for water during critical periods by increasing supply availability.

Sub-theme: Increase storage in the export area and increase Delta export capacity.

Approach: Develop new off-stream storage on the west side of the San Joaquin Valley.

Increase the pumping and conveyance capacities of Delta export facilities.

SOLUTION OVERVIEW

This alternative is intended to reduce the competition for water supplies during critical periods by increasing the amount of available storage and increase the capacity to export flows from the Delta. Additional off-stream storage along the east side of the San Joaquin Valley and increased capacities to divert water from the Delta would allow larger opportunities to capture a greater portion of flood/winter flows and manage captured flows for delivery to exporters.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion Effects

In addition to core actions, Delta export management actions would include:

- Modification of export criteria.
- Modification of diversion timing for in-Delta diversions.
- Enlargement of export pumping and conveyance capacities to generate yield and reduce impacts.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports would remain unchanged.

Water Supply Enhancement and Predictability

Beyond the core actions in this category, the major actions selected for this alternative are:

- Increase off-stream storage in the export areas (+500 TAF).
- Store groundwater south of the Delta for long-term drought supply augmentation.
- Implement long-term planning for drought contingencies above core level implementation.

Management of Water Quality

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Improvement to System Reliability/Vulnerability

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

PRELIMINARY ASSESSMENT

Ecosystem Quality

Ecosystem quality is addressed only to the level of core actions.

Water Supply Reliability

Water supply reliability is the focus of this alternative. The reliability is improved through the development of additional off-stream storage south of the Delta and increased pumping and conveyance capacities at the export facilities. This alternative would allow for a greater portion of the flood/winter flows to be diverted from the Delta. The additional storage would also

provide greater flexibility in managing export diversions and deliveries. The ability to divert and store excess Delta flows, when they occur, would increase the yield available for export and decrease competition for existing supplies.

Water Quality

Water quality is addressed only at the core level. However, the water quality of M&I and agricultural export water could be increased by increasing the diversions made during winter flows.

System Vulnerability

System vulnerability is addressed only at the core level.

ALTERNATIVE 225: REDUCE COMPETITION FOR DELTA SUPPLIES BY EXPANDING OFF-STREAM STORAGE AND INCREASING IN-DELTA STORAGE CAPABILITIES

Theme: Reduce competition for water during critical periods by increasing supply availability.

Sub-theme: Increase storage in the export area and develop storage facilities within the Delta.

Approach: Develop new off-stream storage on the west side of San Joaquin Valley. Develop storage within the Delta through conversion of Delta islands.

SOLUTION OVERVIEW

The alternative is intended to reduce the competition for water supplies during critical periods by increasing the storage capabilities along the east side of the San Joaquin Valley and within the Delta. Additional storage south of the Delta would provide storage capacity to divert winter/flood flows to the available export capacity. Currently the diversion of winter/flood flows is limited by storage capacity south of the Delta. In-Delta storage would allow an additional increment of winter/flood flows to be captured and exported when capacity is available. In-Delta storage could provide operational flexibility for transfers through the Delta. These two projects would increase the yield from the Delta, thereby reducing the competition for supplies during critical periods.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. The following core actions would be implemented to a higher level to mitigate the conversion of several Delta islands to storage facilities:

- Protect existing shallow habitats (action 1.2).
- Improve and protect riparian habitats (actions 4.1 and 4.4).
- Protect, enhance, and expand existing wetlands (actions 4.1, 4.2, and 4.4.).

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion Effects

In addition to core actions, additional actions included in this alternative include:

- Delta export management actions to modify export criteria.
- Modify diversion timing patterns.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports would remain unchanged.

Water Supply Enhancement and Predictability

Beyond the core actions in this category, actions would be selected to:

- Increase off-stream storage in the export areas (+500 TAF).
- Construct in-Delta storage facilities (Bacon Island and Webb Tract).
- Establish conjunctive-use programs for long-term drought contingency south of the Delta.

Management of Water Quality

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Improvement to System Reliability/Vulnerability

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

PRELIMINARY ASSESSMENT

Ecosystem Quality

Ecosystem quality is addressed only to the level of core actions.

Water Supply Reliability

Water supply reliability is the focus of this alternative. The reliability is improved through the development of additional storage which would enable the diversion and capture of flood/winter flows which are currently undiverted due to lack of storage availability. The additional storage would provide greater flexibility in managing export diversions and deliveries.

Water Quality

Water quality is addressed only at the core level. However, the water quality of M&I and agricultural export supplies could be improved from increased diversions of winter/flood flows which are generally of better quality than diversions made during the summer and fall periods.

System Vulnerability

System vulnerability is addressed only at the core level.

ALTERNATIVE 226: REDUCE COMPETITION FOR DELTA SUPPLIES BY EXPANDING ON-STREAM STORAGE AND IMPROVING THROUGH DELTA CONVEYANCE.

Theme:	Reduce competition for water during critical periods by increasing supply availability.
Sub-theme:	Increase storage upstream of the Delta and develop an isolated conveyance facility.
Approach:	Develop new on-stream storage on the east side of the Sacramento Valley. Develop an east side Delta conveyance facility for export water.

SOLUTION OVERVIEW

This alternative is intended to reduce the competition for water supplies during critical periods by increasing the amount of available storage and increasing the ability to convey water to export facilities. Additional on-stream storage along the east side of the Sacramento Valley would provide greater opportunities to increase yields from the east side watersheds and reduce winter/flood flow losses. An isolated conveyance facility would increase the efficiency of water deliveries to the export facilities. The isolated conveyance facility would be developed with the capacity to provide export water as well as environmental releases to the south Delta channels.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of the following core actions would be elevated to mitigate the development of an isolated conveyance facility around the east side of the Delta:

- Enhance and protect existing and acquired wetlands.
- Enhance and protect existing and acquired riparian areas.

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion Effects

In addition to core actions, additional actions included in this alternative include:

- Delta export management actions to modify export criteria.
- Relocate and consolidate pumping facilities.

The increased yield from upstream watersheds and the increased efficiency of transporting water through the Delta will decrease the competition for Delta supplies during critical periods.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports would remain unchanged.

Water Supply Enhancement and Predictability

Beyond the core actions in this category, actions would be selected to:

- Increase on-stream storage upstream of the Delta.
- Implement long-term planning for drought contingencies above core level implementation.
- Construct an isolated conveyance facility including siphons between Delta channels.
- Relocate Delta pumps from key habitats.

Management of Water Quality

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Improvement to System Reliability/Vulnerability

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

PRELIMINARY ASSESSMENT

Ecosystem Quality

Ecosystem quality is addressed only to the level of core actions.

Water Supply Reliability

Water supply reliability is the focus of this alternative. The reliability is improved through the development of additional on-stream storage which would enable the capture of flood/winter flows which are spilled, released for flood control measures, or captured from currently unregulated streams. In addition, opportunities to export water from the Delta will be increased with the development of an isolated transfer facility.

Water Quality

Water quality is addressed only at the core level. However, the water quality of M&I and agricultural export supplies would be increased due to intake of the isolated conveyance facility's location on the Sacramento River.

System Vulnerability

System vulnerability is addressed only at the core level.

ALTERNATIVE 227: REDUCE COMPETITION FOR DELTA SUPPLIES BY EXPANDING OFF-STREAM STORAGE AND IMPROVING THROUGH DELTA CONVEYANCE.

Theme: Reduce competition for water during critical periods by increasing supply availability.

Sub-theme: Increase storage upstream of the Delta and develop an isolated conveyance facility.

Approach: Develop new off-stream storage on the west side of the Sacramento Valley. Develop a west side Delta conveyance facility for west side irrigation deliveries.

SOLUTION OVERVIEW

This alternative is intended to reduce the competition for water supplies during critical periods by increasing the amount of available off-stream storage and increase the efficiency of deliveries to west side Sacramento Valley irrigators. Additional off-stream storage along the west side of the Sacramento Valley would provide opportunities to capture winter/flood flows from the Sacramento River and west side tributaries. A large west side isolated conveyance facility would connect the upper Sacramento River (above Keswick) to off-stream reservoirs and delivery points along the west side of the Sacramento River. A west side conveyance facility would replace west side irrigation diversions on the Sacramento River thereby reducing diversion impacts on the Sacramento River. The west side conveyance facility could also be connect to the Delta and export facilities as an expanded project.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of the following core actions would be unchanged by this alternative.

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion Effects

In addition to core actions, additional actions included in this alternative include:

- Reduce upstream diversions
- Delta export management actions to modify export criteria.
- Relocate and consolidate pumping facilities.

The increased yield from upper Sacramento River and increased efficiency of deliveries to the west side Sacramento Valley will decrease the competition for Delta supplies during critical periods.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports would remain unchanged.

Water Supply Enhancement and Predictability

Beyond the core actions in this category, actions would be selected to:

- Increase off-stream storage upstream of the Delta and along the west of the Sacramento Valley.
- Implement long-term planning for drought contingencies above core level implementation.
- Construct an isolated conveyance facility along the west side of the Sacramento Valley.

Management of Water Quality

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Improvement to System Reliability/Vulnerability

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

PRELIMINARY ASSESSMENT

Ecosystem Quality

Ecosystem quality is addressed only to the level of core actions.

Water Supply Reliability

Water supply reliability is the focus of this alternative. Reliability is improved in this alternative by increasing the yield from the upper Sacramento River and storage capabilities along the west side of the Sacramento Valley. New and expanded west side Sacramento Valley storage would be used to store excess winter and flood flows of the Sacramento River and west side tributaries. This alternative would increase the supply availability during critical periods, thereby decreasing competitions during these critical periods.

Water Quality

Water quality is addressed only at the core level.

System Vulnerability

System vulnerability is addressed only at the core level.

ALTERNATIVE 228: REDUCE COMPETITION FOR DELTA SUPPLIES BY EXPANDING STORAGE IN ALL AREAS AND IMPROVING THROUGH DELTA CONVEYANCE.

Theme:	Reduce competition for water during critical periods by increasing supply availability.
Sub-theme:	Increase storage through the system and develop an isolated conveyance facility.
Approach:	Develop new or expanded storage upstream of the Delta. Develop new or expanded storage within the Delta. Develop new or expanded storage in the export areas. Develop an east side Delta conveyance facility.

Solution Overview

This alternative is intended to reduce the competition for water supplies during critical periods by increasing the amount of available storage throughout the system and increase the efficiency of deliveries to the export facilities with an isolated conveyance facility. Additional storage would provide opportunities to capture winter and flood flows originating upstream of the Delta and manage export diversions from the Delta. An isolated conveyance facility along the east side of the Delta would increase the efficiency of water movement to the export facilities and potentially provide flows for the south Delta.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. However, to mitigate habitat losses associated with the development of an isolated conveyance facility the following core actions would be implemented at a higher level:

- Protect existing shallow habitats (action 1.2).
- Improve and protect riparian habitats (actions 4.1 and 4.4).
- Protect, enhance, and expand existing wetlands (actions 4.1, 4.2, and 4.4.).

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. However, to mitigate habitat losses associated with the development of additional storage facilities the following core actions would be implemented at a higher level:

- Protect riparian habitats (action 11.3).
- Restore flows to dewatered riparian habitats (actions 11.4).

Reduction in Diversion Effects

In addition to core actions, additional actions included in this alternative include:

- Modify upstream diversion operations and Delta inflow timing patterns (actions 13.2 and 13.3).
- Delta export management actions to modify export criteria (action 14.2, 15.1, and 15.2).
- Obtain approvals to fully utilize existing export capacity for yield and to reduce diversion impacts (actions 16.1 and 16.2).

The increased yield from new or expanded storage upstream of the Delta and additional storage to manage Delta exports will decrease the competition for Delta supplies during critical periods.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports would remain unchanged.

Water Supply Enhancement and Predictability

Beyond the core actions in this category, actions would be selected to:

- Increase storage upstream of the Delta (actions 30.2, 31.2, and 33.2).
- Increase storage in the export areas (actions 31.1, 32.2, and 33.1).
- Construct an isolated conveyance facility along the east side of the Delta away from key habitat areas (actions 35.1 and 36.1).

Management of Water Quality

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Improvement to System Reliability/Vulnerability

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

PRELIMINARY ASSESSMENT

Ecosystem Quality

Ecosystem quality is addressed only to the level of core actions.

Water Supply Reliability

Water supply reliability is the focus of this alternative. Reliability is improved in this alternative by increasing the yield from upstream of the Delta and developing new storage within and to the south of the Delta. These storage facilities would be managed to provide better management and opportunities for export diversions.

Water Quality

Water quality is addressed only at the core level. The development of an isolated conveyance facility, however, would improve the quality of water delivered for exports. This facility could also provide flows for the south Delta to improve water quality.

System Vulnerability

System vulnerability is addressed only at the core level. Secondary benefits from new or expanded storage upstream of the Delta would be increased flood protection.

ALTERNATIVE 229: REDUCE COMPETITION FOR DELTA SUPPLIES BY EXPANDING STORAGE IN ALL AREAS AND IMPROVING THROUGH DELTA CONVEYANCE.

Theme:	Reduce competition for water during critical periods by increasing supply availability.
Sub-theme:	Increase storage through the system and expand pumping and conveyance capacities of export facilities.
Approach:	Develop new or expanded storage upstream of the Delta. Develop new or expanded storage within the Delta. Develop new or expanded storage in the export areas. Expand pumping and conveyance capacities for export facilities.

Solution Overview

This alternative is intended to reduce the competition for water supplies during critical periods by increasing the amount of available storage throughout the system and increase pumping and conveyance capacities of the export facilities. Additional storage would provide opportunities to capture winter and flood flows originating upstream of the Delta and manage export diversions from the Delta. Expanded pumping and conveyance capacities of export facilities would provide more opportunity to export excess winter and flood flows in the Delta to storage facilities. Operating in this manner would increase the yield from the Delta, in addition the increased yield developed from expanded upstream storage. This additional yield would be managed to reduce the demand for Delta supplies during critical periods.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

No actions above those identified as core actions were selected in this category. However, to mitigate habitat losses associated with the development of an in-Delta storage facility the following core actions would be implemented at a higher level:

- Protect existing shallow habitats (action 1.2).
- Improve and protect riparian habitats (actions 4.1 and 4.4).
- Protect, enhance, and expand existing wetlands (actions 4.1, 4.2, and 4.4.).

Upstream Habitat Restoration

No actions above those identified as core actions were selected in this category. However, to

mitigate habitat losses associated with the development of additional storage facilities the following core actions would be implemented at a higher level:

- Protect riparian habitats (action 11.3).
- Restore flows to dewatered riparian habitats (actions 11.4).

Reduction in Diversion Effects

In addition to core actions, additional actions included in this alternative include:

- Modify upstream diversion operations and Delta inflow timing patterns (actions 13.2 and 13.3).
- Delta export management actions to modify export criteria (action 14.2, 15.1, and 15.2).
- Obtain approvals to expand export capacity for yield (actions 16.3).

The increased yield from new or expanded storage upstream of the Delta and additional storage to manage Delta exports will decrease the competition for Delta supplies during critical periods.

Management of Anadromous Fish

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Reduction in Diversion/Export Reliance

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative. Reliance on Delta exports would remain unchanged.

Water Supply Enhancement and Predictability

Beyond the core actions in this category, actions would be selected to:

- Increase storage upstream of the Delta (actions 30.2, 31.2, and 33.2).
- Increase storage in the export areas (actions 31.1, 32.2, and 33.1).
- Convert selected Delta islands to storage facilities (action 35.8)

Management of Water Quality

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

Improvement to System Reliability/Vulnerability

No actions above those identified as core actions were selected in this category. The implementation level of core actions would be unchanged by this alternative.

PRELIMINARY ASSESSMENT

Ecosystem Quality

Ecosystem quality is addressed only to the level of core actions.

Water Supply Reliability

Water supply reliability is the focus of this alternative. Reliability is improved in this alternative by increasing the yield from upstream of the Delta and developing new storage within and to the south of the Delta. These storage facilities would be managed to provide better management and opportunities for export diversions.

Water Quality

Water quality is addressed only at the core level.

System Vulnerability

System vulnerability is addressed only at the core level. Secondary benefits from new or expanded storage upstream of the Delta would be increased flood protection.

Alternative 230:
Title: Reduce Competition for Delta Water Supplies Through Increased Flood Flow Use in the San Joaquin Valley

Theme: Reduce competition for water during critical periods by increasing supply availability.

Sub-theme: Increase storage and conveyance along the eastside San Joaquin Valley (on and off-stream storage) with an isolated conveyance facility.

Approach: Increase ability to capture, convey, and manage surplus water along the eastside San Joaquin Valley to increase supply for beneficial use.

Solution Overview
This alternative is intended to reduce the competition for water supplies during critical periods by developing an isolated eastside\San Joaquin Valley conveyance facility to directly provide increased agricultural and environmental water supply to the San Joaquin Valley and to indirectly provide increased supply to the Delta for all beneficial uses. Such a facility would capture, store and convey otherwise unregulated flood flows from the American River in the north and tie into all major eastside tributaries before terminating near Bakersfield. The captured flows would be stored to meet a portion of the needs in the San Joaquin Valley during periods of high competition for water, resulting in more water supply available to the Delta for all beneficial uses.

Actions Selected

Bay-Delta Habitat Restoration
No actions above the those identified as core actions were selected for this category.

Upstream Habitat Restoration
No actions above the those identified as core actions were selected for this category.

Reduction in Diversion Effects
In addition to the core actions, the following actions have been included:
- Increased eastside conveyance and off-stream storage to capture otherwise unregulated flood flows from the American River and eastside tributaries, for use in the San Joaquin Valley thus reducing Delta export levels.

Management of Anadromous Fish
No actions above the those identified as core actions were selected for this category.

Reduction in Diversion/Export Reliance
In addition to the core actions, the following actions have been included:
- Increased eastside conveyance capacity

- Increased eastide storage
- Increased southern San Joaquin Valley storage

Water Supply Enhancement and Predictability
In addition to the core actions, the following actions have been included:
- Increased eastside conveyance and off-stream storage
- Increased off-stream storage in southern San Joaquin Valley
- Implement long-term planning for drought contingencies above core level implementation.

Management of Water Quality
No actions above the those identified as core actions were selected for this category.

Improvement to System Reliability/Vulnerability
In addition to the core actions, the following actions have been included:
- Increase downstream flood protection by coordinating operation eastside\San Joaquin Valley conveyance and storage facility with existing operations.

Preliminary Assessment

Ecosystem Quality
Ecosystem quality is addressed to the level of core actions.

Water Supply Reliability
Water supply reliability is the primary objective of this alternative. Reliability is improved through the development of an eastside/San Joaquin Valley conveyance and storage facility that would capture flood flows from the American River and eastside tributaries as far south as the Bakersfield area. These captured flows would be used in the San Joaquin Valley during periods of high competition, thus reducing diversions from eastside tributaries during critical periods. This would result in an increase in overall water supply reliability by fully utilizing currently unmanaged flood flows.

Water Quality
Water Quality is addressed only at the core level.

System Vulnerability
Vulnerability to the system from downstream flooding would be decreased as periodic flood flows would be diverted before entering the Delta.

Section 4. Alternatives from Fisheries Team

CALFED - TRANSMITTAL
ALTERNATIVES SUBMITTED BY THE "A" TEAM

Don Wagenet (leader)
Stuart Robertson
David Batts
Jim Sherar
Tom Cannon

Jordan:

Enclosed please find an additional 24 alternatives descriptions, with annotated lists of actions attached per the format used as of 12/8/95. Our alternatives have been numbered to correspond to the attached matrix titled "ALTERNATIVE GENERATION FOR FISHERIES." Alternatives were numbered from left to right, top to bottom consistent with the handwritten numbers entered on the matrix. Themes are indicated by the two main columns. These two main columns are divided into separate "approach" sub-columns. Subthemes are indicated by the three rows. The subcolumn/approach columns should be read as "actions that could be taken" either upstream or in the Delta. This becomes evident as one reads the alternatives.

The matrix has a 30-alternative capacity. Five of the matrix alternatives were dropped, mostly because it was not possible to develop strong alternatives for taking upstream actions to benefit Delta fish species. However, nine new alternatives were added for a total of 34 (10 delivered 12/12 + 24 delivered 12/15).

The nine new alternatives cross approaches (natural production/hatchery production [330,331,332]; screens and barriers/consolidating diversions[333,334,335]; and consolidating diversions/operation and management [336,337,338]). Other alternatives tend to become repetitive, especially with those done for the third sub-theme (all fish spp). Other notes regarding the presentation of all alternatives delivered by this team include:

- The alternative numbered 313 (submitted on 12/12) is actually number 303 (see Tom Cannon for clarification);
- If subheadings within the larger section titled "Actions Selected" are missing, that means that core levels of implementation are assumed for core actions under that particular "super-category" heading. We assumed that some introductory text will be written to introduce the core actions set and to tell the reader that those actions will be implemented at the core level (at a minimum) for all alternatives.
- Core actions implemented at greater than core levels have been included on annotated lists, but are not necessarily identified as core actions in the narrative descriptions, because they may have been implemented at much higher levels in several alternatives.

Floppy disk copies are also enclosed.

The following table is an accounting of the alternatives submitted to date, and some notes clarifying their presentation.

If you have any questions regarding the enclosed narrative descriptions and attached lists of actions, please do not hesitate to call Don Wagenet at (916) 852-6166.

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ALTERNATIVES ACCOUNTING- 'A' TEAM

No	Author	Date Subm.	Notes
300	D. Batts	12/15	Includes list of actions and level of implementation (LOI)
301	D. Batts	12/15	Includes list of actions and level of implementation (LOI)
302	T. Cannon	12/12	Being submitted directly at JSA
303	T. Cannon	12/12	Being submitted directly at JSA
304	D. Wagenet	12/12	Includes list of actions
305	D. Wagenet	12/12	Includes list of actions
306	J. Sherar	12/15	Includes list of actions
307	J. Sherar	12/12	Includes list of actions
308	S. Robertson	12/12	Includes list of actions and level of implementation (LOI)
309	S. Robertson	12/12	Includes list of actions and level of implementation (LOI)
310	D. Batts	12/15	Includes list of actions and level of implementation (LOI)
311	D. Batts	12/15	Includes list of actions and level of implementation (LOI)
312	na	na	Dropped by T. Cannon - upstream actions na to Delta spp
313	T. Cannon	12/15	Being submitted directly at JSA
314	na	na	Dropped by D. Wagenet -see alter. 324
315	D. Wagenet	12/15	Includes list of actions
316	na	na	Dropped - better coverage of topics in alt. 326
317	J. Sherar	12/15	Includes list of actions
318	na	na	Dropped by S. Robertson - upstream actions na to Delta spp
319	S. Robertson	12/15	Includes list of actions and level of implementation (LOI)
320	D. Wagenet	12/15	Includes list of actions
321	D. Wagenet	12/15	Includes list of actions
322	T. Cannon	12/15	Being submitted directly at JSA
323	T. Cannon	12/15	Being submitted directly at JSA
324	D. Wagenet	12/15	Includes list of actions
325	D. Wagenet	12/15	Includes list of actions
326	J. Sherar	12/15	Includes list of actions
327	J. Sherar	12/15	Includes list of actions
328	na	na	Dropped by S. Robertson - upstream actions na to Delta spp
329	S. Robertson	12/15	Includes list of actions and level of implementation (LOI)
330	T. Cannon	12/15	Being submitted directly at JSA
331	T. Cannon	12/15	Being submitted directly at JSA
332	T. Cannon	12/15	Being submitted directly at JSA
333	S. Robertson	12/15	Includes list of actions and level of implementation (LOI)
334	S. Robertson	12/15	Includes list of actions and level of implementation (LOI)
335	S. Robertson	12/15	Includes list of actions and level of implementation (LOI)
336	S. Robertson	12/15	Includes list of actions and level of implementation (LOI)
337	S. Robertson	12/15	Includes list of actions and level of implementation (LOI)
338	S. Robertson	12/15	Includes list of actions and level of implementation (LOI)

ALTERNATIVE GENERATION FOR FISHERIES

THEME	INCREASE FISH PRODUCTIVITY (Theme #1)				REDUCE DIVERSION IMPACTS (Theme #2)					
Approach	Increase Natural Production		Increase Hatchery Production		Operation and Management		Screens and Barriers		Consolidate Diversions	
Sub-theme	UPSTREAM	DELTA	UPSTREAM	DELTA	UPSTREAM	DELTA	UPSTREAM	DELTA	UPSTREAM	DELTA
(1) Winter-run & other anadramous fish species	9, 10, 11, 12, 45 300 *DB*	301 *DB*	22 302 *TC*	22 303 *TC*	23 304 *DW*	23 305 *DW*	18, 19 306 35 ~~*DW*~~	18, 19, 41 307 35 ~~*DW*~~	35, 36 308 *SR*	35, 36 309 *SR*
(2) Bay-Delta native fish species	310 *DB*	1, 4 311 *DB*	22 312 *TC*	22 313 *TC*	314 *DW*	15, 17.2 315 *DW*	316 *DW*	18, 19, 41 317 *DW*	318 *SR*	319 *SR*
(3) All fish species (includes T&E)	9, 10, 11, 12, 45 320 *DB*	1, 4, 2, 3, 6, 7 321 *DB*	22 322 *TC*	22 323 *TC*	13, 20, 21, 39, 44, 23 324 *DW*	13, 14, 20, 21, 39, 44, 23, 15, 17.2 325 *DW*	18, 19 326 *DW*	18, 19, 41 327 *DW*	35, 36 328 *SR*	35, 36 329 *SR*
Potential Equity Actions	32.1		32.1		32.1		N/A		16+31.4	

TC: Increase Natural Production + Increase Hatchery Production for (1), (2), and (3) 330, 331, 332

SR: Consolidating Diversions + Screens and Barriers for (1), (2), and (3) 333, 334, 335
Consolidating Diversions + Operations and Management for (1), (2), and (3) 336, 337, 338

B-004098

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ALTERNATIVE #300
Enhancing Anadromous Fish Populations by Emphasizing Upstream Actions that Increase Fish Productivity

Theme:	Enhance fish populations through increased productivity.
Sub-Theme:	Emphasize winter-run chinook salmon and other anadromous species.
Approach:	Increase natural production by upstream actions.

Solution Overview

This alternative is intended to enhance natural production and survival of anadramous fish species that inhabit and transit the Bay-Delta, including winter-run chinook salmon. The alternative emphasizes actions that would either directly or indirectly increase anadramous fish populations by improving upstream habitat conditions. Such actions would enhance spawning habitats, reduce hazards in migration waterways, increase stream flows, reduce temperatures, and improve riverine and riparian habitat. Restoration of Bay-Delta habitat would be implemented to improve feeding, resting, and migration. To meet anadromous fish stream flow requirements and other user demands, upstream water supplies would be supplemented through incentive based conjunctive use programs. Increased anadromous fish populations would improve diversity and quality of the Bay-Delta ecosystem and provide increased sport and commercial fishery opportunities.

Actions Selected

Bay-Delta Habitat Restoration:

Core actions that emphasize protection and restoration of Delta riverine and riparian habitat, including riparian improvement plantings, would be implemented at higher than minimum levels. These actions would improve nearshore habitat, especially for stripped bass, and benefit fish migration through the Delta. No actions above the core actions are included in this category.

Upstream Habitat Restoration:

Restoration of upstream anadramous fish habitat is the primary objective of this alternative. All actions that would restore upstream habitats and improve spawning and migration conditions would be implemented to a maximum extent. Spawning gravel, channel configurations, and shoreline habitat would be restored to enhance spawning and egg/alevin development. Flows and temperatures would be managed to reduce egg/alevin mortality and benefit fry development. Flows for regulating temperature would be most critical during the winter-run incubation period (approximately May through October). Dams and natural barriers would be modified to improve passage and mining activities would be modified to protect spawning habitat. Upstream riparian and wetland habitat would be revegetated and restored to provide shading, snags, detritus, and other physical features essential to fish development. All core actions would be implemented to the maximum extent.

Reduce Effects of Diversions:

No actions above the core actions are included in this category. Instream pulse flows would be implemented during emigration periods and flows for fish attraction would be conducted during immigration periods. These flows would meet the Anadromous Fish Restoration Program (AFRP) recommendations. Screens would be installed on upstream diversions where cost-effective.

Enhancement of Anadromous Fish Populations:

No actions above the core actions are included in this category. All hatchery-bred anadromous fish would be tagged for monitoring and best available technology would be used to reduce effects of hatchery stocks on wild populations. Captive breeding programs would be set up for winter-run chinook salmon to enhance population levels. Existing hatcheries would not be expanded and no new hatcheries would be constructed.

Reducing the Reliance on Delta Exports:

No actions above the core actions are included in this category. Implementation of these actions would be at the core level.

Enhance Water Supplies:

Management of flows and temperatures in upstream habitats would require additional water supply. To achieve supply levels and maintain reliable flows for other users, economic incentives for the development of conjunctive use programs would be implemented. These programs would use market incentives to encourage upstream water users to supplement their surface water supplies with ground water pumping where available. No other actions above the core actions are included in this category.

Increase Supply Predictability:

No actions above the core actions are included in this category. Implementation of these actions would be at the core level.

Managing Water Quality:

No actions above the core actions are included in this category. As a direct benefit to winter-run chinook salmon, abandoned mining sites would be remediated and mining drainage would be managed to remove toxics to the maximum feasible extent.

Improving System Water Reliability:

No actions above the core actions are included in this category. Implementation of these actions would be at the core level.

Preliminary Assessment

This alternative would restore natural elements of upstream watersheds, and to a lesser degree the Delta, to enhance natural production of anadromous fish. Increasing anadromous fish populations would benefit the Bay-Delta and its water users by restoring the ecosystem, thereby increasing species diversity, harvest levels, and sport fishing opportunities. Although results of this approach may take longer than hatchery based alternatives, it would increase the likelihood of obtaining a sustainable wild population of winter-run chinook salmon. Such a sustainable population could lead to the delisting of the species and remove existing operational and land use constraints imposed by the Endangered Species Act. The primary trade-off of this approach is increased flows during migration and spawning periods. These flows may reduce the amount of water available for other users during these times. To augment this effect, regional conjunctive use incentive programs would have to be implemented to supplement surface water uses with ground water. In addition, new off-stream storage facilities upstream of Delta may be constructed and existing off-stream storage reserviors enlarged. There are no actions that would offset any effects from modification of gravel mining practices.

DETAILED LIST OF ACTIONS SELECTED: ALTERNATIVE 300

- All core actions will be implemented at core levels unless noted otherwise below. core actions are indicated by "C" prior to the action number.

Bay-Delta Habitat Restoration:

C3.1 - Improve and protect degraded riparian habitats - maximum (to all degraded riparian areas to enhance habitat quality)

Upstream Habitat Restoration:

C9.1 - Manage flows and temperatures in upstream habitats - Max.
C9.2 - Restore and replenish spawning gravel - Max.
9.3 - Restore channel configurations - 50% of Max.
9.4 - Restore shoreline habitat conditions - Max.
C9.5 - Modify gravel mining practices - Max.
9.6 - Improve floodway drainage to reduce fish stranding - Max.

C10.1 - Modify passage at upstream dams/other barriers - Max.
C10.2 - Modify natural barriers to improve fish passage - 75% of Max.

C11.1 - Restrict livestock grazing in riparian corridors - Max.
C11.2 - Revegetate degraded riparian habitats - Max.
11.3 - Protect riparian lands through purchase/easement - 25% of Max.

Reduce Effects of Diversions:

C13.4 - Provide instream pulse flows for fish passage - Max.
C13.5 - Provide instream flows for fish attraction - Max.

C14.3 - Use real-time monitoring and adaptive mgt. - Max.

C18.4 - Install screens on Delta diversions - Max. (or as cost-effective)
C18.6 - Enforce sreening requirements - Max.

21.2 - Harvest predators in upstream habitats - 50% Max.

Enhancement of Anadromous Fish Populations:

C22.3 - Improve hatchery operations - Max.
C22.4 - Reduce hatchery effects on wild fish populations - 50% of Max.
C22.5 - Implement tagging of hatchery-bred fish - Max.
C22.6 - Establish new captive breeding programs - Max.

Reducing the Reliance on Delta Exports:

Core actions at core levels only.

Enhance Water Supplies:

C29.2 - Manage riparian zone to protect water quality - Max.
C29.3 - Manage land uses to protect water quality - Max.

31.2 - Construct new off-stream storage facilities upstream of Delta- 50% Max. (equity measure)
31.4 - Enlarge existing off-stream storage reserviors - 50% of Max. (equity measure)

32.1 - Establish conjunctive use programs - Max. (equity measure)

Increase Supply Predictability:

Core actions at core levels only.

Managing Water Quality:

C45.1 - Manage discharges from abandoned mines - Max.
C45.2 - Remediate abandoned mining sites discharging pollutants - Max.

Improving System Water Reliability:

Core actions at core levels only.

ALTERNATIVE #301
Enhancing Anadromous Fish Populations by Emphasizing Delta Actions that Increase Fish Productivity

Theme:	Enhance fish populations through increased productivity.
Sub-Theme:	Emphasize winter-run chinook salmon and other anadromous species.
Approach:	Increase natural production by actions that can be implemented in the Delta.

Solution Overview

This alternative is intended to enhance natural production and survival of anadramous fish by improving habitat, flow, and water quality conditions of the Bay-Delta. These improvements would be designed to favor fisheries production and restore historical conditions were feasible. Actions that increase flows for fish attraction and enhance aquatic and riparian habitat would be implemented to improve immigration conditions. Actions benefiting fry emigration would include pulse flows, riparian cover, and increased foraging opportunities. Culmination of these actions would enhance flow regimes, substrate diversity, shading and snags, detritus, and macro invertebrates. In addition to direct benefits to anadromous fish species, this alternative will indirectly improve the overall diversity and quality of the Delta, thereby enhancing other fish species populations. To meet anadromous fish flow requirements and other user demands, water supplies would be supplemented through incentive based conjunctive use programs.

Actions Selected

Bay-Delta Habitat Restoration:

Bay-Delta habitat restoration is one of the primary objective of this alternative. All actions that would protect, improve, or expand existing Bay-Delta riparian and aquatic habitat would be implemented to the maximum extent. Delta riverine habitat would be improved by restoring non-shipping channel configurations, reconstructing river banks, and modifying construction practices to include riverine elements as a standard practice. Delta riparian habitat would be improved by restoring and protecting existing nearshore vegetation and establishing new areas of riparian habitat. Modifications in levee maintenance practices would remove rip-rap and replace it with native vegetation. Existing wetlands would be enhanced, expanded, and protected to provide protective cover, detritus, and macro invertebrates. Nuisance non-native predator species would be removed to reduce adverse effects on emigrating fry.

Upstream Habitat Restoration:

Although this alternative emphasizes in-Delta actions, upstream habitat restoration would be required to protect spawning areas and ensure alevins/fry development. All core actions that improve upstream anadromous fish habitat and fish passage would be implemented to the maximum extent. No actions above the core actions are included in this category. These actions would manage flows and temperatures, restore spawning gravel beds, modify gravel mining practices, and mitigate human made and natural barriers.

Reduce Effects of Diversions:

No actions above the core actions are included in this category. Instream flows for fish attraction and pulse flows for emigration would be conducted to a maximum level. Screening requirements would be enforced to a maximum extent and screens would be installed on in-Delta diversions where cost-effective. Other core actions that would reduce fish mortality or production rates would be implemented to the maximum extent feasible.

Enhancement of Anadromous Fish Populations:

No actions above the core actions are included in this category. All hatchery-bred anadromous fish would be tagged for monitoring and best available technology would be used to reduce effects of hatchery stocks on wild populations. Captive breeding programs for winter-run chinook would be implemented to the maximum extent feasible. However, existing hatcheries would not be expanded and no new hatcheries would be constructed. Regulation of commercial harvest and recreational take of anadromous species would be improved and strictly enforced. All other core actions would be implemented at the core level.

Reducing the Reliance on Delta Exports:

No actions above the core actions are included in this category. Implementation of these actions would be at the core level.

Enhance Water Supplies:

Management of flows and temperatures in the Delta and upstream would require additional water supply. To achieve supply levels and maintain reliable flows for other users, economic incentives for the development of conjunctive use programs would be implemented. These programs would use market incentives to encourage upstream water users to supplement their surface water supplies with ground water pumping where available. No other actions above the core actions are included in this category.

Increase Supply Predictability:

No actions above the core actions are included in this category. Implementation of these actions would be at the core level.

Managing Water Quality:

No actions above the core actions are included in this category. Core actions that would improve Delta ecological water quality, including management of agricultural and urban wastewater discharges, would be implemented above minimum levels.

Improving System Water Reliability:

No actions above the core actions are included in this category.

Preliminary Assessment

This alternative would restore aquatic and riparian elements of the Delta, and to a lesser degree upstream watersheds, to enhance natural production of anadromous fish species. The Delta and its users would benefit from this alternative because the actions would enhance the aquatic and riparian ecosystem, thereby increasing fish populations, riparian and aquatic species diversity, harvest levels, and sport fishing opportunities. Although results of this approach may take longer than hatchery based alternatives, it would increase the likelihood of maintaining a sustainable wild population of winter-run chinook, green sturgeon, and other sensitive anadromous species. Such sustainable populations could avoid federal and state protection and remove existing operational and land use constraints imposed by the Endangered Species Act. The primary trade-off of this approach is that the required increase in flows would reduce the amount of water available for other users during these times. To augment this effect, regional conjunctive use incentive programs would have to be implemented to supplement surface water uses with ground water.

DETAILED LIST OF ACTIONS SELECTED: ALTERNATIVE 301

- All core actions will be implemented at core levels unless noted otherwise below. core actions are indicated by "C" prior to the action number.

Bay-Delta Habitat Restoration:

1.4 - Reconstruct levees to include shallow water habitat - 25% of Max.

2.2 - Reconstruct river banks and shallow areas - Max.
C2.2 - Restore/preserve channel islands - Max.
C2.3 - Restore natural channel configurations - Max.
C2.4 - Modify construction practices to include riverine elements - Max.

C3.1 - Improve and protect degraded riparian habitats - Max.
3.2 - Establish new areas of riparian habitat - 50% max.
3.3 - Reestablish historic riparian areas - 50% max.
C3.4 - Modify levee maintenance practices - Max.
C3.5 - Protect existing riparian habitat - Max.

C4.1 - Enhance existing wetlands - Max.
C4.2 - Expand existing wetland acquisition program - 50% of Max.
C4.4 - Protect existing wetland habitat - Max.

5.4 - Clean up sites containing toxic substances - 50% of Max. (focus on sites with runoff to Delta)

6.2 - Allow river channels to meander - 50% Max.

7.1 - Remove or reduce nuisance species in key habitats - 50% Max. (focused on aquatic species)

Upstream Habitat Restoration:

C9.1 - Manage flows and temperatures in upstream habitats - Max.
C9.2 - Restore and replenish spawning gravel - Max.
C9.5 - Modify gravel mining practices - Max.

C10.1 - Modify passage at upstream dams/other barriers - 75% of Max.
C10.2 - Modify natural barriers to improve fish passage - 50% of Max.

C11.1 - Restrict livestock grazing in riparian corridors - Max.
C11.2 - Revegetate degraded riparian habitats - Max.

Reduce Effects of Diversions:

C13.4 - Provide instream pulse flows for fish passage - Max.
C13.5 - Provide instream flows for fish attraction - Max.

C14.3 - Use real-time monitoring and adaptive mgt. - Max.

C18.4 - Install screens on Delta diversions - Max. (or as cost-effective)
C18.6 - Enforce screening requirements - Max.

C20.2 - Improve operation of fish salvage facilities - Max.

C20.3 - Improve fish hauling and release procedures - Max.

21.1 - Harvest predators at Delta export pumps - 50% Max.

Enhancement of Anadromous Fish Populations:

C22.3 - Improve hatchery operations - Max.
C22.4 - Reduce hatchery effects on wild fish populations - Max.
C22.5 - Implement tagging of hatchery-bred fish - Max.
C22.6 - Establish new captive breeding programs - Max.

Reducing the Reliance on Delta Exports:

Core actions at core levels only.

Enhance Water Supplies:

C29.2 - Manage riparian zone to protect water quality - Max.
C29.3 - Manage land uses to protect water quality - Max.
32.1 - Establish conjunctive use programs - Max. (equity measure)

Increase Supply Predictability:

Core actions at core levels only.

Managing Water Quality:

Core actions at core levels only.

Improving System Water Reliability:

Core actions at core levels only.

Enhance Anadromous Fish Populations by Emphasizing Increasing Hatchery Production and Upstream Habitat Improvements.

Identification of Theme, Subtheme, and Approach:

Theme: Enhance anadromous fish populations by increasing hatchery production and improving upstream fish productivity.
Subtheme: Emphasize winter-run chinook salmon and other anadromous species
Approach: Operation and management actions that could be implemented at hatcheries and upstream locations.

Solution Overview
This alternative places primary emphasis on increasing hatchery production and improving upstream conditions to enhance anadromous fish populations. Actions to increase hatchery production of anadromous fish would receive the highest priority. Core actions to enhance fish populations, including restoration of upstream anadromous fish and riparian habitat, and improving fish passage would also be implemented at a higher level of priority emphasis, in order to substantially increase the overall production of anadromous population. Hatchery operations would be expanded to increase salmon, steelhead, and perhaps sturgeon and striped bass populations. New hatcheries would be constructed on the San Joaquin River tributaries to increase salmon and steelhead runs in that watershed. Efforts to reduce conflicts with wild population restoration would be held at the core action level.

Actions Selected

Restore Upstream Habitats

Core actions to manage flows and temperatures and restore and replenish spawning gravels would be enhanced to high levels to improve anadromous fish production.

Enhance Anadromous Fish Populations

Populations of salmon, steelhead, and perhaps sturgeon and striped bass would be enhanced directly through expanding existing hatchery operations and constructing new hatcheries. Upstream fish habitat and passage would be improved to further increase populations. Upstream habitat restoration actions would be directed towards providing improved management of flows and temperatures in upstream habitats, in combination with the restoration and replenishment of historically depleted spawning gravels would provide even greater improvements to spawning and rearing conditions throughout anadromous fish ranges.

Manage Water Quality

Improved management of mine drainage, through better controls on discharges from abandoned mines, and more expenditures and actions to remediate abandoned mining sites discharging pollutants would achieve important benefits for anadromous populations.

Improve System Reliability

Improved management of upstream flows, temperatures, and riverine/riparian habitats will require that more surface water be dedicated to targeted areas, especially as tributary and upper river flows. In order to increase supply reliability for diverters, this alternative also would include strong economic incentives for the implementation of conjunctive use programs. Specifically, market incentives encouraging agricultural diverters in upstream locations to augment existing surface water supplies with available ground water pumping would be implemented.

Preliminary Assessment

This alternative emphasizes improvements to anadromous fish populations and habitat by placing the greatest priority on actions that could be implemented on hatchery production supplemented with some additional improvements in upstream habitat. Increased hatchery production of anadromous fish could place more competitive and predator pressures on wild populations of anadromous and resident fishes. In order for these actions to be durable, a long-term reduction in the reliability that existing diverters have on surface supplies would result. It is therefore imperative that the conjunctive use programs and incentives be developed with terms and conditions that are economically attractive to surface water diverters, and which can effectively provide a better economic return for replacing surface water use with ground water use, especially in those regions where otherwise diverted surface waters will instead be dedicated to habitat and population improvements.

ALTERNATIVE 302 ACTIONS

SPECIFIC ACTION PACKAGE

Fish Hatchery Operations
Expand hatchery capacities
Construct new hatcheries on the San Joaquin R.

ENHANCED CORE ACTIONS

Restoration of Upstream Anadromous Fish Habitat
Manage flows and temperatures in upstream habitats
Restore and replenish spawning gravels
Modify gravel mining practices

Physical Improvements for Fish Passage
Modify passage at upstream dams/other barriers
Modify natural barriers to improve passage

Restoration of Upstream Riparian Habitat
Restrict livestock grazing in riparian corridors
Revegetate degraded riparian habitats

Management of Mine Drainage
Manage discharges from abandoned mines
Remediate abandoned mining sites discharging pollutants

PRELIMINARY ALTERNATIVE 303
(FISHERIES GROUP)

TITLE: **Enhance Anadromous Fish Populations by Emphasizing Increasing Hatchery Production and In-Delta Habitat Improvements.**

SOLUTION OVERVIEW

Theme. This alternative places primary emphasis on increasing hatchery production and improving in-Delta habitat conditions to enhance anadromous fish populations. Actions to increase hatchery production of anadromous fish would receive the highest priority. Hatchery operations would be expanded to increase salmon (especially winter-run chinook salmon), steelhead, and perhaps sturgeon and striped bass populations. New hatcheries would be constructed on the San Joaquin River tributaries to increase salmon and steelhead runs in that watershed.

Key Actions. The unique character of this alternative is represented by these actions:

- Expand hatchery production capacities for anadromous species
- Provide instream flows for fish attraction and passage
- Restore Bay-Delta shallow-water, riverine, and riparian habitats

ACTIONS SELECTED FOR THE ALTERNATIVE

Bay-Delta Habitat Restoration. Core actions to restore Delta shallow-water, riverine, and riparian habitats would be implemented at higher than core levels, including restore and preserve channel islands, protect existing shallow water habitat, enhance existing Delta wetlands and riparian habitats. These actions would provide more contiguous, diverse, and high quality nearshore habitats throughout the ranges of anadromous fish populations, but especially in critical Delta feeding and resting areas.

Upstream Habitat Restoration. Core actions to restore upstream anadromous fish habitats would also be implemented at higher than core levels. For example, flows and temperatures would be managed to maximum feasible levels and spawning gravels would be restored and replenished in most of the sites where feasible.

Reduction in Diversion Effects. Delta inflow management would be adjusted to provide instream flows for fish attraction, and Delta outflow/export management would use real-time monitoring and adaptive management to benefit flow and temperature conditions essential to support anadromous life-cycles as these fish move through the Delta. These core actions would be implemented in all important time periods for the target anadromous species (ie. at higher than core levels).

Management of Anadromous Fish. Populations of salmon, steelhead, and perhaps sturgeon and striped bass would be enhanced directly through expanding existing hatchery operations and constructing new hatcheries, especially on the San Joaquin River. Efforts to reduce adverse effects of hatchery fish on wild populations would be implemented at the core level of only the most cost effective reductions.

Reduction in Export Reliance. This alternative would rely only on core actions to manage demand in the export service areas. Reliance on Delta exports would remain unchanged.

Water Supply Enhancement. This alternative would include actions to provide strong economic incentives for the implementation of conjunctive use programs. Specifically, market incentives encouraging agricultural diverters in upstream locations to augment existing surface water supplies through improved groundwater management would be implemented.

Increasing Water Supply Predictability. This alternative also would rely only on core actions to increase water supply predictability in the export service areas, such as easing institutional barriers to water transfers, conducting Integrated Resources Planning in service areas where most cost effective, and coordinating land uses with water supplies.

Management of Water Quality. Improved controls on pollutant discharges in the Bay and Delta through better controls on agricultural, municipal, and industrial discharges would be implemented to achieve important benefits for anadromous populations living within or passing through the Bay-Delta. These actions would be implemented at higher than core levels.

Improvements to System Reliability. This alternative would rely only on core actions to improve the reliability of levees in the Delta to protect land use, infrastructure, and water quality.

PRELIMINARY ASSESSMENT

Ecosystem Quality. Ecosystem quality objectives would be well met by this alternative. Increased hatchery production of anadromous fish, however, could place more competitive and predator pressures on wild populations of anadromous and resident fishes.

Water Supply. This alternative could cause a long-term reduction in the reliability that existing diverters have on surface supplies. Conjunctive use programs and incentives are crucial to be developed with terms and conditions that are economically attractive to surface water diverters.

Water Quality. Water quality in the Delta would be addressed primarily to benefit fish populations. Therefore this alternative may not achieve the solution principle of equity in addressing water quality needs of all beneficial uses.

Reliability of Delta Functions. System reliability would be improved only to the core level of implementation, therefore, not achieving equity relative to this program objective.

Enhance Anadromous Fish Populations by Emphasizing In-Delta Actions that Reduce the Impacts of Diversions

Identification of Theme, Subtheme, and Approach

Theme:	Enhance fish populations by reducing diversion impacts.
Subtheme:	Emphasize winter-run chinook salmon and other anadromous species
Approach:	Operation and management actions that could be implemented at in-Delta locations.

Solution Overview

This alternative places primary emphasis on improving in-Delta conditions for anadromous fish populations. Actions to accelerate the installation of new fish screens at in-Delta diversions, and to improve existing screens that pose the greatest potential threat to anadromous species receive the highest priority. Actions to enhance fish populations, including improved fish harvest regulation and salvage management would also be implemented at a higher level of priority emphasis, in order to substantially increase the overall rate of anadromous population increases through in-Delta actions. Actions emphasizing the restoration of extensive historically higher quality Bay-Delta habitats receive high implementation priority in order to provide substantially improved feeding, resting, and cover areas more contiguously throughout the ranges of the anadromous species using the Delta. Fish screening and habitat improvements, and the removal of impediments to fish passage conditions in upstream areas would be implemented in coordination with in-Delta actions.

Actions Selected

Reduce Effects of Diversions

Anadromous fish population improvements would be focused and emphasized by greatly increasing the level of effort for installing and improving fish screens on in-Delta diversions, and through stronger enforcement of screening requirements at all diversions having the capability to entrain anadromous fish. Delta diversions allegedly having the greatest impact on listed anadromous fry and juveniles would receive the highest priority. The installation and improvement of fish screens on upstream diversions, and more expenditures on the enforcement of screening requirements at all diversions would be important and highly visible components of this alternative.

Restore Bay-Delta Habitats

Delta riverine and riparian habitat improvements, including channel improvements and riparian habitat restoration plantings would be emphasized in this alternative in to provide a more contiguous, diverse, and high quality nearshore habitat throughout the ranges of anadromous fish populations, but especially in critical Delta feeding and resting areas. Agricultural operations, specifically restricted livestock grazing in Delta riparian corridors, and the revegetation of degraded Delta riparian habitats would complement upstream habitat improvements and would achieve important habitat quantity and quality benefits for anadromous species. Delta inflow management would be adjusted to provide instream flows for fish attraction, and Delta

outflow/export management would use real-time monitoring and adaptive management to the benefit of flow and temperature conditions essential to successful anadromous life-cycles.

Enhance Anadromous Fish Populations
Actions directing tighter controls on fish harvest would receive very high priority in the implementation of this alternative. They would be coordinated with passage improvements, and would include stronger regulation and enforcement of commercial and recreational take of anadromous species, with more enforcement personnel in Delta waters. The improvement of fish salvage operations at the CVP and SWP pumps, including improved operation of salvage facilities, and reduced mortality through better fish hauling and release procedures also would be emphasized in this alternative. Anadromous fish populations would also be directly enhanced through physical improvements for fish passage at upstream locations, which would be implemented after in-Delta improvements. Upstream actions would have a primary goal of making passage easier at upstream dams and other barriers. Those man-made and natural barriers posing the greatest obstacles to candidate and listed anadromous species would receive higher priority among upstream actions in order to achieve immediate physical improvements.

Restore Upstream Habitats

Actions directed towards restoring upstream anadromous fish habitat, and upstream riparian habitat would be implemented at some level exceeding their minimum as a complement to the in-Delta focus of this alternative. Upstream habitat restoration actions would be directed towards providing better feeding, resting, and cover opportunities for outmigrating anadromous fish. Improved management of flows and temperatures in upstream habitats, in combination with the restoration and replenishment of historically depleted spawning gravels would provide even greater improvements to spawning and rearing conditions throughout anadromous fish ranges. This alternative would include actions requiring improved gravel mining management through restrictions on the timing and magnitude of in-channel operations that degrade anadromous fish habitat.

Manage Water Quality

Improved management of mine drainage, through better controls on discharges from abandoned mines, and more expenditures and actions to remediate abandoned mining sites discharging pollutants would achieve important benefits for anadromous populations.

Increase Supply Reliability

Improved Bay-Delta habitats and better management of upstream flows, temperatures, and riverine/riparian habitats will require that more surface water be dedicated to targeted areas, especially as Delta outflow. In order to increase supply reliability for diverters, this alternative also would include strong economic incentives for the implementation of conjunctive use programs. Specifically, market incentives encouraging agricultural, municipal, and industrial diverters in Delta and upstream locations to augment existing surface water supplies with available ground water pumping would be implemented.

Preliminary Assessment

This alternative emphasizes improvements to anadromous fish populations and habitat by placing the greatest priority on actions that could be implemented at in-Delta locations. The Restoration of Bay-Delta habitat needed for improving the quality of the range of habitat types used by anadromous species, and reduced effects of in-Delta diversions and fish screens would receive the highest priority. Additional upstream habitat improvements, fish screening installation and improved performance criteria, and improvements to fish passage are complementary, and affordable. In order for these in-Delta actions to be durable, a long-term reduction in the reliability that existing diverters have on surface supplies would result. It is therefore imperative that the conjunctive use programs and incentives be developed with terms and conditions that are economically attractive to surface water diverters, and which can effectively provide a better economic return for replacing surface water use with ground water use, especially in those regions where otherwise diverted surface waters will instead be dedicated to habitat and population improvements.

IMPROVE CONDITIONS FOR WINTER-RUN CHINOOK SALMON AND OTHER ANADRAMOUS FISH SPECIES BY REDUCING THE IMPACTS OF DIVERSIONS THROUGH THE INSTALLATION AND OPERATION OF FISH SCREENS AND BARRIERS UPSTREAM FROM THE DELTA (ALTERNATIVE 306).

Identification of Theme, Subtheme, and Approach

Theme: Enhance anadramous fish populations through reduced diversion impacts.
Sub-theme: Increase anadramous fish populations.
Approach: Installation and operation of upstream fish screens and barriers.

SOLUTION OVERVIEW

The overall strategy for this alternative is to enhance anadramous fish populations (including winter-run chinook salmon) by implementing upstream actions to improve fish passage. These actions were chosen to produce large-scale reductions in entrainment by implementing extensive fish screening programs in the upstream tributaries of the Delta. Improvements for upstream migration also feature prominently in this alternative, providing flow conditions and a system of barriers that recruit more fish for upstream spawning. In addition, pulse flows have been included to enhance down stream migration of juvenile fish. When implemented in concert with the core actions, this strategy builds considerable momentum and provides considerable benefits for winter-run salmon and other anadramous fish species.

ACTIONS SELECTED

Upstream Habitat Restoration: While this alternative focuses on population increases by decreasing entrainment, flow management actions have been added to enhance fish passage, including pulse and attraction flows at a maximum level. In addition, reservoir operations would be modified to improve instream flows where necessary.

Reduction in Diversion Effects: In addition to the core actions for the operation of a fish barrier on the Merced River, additional actions would be implemented to improve fish passage at wide-spread locations throughout the headwaters of Delta tributaries, including installation of new fish ladders at key diversions and repair and reoperation of existing passage facilities. Special attention would be focused on high profile barrier problems on the upper Sacramento River.

To increase the overall success of upstream and downstream migrations, several fish barriers (acoustical and physical) would be installed and operated, including barriers along the Mokelumne, San Joaquin, and Sacramento rivers. In addition, barriers would be placed in locations throughout the watershed to exclude or guide migrating fish away from gravel pits and other potentially detrimental situations.

To provide for the greatest possible upstream benefits for anadramous fish species several, core actions would be implemented at a maximum level, including installation of

new and improvement of existing fish screens (install screens on upstream diversions and increased enforcement of existing screening regulations). These actions would be complemented by in-Delta improvements specified by other core actions (in-Delta actions would be implemented at the core level).

Reduction in Export Reliance: To partially balance losses in exports due to implementation of flow modifications for fisheries enhancement, a variety of actions have been included including increased water conservation, expansion of water reclamation, land retirement and fallowing.

Water Supply Enhancement and Predictability: To buffer any losses in exports and to provide some level of equity to water users that may be indirectly affected by flow alterations, measures to increase water supply and flexibility have also been included within this alternative. These actions include expansion of on-stream or off-stream storage south of the Delta, implementation of groundwater banking and conjunctive use programs, and improvement of through Delta conveyance.

PRELIMINARY ASSESSMENT

This alternative has been designed to focus on the resolution of the fisheries and diversions conflict, centering on the issue of declining winter-run salmon and other anadramous fish species. Inclusion of core actions and additional actions to balance potential export losses associated with improvements in stream flow conditions ensure equity in this solution. The actions included within this alternative are reasonably affordable and implementable. Physical enhancement as well as improvements in operation and management of existing facilities provide guarantees that this alternative is durable. Careful review of the actions selected in this alternative does not revel any significant redirected impacts.

Actions Selected:

In addition to the Core Actions, this alternative includes several other actions included in the following list:

Delta Inflow Management

Decease upstream diversions

modify upstream reservoir operations

Installation of Barriers to Guide Fish Movement

Installation of new fish ladders at key diversions

Repair and reoperation of existing passage facilities.

Installation of fish barriers

Installation and Operation of Fish Screens

Install screens on upstream diversions

Increased enforcement of existing screening regulations

Reduction in Export Reliance

Water conservation

Water reclamation

Land retirement and fallowing

Groundwater Banking and Conjunctive Use

Establishment of conjunctive use programs

Store groundwater south of the Delta

Implement techniques to increase groundwater recharge

Improvement of Through-Delta Conveyance

Increase capacities of existing east-side channels

increase flows form the Sacramento River to the Central Delta

Modify Delta levees to increase flow cross section

IMPROVE CONDITIONS FOR WINTER-RUN CHINOOK SALMON AND OTHER ANADRAMOUS FISH SPECIES BY REDUCING THE IMPACTS OF DIVERSION THROUGHT THE INSTALLATION AND OPERATION OF FISH SCREENS AND BARRIERS WITHIN THE BAY-DELTA SYSTEM (ALTERNATIVE 307).

Identification of Theme, Subtheme, and Approach

Theme: Enhance anadramous fish populations through reduced diversion impacts.
Sub-theme: Increase anadramous fish populations.
Approach: Installation and operation of in-Delta fish screens and barriers.

SOLUTION OVERVIEW

This alternative focuses on reducing the conflict between anadramous fish species (including winter-run chnook salmon) and water diversions through the implementation of in-Delta actions to reduce entrainment and improve fish passage. In addition to the core actions, additional actions focusing on in-Delta fish screening and installation and operation of barriers to guide fish movement would be implemented. These actions would increase anadramous fish populations,

ACTIONS SELECTED

Bay-Delta Habitat Restoration: Implementation of the core habitat restoration action would provide benefits for anadramous fish populations, including resting, foraging, and nursery habitat. With the implementation of this alternative, habitat restoration within the Delta would focus on key habitat improvements for migrating fish populations, including restoration of shallow water habitat and shaded riverine aquatic habitat with a focus for providing resting habitat.

To minimize standing effects on species such as Sacramento splittail, drainage improvements would be implemented in floodway areas to maximize the productivity of these spawning areas, resulting in the net increase of fish from these areas.

Reduction in Diversion Effects: In-Delta improvement of anadramous fish conditions include the following actions that minimize in-Delta entrainment and greatly improve fish passage through the Delta during both upstream and downstream migrations.

To lower existing levels of entrainment, actions to be implemented at a maximum level throughout the Bay-Delta system include: improvements to existing fish screens at the Delta export pumps and other existing facilities; consolidation and screening of existing (small) in-Delta diversions; and conversion of industrial water use for cooling towers. Improvement of existing fish screening facilities will include improved performance criteria, including reduced approach and sweeping velocities.

Existing salvage operations for anadramous fish species may be enhanced through the implementation of predator control programs which remove predators and predator friendly habitats from key sites including Clifton Court Forebay, Rock Slough, Barker Slough, Montezuma Slough and others. This program may also include small scale habitat development to provide resting and escape cover at these sites.

To improve fish passage in the Delta, a system of barriers would be installed and operated for maximum benefit to fish, including the Old River fish barrier; a series of barriers at key points along the Sacramento River (designed to keep fish in the river), and barriers to divert fish from the Sacramento River toward the western islands. In addition, actions to improve in-Delta flows for fish would also be implemented at a maximum level, such as pulse and attraction flows.

To provide maximum in-Delta benefits for anadramous fish species several core actions would be implemented at a maximum level, including Delta inflow management, Delta outflow/export management, installation and improvement of fish screens (in-Delta), and improvement of in-Delta fish salvage operations. Other core actions focusing on upstream diversion effects would also be implemented, but at the core level.

Water Supply Enhancement and Predictability: Actions that would provide equity to those interests that may be adversely affected by flow modifications intended to improve anadramous fish populations, generally would include improved conjunctive use programs and incentives, increased surface water storage capacity, and inmproved export flexibility. Conjunctive use actions would include groundwater banking and more attractive incentives for groundwater recharge program initiation. Increased surface water storage capacity (north and/or south of the Delta), either on- or off-stream, would also be an integral component of this alternative, in order to compensate for deliveries that were reduced or otherwise adversity affected by actions intended to improve in-Delta flow conditions to anadramous fish populations. This could be done by either expanding the capacity of existing reservoirs, increasing in-Delta storage, re-operating some reservoirs to provide supply replacement, or by providing greater incentives for retiring some lands with high consumptive uses. As appropriate, this alternative also could include pump relocation and increased pumping capacity to the extent that these actions reduce impacts to winter-run and other anadramous fish species while increasing water supply flexibility.

PRELIMINARY ASSESSMENT

Implementation of these affordable actions in coordination with each other as put forth in this alternative would reduce conflicts between fishery resources and water diversion activities, by directly reducing in-Delta entrainment and improving fish passage. In conjunction with these actions, fish populations would be enhanced through implementation of core actions achieving a minimum amount of habitat restoration both upstream of and in the Delta. To become an equitable alternative, actions have been added for enhanced water supply and improved operational flexibility. To ensure durability, this alternative includes long-term habitat improvements and adaptive management that will increase winter-run and other anadramous fish populations in the long-run. This action does not relocate or redirect impacts from one user group to another.

Actions Selected:

In addition to the Core Actions, this alternative includes several other actions included in the following list:

Restoration of Upstream Anadramous Fish Habitat
Improve floodway drainage to reduce stranding
(to be implement at in-Delta locations)
Installation and Operation of Fish Screens
Improve screens at Delta export pumps
Improve other existing in-Delta screen systems
Convert water use of industrial water towers
Consolidation and screening of existing small in-Delta diversions
Installation of Barriers to Guide Fish Movement
Install fish barriers to black fish movent into Old River
Install barriers to keep fish in the Sacramento River
Install barriers to divert fish from Sacramento River toward western channels
Removal and Control of Aquatic Predators
Harvest predators at the Delta pumps
Control of Introduced Species
Modify habitat to favor native species
Groundwater Banking and Conjunctive Use
Establishment of conjunctive use programs
Store groundwater south of the Delta
Implement techniques to increase groundwater recharge
New or Expanded On-Stream Storage
Enlarge existing on-stream storage
New or Expanded Off-Stream Storage
Enlarge existing off-stream storage
Construct new off-stream storage facilities in Delta

Changes in Locations for Diversions

ALTERNATIVE 308: REDUCE UPSTREAM ANADROMOUS FISH DIVERSION IMPACTS AND ENHANCE OUTMIGRATION THROUGH THE BAY-DELTA USING CONSOLIDATED DIVERSIONS AND FLOW MANAGEMENT

Theme: Enhance fishery population through reduced diversion impacts.
Sub-Theme: Enhancing winter run and other anadromous fishery.
Approach: Consolidating and relocating diversions with emphasis on measures taken upstream of the Delta.

SOLUTION OVERVIEW

Alternative 308 focuses on enhancing the anadromous fishery by reducing the impacts of upstream diversions. The principal focus of actions is the consolidation of diversions to minimize potential unscreened entainment of smolts and maximize their outmigration success. Coordinated flow management as mitigated by moderate export enhancements assures successful outmigration of smolts.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

All core actions without modification are included. Actions would be targeted to guide/attract fish migration away from diversion sites.

Upstream Habitat Restoration

Management of flows and temperatures would be targeted to retain and then initiate migration of fish past diversion points to the Delta at the maximum core level--50 percent of Anadromous Fish Restoration Program goals. All other core actions implemented without modification.

Reduction in Diversion Effects

Construct Westside Sacramento Valley Isolated Conveyance Facility to allow diversions upstream of all major spawning habitats. Eastside Sacramento Valley conveyance considered ineffectual.

Provision of instream pulse flows coordinated with upstream habitats for fish passage would be enhanced from 20 percent to 50 percent to initiate migration of smolts.

Management of Anadromous Fish

The core action for improved hatchery operation should target the introduction of smolts in coordination with pulse flow management.

Reduction in Export Reliance

Unmodified or qualified core actions are appropriate for this alternative.

December 13, 1995

Water Supply Enhancement and Predictability (34.1.2, 35.5)

A westside Sacramento Valley isolated transfer facility will restore certainty for upstream users while moderately increased export and Delta conveyance capacity will mitigate uncertainty of export diversion restrictions during fish migrations.

Management of Water Quality

Minimum core actions are appropriate for this alternative.

Improvements to System Reliability/Vulnerability

Enhanced conveyance from the Sacramento River to the Central Delta and Eastern Delta channels, coupled with core-level levee maintenance, will reduce system vulnerability.

PRELIMINARY ASSESSMENT

As anadromous fish are particularly subject to diversion impacts in their rearing habitats, the focus of this alternative, consolidation of upstream diversions through a Westside Sacramento Valley isolated transfer facility removes the immediate threat of anadromous fish losses. This, in concert with a managed flow regime and strategically targeted core level Bay-Delta habitat enhancement, would facilitate unimpeded conveyance of the smolts through the Bay-Delta. Water supply losses due to pulse flows would be mitigated and central Delta/export quality enhanced through moderately increased Delta conveyance and unrestricted pumping capability at existing Delta export facilities.

ALTERNATIVE 308: ANNOTATED ACTION LIST

ACTIONS SELECTED

Bay-Delta Habitat Restoration

1.-8.--Core level.

Upstream Habitat Restoration

9.1--50 percent of AFRP modifications.

9.-12.--Core level.

Reduction in Diversion Effects

9.1 and 13.1--50 percent of AFRP recommendation. Water supply coordinated to not duplicate losses.

35.5--Full develop westside system for April-May capacity requirements. During nonsensitive periods, flow supplied via river to provide multiple beneficial uses.

Management of Anadromous Fish

22.3--Implement at maximum level.

Reduction in Export Reliance

Core only.

Water Supply Enhancement and Predictability

16.1 and 16.2--Maximum action to both.

34.1 and 34.2--Moderate 30 percent of maximum to complement Actions 16.1 and 16.2.

Management of Water Quality

Core actions only.

Improvements to System Reliability/Vulnerability

16.1 and 16.2
34.1 and 34.2
35.5

December 13, 1995

ALTERNATIVE 309: REDUCE ANADROMOUS FISH DIVERSION IMPACTS IN THE DELTA AND ENHANCE FISH PASSAGE THROUGH THE BAY-DELTA USING CONSOLIDATED IN-DELTA DIVERSIONS AND FLOW MANAGEMENT

Theme: Enhance fishery population through reduced diversion impacts.
Sub-Theme: Enhancing winter run and other anadromous fishery.
Approach: Consolidating and relocating diversions with emphasis on measures taken in the Delta.

SOLUTION OVERVIEW

Alternative 309 focuses on enhancing the anadromous fishery by reducing the impacts due to in-Delta diversions. The principal focus of actions is the consolidation of diversions to minimize potential unscreened entrainment of migrating smolts and maximize their out-migration success. Coordinated flow management as mitigated by moderate export enhancements assures successful out-migration of smolts.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

All core actions without modification are included. Actions would be targeted to guide/attract fish migration away from diversion sites.

Upstream Habitat Restoration

Management of flows and temperatures would be targeted to retain and then initiate migration of fish past diversion points to the Delta at the minimum core level. All other core actions implemented without modification.

Reduction in Diversion Effects

Construct a small eastside Delta isolated conveyance facility to consolidate Delta diversions during the migration periods. Timing of all diversions could be modified through adaptive management which would allow for alternating diversion locations to avoid fish entrainment.

Pulse flows accentuating minimum instream pulses, timed for anadromous fishery population peaks in the Delta, would be provided to move fish past the principal Delta diversion site. To accomplish this, the pulse flow would be enhanced from the minimum core level of 20 percent to 50 percent of the AFRP suggested target for the Delta.

Management of Anadromous Fish

The core action for improved hatchery operation should target the introduction of smolts in coordination with pulse flow management.

December 14, 1995

Reduction in Export Reliance

Unmodified or qualified core actions are appropriate for this alternative.

Water Supply Enhancement and Predictability

A fully screened small eastside isolated Delta transfer facility would moderately increase Delta conveyance and export capacity and would mitigate pulse flow losses and uncertainty of export diversion restrictions during fish migrations.

Management of Water Quality

A small eastside isolated Delta transfer facility would supply reduced reverse flow gradients in the eastern and southern Delta and supply higher quality water to the export facilities. This complements the minimum core actions for this alternative.

Improvements to System Reliability/Vulnerability

Enhanced conveyance from the Sacramento River around the Delta channels nearly assures some minimum level of supply in the event of a Delta calamity. Coupled with core-level levee maintenance, the small isolated facility would significantly reduce system vulnerability.

PRELIMINARY ASSESSMENT

Anadromous fish losses in the Delta have been significant enough to measurably impact export operations in the Delta; accordingly, as a lasting solution to this diversion impact, the focus of this alternative is a screened eastside Delta isolated transfer facility. The consolidation of Delta diversions and strategically targeted core level Bay-Delta habitat enhancement would minimize conveyance of the smolts into the central and southern Delta. Water supply losses due to pulse flows would be mitigated and central Delta/export quality enhanced through reduced reverse flow gradients and timely allowance of full pumping capacity at existing Delta export facilities. With a significant reduction of vulnerability to the export supply, the alternative provides a fairly significant and durable solution to each area of Bay-Delta conflicts.

December 14, 1995

ALTERNATIVE 309: ANNOTATED ACTION LIST

ACTIONS SELECTED

Bay-Delta Habitat Restoration

1.-8. Core level.

Upstream Habitat Restoration

9.-12. Core level.

Reduction in Diversion Effects

13.4 Enhanced to 50 percent of AFRP recommendation. Water supply coordinated to with core level of 9.1 to minimize duplicating losses.

35.3 Construction of a fully screened small isolated Delta transfer system would allow reduced migration of smolts from the northern to the southern Delta and avoid diversion entrainment of eastside and southern stream smolts during the spring out-migration.

Management of Anadromous Fish

22.-23. Core actions emphasizing timing of actions.

Reduction in Export Reliance

Core actions only.

Water Supply Enhancement and Predictability

14.2.3
15.1.2 Allow for shifts in diversion locations
18.4

16.1 and 16.2 Maximum action to both complements the small facility of 35.3.

35.3

Management of Water Quality

13.4 At 50 percent of AFRP.

Improvements to System Reliability/Vulnerability

16.1 and 16.2
35.3

December 14, 1995

ALTERNATIVE #310
Enhancing Bay-Delta Native Fish Species by Emphasizing Upstream Actions that Increase Fish Productivity

Theme: Enhance fish populations through increased productivity.
Sub-Theme: Emphasize fish species native to the Bay-Delta, including the Delta Smelt.
Approach: Increase natural production by upstream actions.

Solution Overview

This alternative is intended to enhance natural production and survival of native Delta fish species, including the Delta smelt and Sacramento splittail, by improving flows and ecological conditions of upstream watersheds. Actions in this alternative would control and increase flows, reduce in-flow temperatures, and improve in-flow water quality. These actions would directly enrich the Delta aquatic food chain by increasing the amount of detritus and macro invertebrates drifting into the Delta, and indirectly by enhancing conditions for anadromous fish productivity. This alternative would improve diversity and ecological quality of the Delta and would increase natural fish production, thereby potentially increasing resources for sport and commercial fisheries. To minimize water supply effects to other water users, an incentive based conjunctive use program would be implemented that encourages users to supplement surface water demand with ground water supplies. On- and off-stream storage facilities may also be constructed and existing on-stream storage reservoirs may be enlarged to meet instream flow goals.

Actions Selected

Bay-Delta Habitat Restoration:

Core actions that emphasize protection and restoration of Delta riverine and riparian habitat, including riparian improvement plantings, would be implemented at higher than minimum levels. These actions would improve nearshore habitat and create additional shallow water habitat. No actions above the core actions are included in this category.

Upstream Habitat Restoration:

Restoration of upstream habitats to benefit Delta native fish species is a primary objective of this alternative. Upstream core actions that could improve water quality and Delta aquatic habitat conditions would be implemented to the maximum extent, including management of flows and temperatures for the needs of native Delta fish species. In addition to the core actions, approximately ten percent of existing agricultural drainage would be diverted for create wetland habitat to reduce nutrient loading and turbidity.

Reduce Effects of Diversions:

No actions above the core actions are included in this category. Screening requirements would be enforced to a maximum extent and screens would be installed on in-Delta diversions where cost-effective. Other core actions that would reduce fish mortality or production rates would be implemented to the maximum extent feasible.

Enhancement of Anadromous Fish Populations:

No actions above the core actions are included in this category. New captive breeding programs for Delta smelt would be implemented to the maximum extent feasible, however, existing hatcheries would not be expanded and no new hatcheries would be constructed. Regulation of

commercial and recreational take of native species would be improved and strictly enforced. All other core actions would be implemented at the core level.

Reducing the Reliance on Delta Exports:

No actions above the core actions are included in this category. Implementation of these actions would be at the core level.

Enhance Water Supplies:

Management of flows and temperatures in the Delta would require additional water supply. To achieve supply levels and maintain reliable flows for other users, economic incentives for the development of conjunctive use programs would be implemented. These programs would use market incentives to encourage upstream water users to supplement their surface water supplies with ground water pumping where available. On- and off-stream storage facilities may also be constructed and existing on-stream storage reservoirs may be enlarged to meet instream flow goals. No other actions above the core actions are included in this category.

Increase Supply Predictability:

No actions above the core actions are included in this category. Implementation of these actions would be at the core level.

Managing Water Quality:

No actions above the core actions are included in this category. Core actions that would improve ecosystem water quality, including management of agricultural and urban wastewater discharges and source control regulations, would be implemented above minimum levels.

Improving System Water Reliability:

No actions above the core actions are included in this category.

Preliminary Assessment

To enhance natural production of native Delta fish species, this alternative would manage ecological water quality and control in-flows rates to the Delta. This would be accomplished by restoring aquatic and riparian elements of upstream watersheds, reducing pollutant loading, and increasing flows. Increasing Delta fish populations would benefit the Bay-Delta and its water users by enhancing the ecosystem, thereby increasing species diversity, harvest levels, and sport fishing opportunities. Although results of this approach may take longer than hatchery based alternatives, it would increase the likelihood of maintaining a sustainable wild population of Delta smelt and other sensitive species. Such sustainable populations could avoid federal and state protection and remove existing operational and land use constraints imposed by the Endangered Species Act for the Delta smelt. The primary trade-off of this approach is that the required increase in flows would reduce the amount of water available for other users during these times. To augment this effect, regional conjunctive use incentive programs would have to be implemented to supplement surface water uses with ground water. Additionally, existing on- and off-stream storage reservoirs would be enlarged and new off-stream storage facilities may be built.

DETAILED LIST OF ACTIONS SELECTED: ALTERNATIVE 310

- All core actions will be implemented at core levels unless noted otherwise below. core actions are indicated by "C" prior to the action number.

Bay-Delta Habitat Restoration:

C2.2 - Restore/preserve channel islands - Max.
C2.4 - Modify construction practices to include riverine elements - Max.

C3.1 - Improve and protect degraded riparian habitats - Max.
C3.4 - Modify levee maintenance practices - Max.
C3.5 - Protect existing riparian habitat - Max.

C4.1 - Enhance existing wetlands - Max.
C4.4 - Protect existing wetland habitat - Max.

Upstream Habitat Restoration:

C9.1 - Manage flows and temperatures in upstream habitats - Max.
9.4 - Restore shoreline habitat conditions - Max.
C9.5 - Modify gravel mining practices - Max.

C11.1 - Restrict livestock grazing in riparian corridors - Max.
C11.2 - Revegetate degraded riparian habitats - Max.

12.2 - Reuse agricultural drainage to create wetlands - Max.

Reduce Effects of Diversions:

C13.5 - Provide instream flows for fish attraction - Max.

C14.3 - Use real-time monitoring and adaptive mgt. - Max.

C18.4 - Install screens on Delta diversions - Max. (or as cost-effective)
C18.6 - Enforce screening requirements - Max.

C20.2 - Improve operation of fish salvage facilities - Max.
C20.3 - Improve fish hauling and release procedures - Max.

Enhancement of Anadromous Fish Populations:

C22.4 - Reduce hatchery effects on wild fish populations - 50% of Max.
C22.6 - Establish new captive breeding programs - Max.

Reducing the Reliance on Delta Exports:

Core actions at core levels only.

Enhance Water Supplies:

C29.2 - Manage riparian zone to protect water quality - Max.
C29.3 - Manage land uses to protect water quality - Max.

30.3 - Enlarge existing on-stream storage reservoirs - Max. (equity measure)

31.2 - Construct new off-stream storage facilities upstream of Delta- 50% Max. (equity measure)
31.4 - Enlarge existing off-stream storage reservoirs - 50% of Max. (equity measure)

32.1 - Establish conjunctive use programs - Max. (equity measure)

Increase Supply Predictability:

Core actions at core levels only.

Managing Water Quality:

C42.01 -Implement source control regulations for pollutants - Max.
C42.03 -Reduce or control volume of agricultural discharges - Max.
C42.08 -Manage irrigation tailwater to reduce pesticides - Max.

Improving System Water Reliability:

Core actions at core levels only.

ALTERNATIVE #311
Enhancing Bay-Delta Native Fish Species by Emphasizing Delta Actions that Increase Fish Productivity

Theme: Enhance fish populations through increased productivity.
Sub-Theme: Emphasize fish species native to the Bay-Delta, including the Delta Smelt.
Approach: Increase natural production by actions that can be implemented in the Delta.

Solution Overview

This alternative is intended to enhance natural production and survival of native Delta fish species, including the Delta smelt and Sacramento splittail. The alternative emphasizes actions that would either directly or indirectly increase Delta native fish populations by improving ecological conditions in the Delta. Such actions would increase flows, reduce temperatures, and improve aquatic and riparian habitat, including wetlands. These actions would increase detritus and enrich the aquatic food chain and provide shading, snags, and other physical features paramount to increasing natural fisheries production. This alternative would increase natural fish production, improve diversity and ecological quality of the Delta, and may indirectly benefit other fish species, thereby increasing sport and commercial fisheries. To minimize water supply effects to other water users, an incentive based conjunctive use program would be implemented that encourages users to supplement surface water demand with ground water supplies.

Actions Selected

Bay-Delta Habitat Restoration:

Bay-Delta habitat restoration is the primary objective of this alternative. All actions that would protect, improve, restore, or expand existing Bay-Delta riparian and aquatic habitat would be implemented to the maximum extent. Levees would be set back and some areas of deep water, such as Frank's Tract, would be filled in to provide additional shallow water habitat. Historic riparian areas would be reestablished and levee maintenance practices would be modified to include planting of native riparian vegetation. Overall, approximately ten percent of existing Delta habitat would be modified to favor native species. Wetlands would be protected and restored, to increase detritus, foraging habitat, and shading. Nuisance species would be regulated and removed. In addition to these actions, all core action would be implemented to the maximum extent feasible.

Upstream Habitat Restoration:

No actions above the core actions are included in this category. Upstream core actions that could improve water quality and Delta aquatic habitat conditions would be implemented to the maximum extent, including management of flows and temperatures.

Reduce Effects of Diversions:

No actions above the core actions are included in this category. Instream flows for fish attraction and pulse flows for fish passage would be conducted to a maximum level. Screening requirements would be enforced to a maximum extent and screens would be installed on in-Delta diversions where cost-effective. Other core actions that would reduce fish mortality or production rates would be implemented to the maximum extent feasible.

Enhancement of Anadromous Fish Populations:

No actions above the core actions are included in this category. New captive breeding programs would be implemented to the maximum extent feasible, however, existing hatcheries would not

be expanded and no new hatcheries would be constructed. Regulation of commercial and recreational take of native species would be improved and strictly enforced. All other core actions would be implemented at the core level.

Reducing the Reliance on Delta Exports:

No actions above the core actions are included in this category. Implementation of these actions would be at the core level.

Enhance Water Supplies:

Management of flows and temperatures in the Delta would require additional water supply. To achieve supply levels and maintain reliable flows for other users, economic incentives for the development of conjunctive use programs would be implemented. These programs would use market incentives to encourage upstream water users to supplement their surface water supplies with ground water pumping where available. No other actions above the core actions are included in this category.

Increase Supply Predictability:

No actions above the core actions are included in this category. Implementation of these actions would be at the core level.

Managing Water Quality:

No actions above the core actions are included in this category. Core actions that would improve ecosystem water quality, including management of agricultural and urban wastewater discharges, would be implemented above minimum levels.

Improving System Water Reliability:

No actions above the core actions are included in this category.

Preliminary Assessment

This alternative would restore aquatic and riparian elements of the Delta, and to a lesser degree upstream watersheds, to enhance natural production of native Delta fish species. Increasing Delta fish populations would benefit the Bay-Delta and its water users by enhancing the ecosystem, thereby increasing species diversity, harvest levels, and sport fishing opportunities. Although results of this approach may take longer than hatchery based alternatives, it would increase the likelihood of maintaining a sustainable wild population of Delta smelt and other sensitive species. Such sustainable populations could avoid federal and state protection and remove existing operational and land use constraints imposed by the Endangered Species Act for the Delta smelt. The primary trade-off of this approach is that the required increase in flows would reduce the amount of water available for other users during these times. To augment this effect, regional conjunctive use incentive programs would have to be implemented to supplement surface water uses with ground water.

DETAILED LIST OF ACTIONS SELECTED: ALTERNATIVE 311

- All core actions will be implemented at core levels unless noted otherwise below. core actions are indicated by "C" prior to the action number.

Bay-Delta Habitat Restoration:

1.4 - Reconstruct levees to include shallow water habitat - 50% of Max.
1.5 - Fill deep water to produce shallow habitat - 50% of Max.

2.2 - Reconstruct river banks and shallow areas - Max.
C2.2 - Restore/preserve channel islands - Max.
C2.3 - Restore natural channel configurations - Max.
C2.4 - Modify construction practices to include riverine elements - Max.

C3.1 - Improve and protect degraded riparian habitats - Max (to all degraded riparian areas to enhance habitat quality)
3.2 - Establish new areas of riparian habitat - 50% max.
3.3 - Reestablish historic riparian areas - 50% max.
C3.4 - Modify levee maintenance practices - Max.
C3.5 - Protect existing riparian habitat - Max.

C4.1 - Enhance existing wetlands - Max.
C4.2 - Expand existing wetland acquisition program - 50% of Max.
C4.4 - Protect existing wetland habitat - Max.

5.4 - Clean up sites containing toxic substances - 50% of Max. (focus on sites were there is runoff to Delta)

6.2 - Allow river channels to meander - 50% Max.

7.1 - Remove or reduce nuisance species in key habitats - 50% Max. (focused on aquatic species)
7.4 - Inspect for invasions of nuisance species - Max.
7.5 - Modify habitat for native species - 50% Max. (focus on aquatic habitat)

Upstream Habitat Restoration:

C9.1 - Manage flows and temperatures in upstream habitats - 50% of Max.

C11.2 - Revegetate degraded riparian habitats - Max. (temperature and sediment control)

Reduce Effects of Diversions:

C13.4 - Provide instream pulse flows for fish passage - Max.
C13.5 - Provide instream flows for fish attraction - Max.

C14.3 - Use real-time monitoring and adaptive mgt. - Max.

C18.4 - Install screens on Delta diversions - Max. (or as cost-effective)
C18.6 - Enforce screening requirements - Max.

C20.2 - Improve operation of fish salvage facilities - Max.
C20.3 - Improve fish hauling and release procedures - Max.

21.1 - Harvest predators at Delta export pumps - 50% Max.

Enhancement of Anadromous Fish Populations:

C22.4 - Reduce hatchery effects on wild fish populations - 50% of Max.
C22.6 - Establish new captive breeding programs - Max.

Reducing the Reliance on Delta Exports:

Core actions at core levels only.

Enhance Water Supplies:

C29.2 - Manage riparian zone to protect water quality - Max.
C29.3 - Manage land uses to protect water quality - Max.
32.1 - Establish conjunctive use programs - Max. (equity measure)

Increase Supply Predictability:

Core actions at core levels only.

Managing Water Quality:

Core actions at core levels only.

Improving System Water Reliability:

Core actions at core levels only.

Alternative 313

Enhance Bay-Delta Native Fishes by Emphasizing Increasing Hatchery Production and In-Delta Habitat Improvements.

Identification of Theme, Subtheme, and Approach:

Theme: Enhance anadromous fish populations by increasing hatchery production and improving in-Delta fish productivity.
Subtheme: Emphasize delta smelt and other native Bay-Delta fish species.
Approach: Operation and management actions that could be implemented at hatcheries and in-Delta locations.

Solution Overview
This alternative places primary emphasis on increasing hatchery production and improving in-Delta conditions to enhance native fish populations. Actions to increase hatchery production of Delta fish would receive the highest priority. Core actions to enhance fish populations, including restoration of in-Delta fish and riparian habitat would also be implemented at a higher level of priority emphasis, in order to substantially increase the overall production of native fish populations. Hatchery operations would be expanded to increase delta smelt, Sacramento perch, and perhaps sturgeon and longfin smelt populations. Efforts to reduce conflicts with wild population restoration would be held at the core action level.

Actions Selected

Restore Bay-Delta Habitats

Core actions to restore Delta riverine and riparian habitat improvements, including restore and preserve channel islands, protect existing shallow water habitat, enhance existing Delta wetlands and riparian habitats would provide a more contiguous, diverse, and high quality nearshore habitat throughout the ranges of native resident fish populations, but especially in critical Delta feeding and resting areas. Delta inflow management would be adjusted to provide instream flows for fish attraction, and Delta outflow/export management would use real-time monitoring and adaptive management to the benefit of flow and temperature conditions essential to successful anadromous life-cycles.

Enhance Native Resident Bay-Delta Fish Populations

Populations of delta smelt, Sacramento splittail, longfin smelt, and other native resident fish populations would be enhanced directly through expanding existing hatchery operations and constructing new hatcheries, and indirectly by protecting, enhancing, and restoring key Bay-Delta wetland, riparian, and aquatic habitats.

Manage Water Quality

Improved controls on pollutant discharges in the Bay and Delta through better controls on agricultural, municipal, and industrial discharges would achieve important benefits for anadromous populations living within or passing through the Bay-Delta.

Improve System Reliability
Improved management of Delta flows, temperatures, and riverine/riparian habitats will require that more surface water be dedicated to Delta inflow and outflow. In order to increase supply reliability for diverters, this alternative also would include strong economic incentives for the implementation of conjunctive use programs. Specifically, market incentives encouraging agricultural diverters in upstream locations to augment existing surface water supplies with available ground water pumping would be implemented

Preliminary Assessment
This alternative emphasizes improvements to native resident Bay-Delta fish populations and habitat by placing the greatest priority on actions that could be implemented on hatchery production supplemented with some additional improvements in Delta habitat. Increased hatchery production of Delta native resident fish could place more competitive and predator pressures on wild populations of anadromous and resident fishes. In order for these actions to be durable, a long-term reduction in the reliability that existing diverters have on surface supplies would result. It is therefore imperative that the conjunctive use programs and incentives be developed with terms and conditions that are economically attractive to surface water diverters, and which can effectively provide a better economic return for replacing surface water use with ground water use, especially in those regions where otherwise diverted surface waters will instead be dedicated to habitat and population improvements.

ALTERNATIVE 313 ACTIONS

SPECIFIC ACTION PACKAGE

Fish Hatchery Operations
Expand hatchery capacities

ENHANCED CORE ACTIONS

Restoration of Delta Riverine Habitat
Restore/preserve channel islands
Modify maintenance designs to include riverine elements

Restoration of Delta Riparian Habitat
Improve and protect degraded riparian habitats
Modify levee maintenance practices
Protect existing riparian habitat

Restoration of Delta Wetland Habitat
Enhance existing wetlands
Expand wetland acquisition programs
Protect existing wetland habitat

Delta Inflow Management
Provide instream pulse flows for fish passage
Provide instream flows for fish attraction

Enhancing Bay-Delta Native Species Populations Emphasizing In-Delta Operation And Management Actions That Reduce The Impacts Of Diversions (Alternative 315)

Identification of Theme, Subtheme, and Approach:

Theme: Enhance fish populations by reducing diversion impacts
Subtheme: Emphasize Bay-Delta native species
Approach: Operation and management actions that could be implemented at Delta locations

Solution Overview

The emphasis of this alternative is to enhance Bay-Delta native fish populations by coordinating operational releases, habitat restoration actions, and improved management of diversion/fish interactions. It emphasizes actions in Delta locations, but also includes upstream actions at some core level of implementation to ensure that the entire range of fisheries habitats of importance are addressed.

Actions Selected

Reduce Effects of Diversions

Delta outflow/export management would place primary emphasis on real-time monitoring and adaptive management to better control salinities at key monitoring locations in the west and south Delta areas. Improved Delta inflow management, through improved reservoir release timing and decreased surface water diversions would provide instream pulse flows for fish passage and fish attraction. Diversion timing through Montezuma SCG would provide better management and achievement of Suisun Marsh salinity goals now being investigated. Fish salvage design, operations, and procedures improvements also would receive high priority. The removal and control of aquatic predators, through aggressive predator harvest programs at Delta pumping plants would be emphasized.

Restore Bay-Delta Habitats

Delta riverine, riparian, and wetland habitat restoration actions would be emphasized to protect and improve existing aquatic habitat values, and to increase its extent. Restoration and improvement actions would extend to channel islands, degraded riparian habitats, and existing wetlands. Wetlands acquisition programs would be included in an effort to substantially increase fisheries habitat.

Restore Upstream Habitats

Upstream anadromous fish habitat restoration, the restoration and replenishment of spawning gravels, and improved passage both for adults migrating upstream, and for outmigrating juveniles would be implemented at some level above the minimum, or core level.

Manage Water Quality

Water quality improvements for beneficial fish uses would include dredged material management actions. Actions would include limiting dredging to avoid fish migration periods, techniques to localize sediment movement, disposal of dredged materials at nonaquatic sites, removal of contaminated sediments in critical habitat sites, and reporting requirements to ensure that material used for levee maintenance is not contaminated.

Enhance Anadromous Fish Populations

Fish harvest management, including improved regulations and enforcement of commercial and recreational take would enhance populations in the Bay-Delta habitats.

Preliminary Assessment

This alternative effectively affords greater priority for operational changes (flow release volumes, timing, and purposes) and management actions (new and better fish screens, habitat restoration, harvest management, predator control, etc.) for Delta fish population and fisheries habitat protection than are now provided. In order for the benefits of these actions to be durable, increased water will need to be dedicated to them. Water supply augmentation is therefore needed in order to increase system reliability for those water users affected by operational changes resulting from this alternative's implementation. The equability of this alternative is therefore dependent upon the priority placed on establishing economically effective incentives for conjunctive providing a reasonable return on investment for users encouraged to replace surface water diversions with ground water pumping.

ALTERNATIVE 315 - ANNOTATED ACTION LIST

Actions Selected

2. Restoration of Delta Riverine Habitat
- Restore/preserve channel islands
- Modify maintenance designs to include riverine elements

3. Restoration of Delta Riparian Habitat
- Improve and protect degraded riparian habitats
- Modify levee maintenance practices
- Protect existing riparian habitat

4. Restoration of Delta Wetland Habitat
- Enhance existing wetlands
- Expand wetland acquisition programs
- Protect existing wetland habitat

9. Restoration of Upstream Anadromous Fish Habitat
- Manage flows and temperatures in upstream habitats
- Restore and replenish spawning gravels
- Modify gravel mining practices

10. Physical Improvements for Fish Passage
- Modify passage at upstream dams/other barriers
- Modify natural barriers to improve passage

11. Restoration of Upstream Riparian Habitat
- Restrict livestock grazing in riparian corridors
- Revegetate degraded riparian habitats

13. Delta Inflow Management
- Decrease upstream diversions
- Modify upstream reservoir operations
- Modify Delta inflow timing pattern
- Provide instream pulse flows for fish passage
- Provide instream flows for fish attraction

14. Delta Outflow/Export Management
- Use real-time monitoring and adaptive management

15. Modification of Diversion Timing Patterns
- Modify diversion timing of in-Delta diversions
- Modify diversion timing through Montezuma SCG

17.2. Obtain shifts in diversion timing patterns

18. Installation and Improvement of Fish Screens
- Install screens on upstream diversions
- Install screens on other in-Delta diversions
- Enforce Screening requirements

20. Improvement of Fish Salvage Operations
- Improve design of salvage facilities

Improve operation of salvage facilities
Improve fish hauling and release procedures

21. Removal and Control of Aquatic Predators

Harvest predators at Delta export pumps
Harvest predators in upstream habitats

32. Groundwater Banking and Conjunctive Use

Establish conjunctive use programs

44. Dredged Material Management

Limit dredging to avoid fish migration periods
Use techniques to localize sediment movement
Dispose dredged materials at nonaquatic sites
Remove contaminated sediments in critical habitat sites
Ensure material used for levee maintenance is noncontaminated

IMPROVE CONDITIONS FOR BAY-DELTA NATIVE FISH SPECIES BY REDUCING THE IMPACTS OF DIVERSION THROUGH INSTALLATION AND OPERATION OF IN-DELTA FISH SCREENS AND BARRIERS (ALTERNATIVE 317).

Identification of Theme, Subtheme, and Approach

Theme: Enhance populations of Bay-Delta native fish species through reduced diversion impacts.
Sub-theme: Increase Bay-Delta native fish populations.
Approach: Installation and operation of in-Delta fish screens and barriers.

SOLUTION OVERVIEW

This alternative has been geared toward improving conditions for Delta native fishes with a main focus on using in-Delta improvements to reduce entrainment. Other actions are also presented which bolster population increases, including predator control programs, utilization of real-time monitoring and adaptive management, and manage Delta outflow. These actions are combined to provide for expedited population recovery for key Delta species.

ACTIONS SELECTED

Bay-Delta Habitat Restoration: To minimize stranding effects on species such as Sacramento splittail, drainage improvements would be implemented in floodway areas to maximize the productivity of these spawning areas, to increase fish production from these areas.

Reduction in Diversion Effects: In-Delta improvements for Delta native fish include the following actions that minimize in-Delta entrainment, reduce predation, and improve in-Delta fish movement.

High priority actions for immediate implementation include improvements to current Delta export operations. Improvement of existing fish screening facilities would include improved performance criteria, including reduced approach and sweeping velocities. To further lower existing levels of entrainment, actions to be implemented at a maximum level throughout the Bay-Delta system include: improvements to existing fish screens at the Delta export pumps and other existing facilities; consolidation and screening of existing (small) in-Delta diversions; and conversion of industrial water use for cooling towers. In addition, a comprehensive enforcement program would be implemented to ensure strict compliance with existing regulations.

Actions minimizing entrainment through the consolidation of small diversions and/or the relocation of existing diversions from key habitat areas these actions would also be implemented.

Additional reductions in entrainment may also be achieved through the modification of diversion timing patterns and increasing rates of diversion capacity. These actions would

provide maximum benefits when implemented under a real-time monitoring and adaptive management program (at maximum levels).

Existing salvage operations may be enhanced through the implementation of predator control programs which remove predators and "predator friendly" habitats from key sites including Clifton Court Forebay, Rock Slough, Barker Slough, Montezuma Slough and others. This program may also include small scale habitat development to provide resting and escape cover at these sites.

To provide maximum in-Delta benefits for Delta native fish species several core actions would be implemented at a maximum level, including Delta inflow management, Delta outflow/export management (pulse flows), installation and improvement of fish screens (in-Delta), and improvement of in-Delta fish salvage operations. Other core actions focusing on upstream diversion effects would also be implemented at the core level.

Water Supply Enhancement and Predictability: An integral part of this alternative is the development of a dual purpose in-Delta storage facility. While the primary focus of the facility would be for maintaining improved salinity conditions in Suisun Bay, a complementary mission could be salinity management for increased operational flexibility or enhanced export capacity.

In addition, this alternative includes south of the Delta storage (ground water banking [conjunctive use] and/or on-or off-stream reservoir enlargement) to maximize the benefits associated with in-Delta storage and to provide equity to water users south the Delta, who may be adversely affected by the implementation of flow management measures that improve conditions for Delta native fish species.

PRELIMINARY ASSESSMENT

This alternative has been designed to focus on the resolution of the fisheries and diversions conflict with emphasis on the issue of declining Delta native fish species. Inclusion of core actions and additional actions to balance potential export losses associated with improvements flow conditions ensure equity in this solution for all Delta user groups. The actions included within this alternative are reasonably affordable and implementable. Physical improvements as well as positive changes in operation and management of existing facilities provide guarantees that this alternative is durable. Careful review of the actions selected in this alternative does not revel any significant redirected impacts.

Actions Selected:

In addition to the Core Actions, this alternative includes several other actions included in the following list:

Restoration of Upstream Anadramous Fish Habitat

Improve floodway drainage to reduce stranding

(to be implement at in-Delta locations)

Installation and Operation of Fish Screens

Improve screens at Delta export pumps

Improve other existing in-Delta screen systems

Convert water use of industrial water towers

Consolidation and screening of existing small in-Delta diversions

Removal and Control of Aquatic Predators

Harvest predators at the Delta pumps

Control of Introduced Species

Modify habitat to favor native species

Groundwater Banking and Conjunctive Use

Establishment of conjunctive use programs

Store groundwater south of the Delta

Implement techniques to increase groundwater recharge

New or Expanded On-Stream Storage

Enlarge existing on-stream storage

New or Expanded Off-Stream Storage

Enlarge existing off-stream storage

Construct new off-stream storage facilities in Delta

ALTERNATIVE 319: REDUCE DELTA DIVERSION IMPACTS TO INDIGENOUS BAY-DELTA RESIDENT FISHERY BY CONSOLIDATED IN-DELTA DIVERSIONS AND FLOW MANAGEMENT

Theme: Enhance fishery population through reduced diversion impacts.
Sub-Theme: Enhancing indigenous Bay-Delta resident fishery.
Approach: Consolidating and relocating diversions with emphasis on measures taken in the Delta.

SOLUTION OVERVIEW

Alternative 319 focuses on enhancing the Delta resident fishery by reducing the impacts resulting from in-Delta diversions. The principal focus of actions is the consolidation of all diversions by an eastside isolated Delta transfer facility to eliminate potential unscreened entrainment of fishes. Coordinated flow management would be more than mitigated by moderate export enhancements, and vulnerability would be effectively eliminated.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

All core actions without modification are included. Actions would be targeted to guide/attract fish migration away from the principal diversion site.

Upstream Habitat Restoration

Management of core flows would be targeted to enhance capability of managing the salinity gradient. All other core actions would be implemented without qualification.

Reduction in Diversion Effects

Construct an east-side Delta isolated conveyance facility to consolidate all Delta diversions throughout the year. Timing of all diversions could be modified through adaptive management which would occasionally restrict diversion to avoid entrainment of monitored fish populations.

Pulse flows at minimum core amounts accentuating minimum instream pulses, timed for anadromous fishery population peaks in the Delta, would be provided to move fish past the principal Delta diversion site.

Management of Anadromous Fish

Core-level management is appropriate for this alternative.

Reduction in Export Reliance

Unmodified/unqualified core actions are appropriate for this alternative.

Water Supply Enhancement and Predictability

A fully screened east-side isolated Delta transfer facility, coupled with allowance for timely use of full export capacity, would almost completely alleviate Delta conveyance problems and would more than fully mitigate minor pulse flow losses.

Management of Water Quality

An east-side isolated Delta transfer facility would supply water to develop positive flow gradients in the eastern and southern Delta and supply higher quality water for all beneficial uses in the Delta. This complements the minimum core actions for this alternative.

Improvements to System Reliability/Vulnerability

Enhanced conveyance from the Sacramento River around the Delta channels assures a nearly full supply for exports and potential for mitigation of environmental losses in the event of a Delta calamity. Coupled with core-level levee maintenance, the isolated facility would significantly reduce system vulnerability.

Preliminary Assessment

The location of Bay-Delta resident fishery in the Delta is much too diffuse to effectively monitor and schedule multiple Delta conveyance routes to avoid diversion entrainment of these species. A completely isolated system along the eastside of the Delta would not only alleviate Delta conveyance and export restrictions, but also provide high quality water to the central and southern Delta. Water supply losses resulting from pulse flows would be more than fully mitigated and central Delta/export quality enhanced through positive flow gradients and timely allowance of full pumping capacity at existing Delta export facilities. With a significant reduction of vulnerability to the export supply, the alternative provides a very significant and durable solution to each area of Bay-Delta conflicts.

ALTERNATIVE 319: ANNOTATED ACTION LIST

ACTIONS SELECTED

Bay-Delta Habitat Restoration

1.-8. Core level.

Upstream Habitat Restoration

9.-12. Core level.

Reduction in Diversion Effects

13. Water supply coordinated to with core level of 9.1 to minimize duplicating losses.

35.1 Construction of a fully screened isolated Delta transfer system would eliminate migration of smolts from the northern to the southern Delta and avoid diversion entrainment of resident species.

Management of Anadromous Fish

22.-23. Core actions emphasizing timing of actions.

Reduction in Export Reliance

Core actions only.

Water Supply Enhancement and Predictability

14.3
18.5
16.1 and 16.2 Maximum implementation of each complements the facility of 35.1.
35.1

Management of Water Quality

35.1 Capacity allowance for this.

Improvements to System Reliability/Vulnerability

16.1 and 16.2
35.1

DECEMBER 14, 1995

Enhancing Anadromous Fish Populations by Emphasizing Upstream Actions that Increase Fish Productivity (Alternative 320)

Theme: Enhance fish populations through increased productivity.
Sub-Theme: Equally emphasize anadromous and Bay-Delta native species.
Approach: Increase natural production.

Solution Overview

This alternative is intended to achieve sustainable production and survival of fish species that either reside in, or use the Bay-Delta. It emphasizes actions that would either directly or indirectly increase all resident and anadromous fish populations by improving Delta and upstream habitat conditions. Such actions would improve spawning habitats, reduce hazards in migration waterways, increase stream flows, reduce temperatures, and improve riverine and riparian habitat. Restoration of Bay-Delta habitat would be implemented to improve feeding, resting, and migration. To meet anadromous fish instream flow requirements and other user demands, upstream water supplies will be augmented through incentive–based conjunctive use programs. Increased fish populations will improve diversity and quality of the Bay-Delta ecosystem and provide increased sport and comerical fishery opportunities.

Actions Selected

Upstream Habitat Restoration

Restoration of upstream anadramous fish habitat is the primary objective of this alternative. All actions that would restore upstream habitats and improve spawning and migration conditions would be implemented to a maximum extent. Spawning gravel, channel configurations, and shoreline habitat would be restored to enhance spawning and egg development. Flows and temperatures will be managed to provide a maximum benefit to winter-run chinook spawning and migration locations and periods. Dams and natural barriers would be modified to improve passage, and mining activities would be modified to protect spawning habitat. Upstream riparian and wetland habitat would be revegetated and restored to provide shading, snags, detritus, and other physical features essential to fish development. All core actions would be implemented to the maximum extent.

Bay-Delta Habitat Restoration

Core actions that emphasize protection and restoration of Delta riverine and riparian habitat, including riparian improvement plantings, would be implemented at higher than minimum levels. These actions will improve nearshore habitat, especially for stripped bass, and benefit fish migration through the Delta. No actions above the core actions are included in this category.

Enhancement of Anadromous Fish Populations

No actions above the core actions are included in this category. All hatchery-bred fish will be tagged for monitoring and best available technology will be used to reduce hatchery effects on wild populations. Captive breeding programs will be set up for winter-run

chinook salmon to enhance population levels. Existing hatcheries will not be expanded and no new hatcheries will be constructed.

Enhance Water Supplies

Management of flows and temperatures in upstream habitats will require additional water supply. To achieve supply levels and maintain reliable flows for other users, economic incentives for the development of conjunctive use programs will be implemented. These programs would use market incentives to encourage upstream water users to supplement their surface water supplies with ground water pumping where available. No other actions above the core actions are included in this category.

Reduce Effects of Diversions

No actions above the core actions are included in this category. Instream pulse flows for fish passage and flows for fish attraction would be implemented to meet Anadromous Fish Restoration Program (AFRP) recommendations. Screens will be installed on upstream diversions where cost-effective.

Managing Water Quality

As a direct benefit to winter-run chinook salmon, abandoned mining sites would be remediated and mining drainage will be managed to remove toxics to the maximum feasible extent.

Preliminary Assessment

This alternative would primarily restore natural upstream and Delta riverine and riparian aquatic habitat values to enhance natural production of all fish species that use the Delta. Increasing fish populations would benefit the Bay-Delta and its water users by restoring the ecosystem, thereby increasing species diversity, harvest levels, and sport fishing opportunities. Although results of this approach may take longer than hatchery based alternatives, it would increase the likelihood of obtaining a sustainable wild population of winter-run chinook salmon. Such a sustainable population could lead to the delisting of the species and remove existing operational and land use constraints imposed by the Endangered Species Act. The primary trade-off of this approach is increased flows during migration and spawning periods. These flows may reduce the amount of water available for other users during these times. To augment this effect, regional conjunctive use incentive programs will have to be implemented to supplement surface water uses with ground water. There are no actions that would offset any effects from modification of gravel mining practices.

DETAILED LIST OF ACTIONS SELECTED: ALTERNATIVE 320

Bay-Delta Habitat Restoration

2. **Restoration of Delta Riverine Habitat**
   Restore/preserve channel islands
   Modify maintenance designs to include riverine elements

3. **Restoration of Delta Riparian Habitat**
   Improve and protect degraded riparian habitats
   Modify levee maintenance practices
   Protect existing riparian habitat

4. **Restoration of Delta Wetland Habitat**
   Enhance existing wetlands
   Expand wetland acquisition programs
   Protect existing wetland habitat

Upstream Habitat Restoration:

9. **Restoration of Upstream Anadromous Fish Habitat**
   Manage flows and temperatures in upstream habitats
   Restore and replenish spawning gravels
   Restore channel configurations
   Restore shoreline habitat conditions
   Modify gravel mining practices
   Improve floodway drainage to reduce fish stranding

10. **Physical Improvements for Fish Passage**
    Modify passage at upstream dams/other barriers
    Modify natural barriers to improve passage

11. **Restoration of Upstream Riparian Habitat**
    Restrict livestock grazing in riparian corridors
    Revegetate degraded riparian habitats
    Protect riparian lands through purchase/easements
    Restore flows to dewatered riparian habitats

12. **Restoration of Upstream Wetland Habitat**
    Modify floodways to support wetland habitats
    Reuse agricultural drainage to create wetlands
    Reuse urban wastewater effluent to create wetlands
    Manage groundwater recharge for wetland habitat

Reduce Effects of Diversions

18. **Installation and Improvement of Fish Screens**
    Install screens on upstream diversions
    Enforce Screening requirements

Enhance Water Supplies

32.1. Establish conjunctive use programs

Managing Water Quality:

45. Management of Mine Drainage

Manage discharges from abandoned mines

Remediate abandoned mining sites discharging pollutants

Enhancing Anadromous Fish Populations by Emphasizing In-Delta Actions that Increase Fish Productivity (Alternative 321)

Theme: Enhance fish populations through increased productivity.
Sub-Theme: Equally emphasize anadromous and Bay-Delta native species.
Approach: Increase natural production.

Solution Overview

This alternative is intended to achieve improvements in the production of Bay-Delta native fish species. It emphasizes actions that could be implemented in the Delta, including extensive aquatic habitat restoration, and inflow and export management. The overall objectives of this alternative are the protection of existing habitat values, restoration of degraded habitats, and the extension of high quality estuarine conditions throughout the Delta system.

Actions Selected

Bay-Delta Habitat Restoration

Restoration of Delta fish habitat is the primary objective. Riparian improvement plantings and vegetation conversion programs (to less noxious species) would be implemented to the maximum feasible level. These actions would improve estuarine food source development, provide resting and cover areas for rearing juveniles, and would, through natural erosion control, reduce the volume of suspended sediment entering Delta waterways.

Upstream Habitat Restoration

Actions that would restore upstream habitats and improve spawning and migration conditions would be implemented to a minimum extent. Upstream channel configurations, and shoreline habitat would be enhanced to the extent that it would reduce upstream depletions of water that would otherwise reach the Delta.

Enhancement of Anadromous Fish Populations

No actions above the core actions are included in this category. All hatchery-bred fish will be tagged for monitoring and best available technology will be used to reduce hatchery effects on wild populations. Captive breeding programs will be set up for winter-run chinook salmon to enhance population levels. Existing hatcheries will not be expanded and no new hatcheries will be constructed.

Enhance Water Supplies

Management of flows and temperatures in upstream habitats will require additional water supply. To achieve supply levels and maintain reliable flows for other users, economic incentives for the development of conjunctive use programs will be implemented. These programs would use market incentives to encourage upstream water users to supplement their surface water supplies with ground water pumping where available. No other actions above the core actions are included in this category.

Reduce Effects of Diversions

Fish screen improvements, and increased in-Delta screening of presently unscreened diversions would be important components of this alternative. Pulse flows for fish passage and flows for fish attraction would be implemented to meet Anadromous Fish Restoration Program (AFRP) recommendations, and flows needed by Delta smelt. No other actions above the core actions are included in this category

Managing Water Quality

As a direct benefit to winter-run chinook salmon, abandoned mining sites would be remediated and mining drainage will be managed to remove toxics to the maximum feasible extent.

Preliminary Assessment

This alternative would primarily restore Delta riverine and riparian aquatic habitat values to enhance natural production of all fish species that use the Delta. Increasing fish populations would benefit the Delta and its water users by restoring the ecosystem, thereby increasing species diversity, harvest levels, and sport fishing opportunities. Although results of this approach may take longer than hatchery based alternatives, it would increase the likelihood of obtaining a sustainable wild population. Such a sustainable population could lead to the delisting of some listed species and remove existing operational and land use constraints imposed by the Endangered Species Act. The primary tradeoff of this approach is increased flows during migration and spawning periods. These flows may reduce the amount of water available for other users during these times. To augment this effect, regional conjunctive use incentive programs will have to be implemented to supplement surface water uses with ground water.

DETAILED LIST OF ACTIONS SELECTED: ALTERNATIVE 321

Bay-Delta Habitat Restoration

2. Restoration of Delta Riverine Habitat
Restore/preserve channel islands
Modify maintenance designs to include riverine elements

3. Restoration of Delta Riparian Habitat
Improve and protect degraded riparian habitats
Modify levee maintenance practices
Protect existing riparian habitat

4. Restoration of Delta Wetland Habitat
Enhance existing wetlands
Expand wetland acquisition programs
Protect existing wetland habitat

Upstream Habitat Restoration:

9. Restoration of Upstream Anadromous Fish Habitat
Manage flows and temperatures in upstream habitats
Restore shoreline habitat conditions

11. Restoration of Upstream Riparian Habitat
Restrict livestock grazing in riparian corridors
Revegetate degraded riparian habitats
Protect riparian lands through purchase/easements
Restore flows to dewatered riparian habitats

Reduce Effects of Diversions

18. Installation and Improvement of Fish Screens
Install screens on in-Delta diversions
Enforce Screening requirements

Enhance Water Supplies

Establish conjunctive use programs

Alternative 323

Enhance Anadromous and Bay-Delta Native Resident Fishes by Emphasizing Increasing Hatchery Production and In-Delta Habitat Improvements.

Identification of Theme, Subtheme, and Approach:

Theme: Enhance anadromous and Delta native resident fish populations by increasing hatchery production and improving in-Delta fish productivity.
Subtheme: Emphasize winter-run salmon and delta smelt and other anadromous and native Bay-Delta fish species.
Approach: Operation and management actions that could be implemented at hatcheries and in-Delta locations.

Solution Overview
This alternative places primary emphasis on increasing hatchery production and improving in-Delta conditions to enhance anadromous and native resident fish populations. Actions to increase hatchery production of Delta fish would receive the highest priority. Core actions to enhance fish populations, including restoration of in-Delta fish and riparian habitat would also be implemented at a higher level of priority emphasis, in order to substantially increase the overall production of anadromous and Delta native resident fish populations. Hatchery operations would be expanded to increase winter run salmon, other salmon and steelhead runs, delta smelt, striped bass, and perhaps sturgeon, Sacramento perch, and longfin smelt populations. Efforts to reduce conflicts with wild population restoration would be held at the core action level.

Actions Selected

Restore Bay-Delta Habitats

Core actions to restore Delta riverine and riparian habitat improvements, including restore and preserve channel islands, protect existing shallow water habitat, enhance existing Delta wetlands and riparian habitats would provide a more contiguous, diverse, and high quality nearshore habitat throughout the ranges of anadromous and resident native fish populations, but especially in critical Delta feeding and resting areas. Delta inflow management would be adjusted to provide instream flows for fish attraction, and Delta outflow/export management would use real-time monitoring and adaptive management to the benefit of flow and temperature conditions essential to successful anadromous life-cycles.

Enhance Anadromous Fish Populations

Populations of salmon, steelhead, and perhaps sturgeon and striped bass would be enhanced directly through expanding existing hatchery operations and constructing new hatcheries. Additional in-Delta habitat improvements would further increase populations. In-Delta habitat restoration actions would be directed towards providing improved management of flows in important habitats and seasons.

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Enhance Native Resident Bay-Delta Fish Populations

Populations of delta smelt, Sacramento splittail, longfin smelt, and other native resident fish populations would be enhanced directly through expanding existing hatchery operations and constructing new hatcheries, and indirectly by protecting, enhancing, and restoring key Bay-Delta wetland, riparian, and aquatic habitats.

Manage Water Quality

Improved controls on pollutant discharges in the Bay and Delta through better controls on agricultural, municipal, and industrial discharges would achieve important benefits for anadromous populations living within or passing through the Bay-Delta.

Improve System Reliability

Improved management of Delta flows, temperatures, and riverine/riparian habitats will require that more surface water be dedicated to Delta inflow and outflow. In order to increase supply reliability for diverters, this alternative also would include strong economic incentives for the implementation of conjunctive use programs. Specifically, market incentives encouraging agricultural diverters in upstream locations to augment existing surface water supplies with available ground water pumping would be implemented.

Preliminary Assessment

This alternative emphasizes improvements to anadromous and native Delta resident fish populations and Delta habitat by placing the greatest priority on actions that could be implemented on hatchery production supplemented with some additional improvements in Delta habitat. Increased hatchery production of anadromous and resident native Delta fish could place more competitive and predator pressures on wild populations of anadromous and resident fishes. In order for these actions to be durable, a long-term reduction in the reliability that existing diverters have on surface supplies would result. It is therefore imperative that the conjunctive use programs and incentives be developed with terms and conditions that are economically attractive to surface water diverters, and which can effectively provide a better economic return for replacing surface water use with ground water use, especially in those regions where otherwise diverted surface waters will instead be dedicated to habitat and population improvements.

323

ALTERNATIVE ~~332~~ ACTIONS

SPECIFIC ACTION *PACKAGE*

HABITAT RESTORATION

Restoration of Delta Shallow Water Habitat
Convert existing leveed lands to tidal action - modest level
Restore tidal action to existing diked wetlands - modest level
Reconstruct levees to include shallow water habitat - modest level
Fill deep water to produce shallow water habitat - modest level

Restoration of Delta Riverine Habitat
Reconstruct river banks and shallow areas - modest level
Restore natural channel configuration - modest level

Restoration of Delta Riparian Habitat
Establish new areas of riparian habitat - modest level
Reestablish historic riparian areas - modest level

Restoration of Delta Terrestrial Habitat
Protect existing upland habitat - modest level
Establish upland habitat - modest level
Clean-up sites containing toxic substances - moderate level

Integrated Habitat Management Programs
Establish integrated habitat management programs - full implementation

Establishment of Floodways and Meander Belts
Relocate levees to widen floodways - modest level
Allow river channels to meander - modest level
Restore floodways as habitat corridors - moderate level

Control of Introduced/Nuisance Species
Remove or reduce nuisance species in key habitats - modest level
Modify habitat to favor native species - modest level

Restoration of Upstream Anadromous Fish Habitat
Restore channel configuration - modest level
Restore shoreline habitat conditions - modest level
Improve floodway drainage to reduce fish stranding - moderate level

Restoration of Upstream Riparian Habitat
Protect riparian lands through purchase/easements - moderate level
Restore flows to dewatered riparian habitats - modest level

Restoration of Upstream Wetland Habitat
Modify floodways to support wetland habitats - modest level

Delta Inflow Management
Decrease upstream diversions - modest level
Modify upstream reservoir operations - moderate level

Modify Delta inflow timing pattern - moderate level

MANAGEMENT OF ANADROMOUS FISH

Fish Hatchery Operations
Expand hatchery capacities - modest level
Construct new hatcheries on the San Joaquin R. - moderate level

ENHANCED CORE ACTIONS

HABITAT RESTORATION
Restoration of Upstream Anadromous Fish Habitat
Manage flows and temperatures in upstream habitats - moderate level
Restore and replenish spawning gravels - moderate level
Modify gravel mining practices - moderate level

Physical Improvements for Fish Passage
Modify passage at upstream dams/other barriers - moderate level
Modify natural barriers to improve passage - moderate level

Restoration of Upstream Riparian Habitat
Restrict livestock grazing in riparian corridors - moderate level
Revegetate degraded riparian habitats - moderate level

Management of Mine Drainage
Manage discharges from abandoned mines - moderate level
Remediate abandoned mining sites discharging pollutants - moderate level

Restoration of Delta Riverine Habitat
Restore/preserve channel islands - moderate level
Modify maintenance designs to include riverine elements - moderate level

Restoration of Delta Riparian Habitat
Improve and protect degraded riparian habitats - moderate level
Modify levee maintenance practices - moderate level
Protect existing riparian habitat - moderate level

Restoration of Delta Wetland Habitat
Enhance existing wetlands - moderate level
Expand wetland acquisition programs - moderate level
Protect existing wetland habitat - moderate level

Delta Inflow Management
Provide instream pulse flows for fish passage - moderate level
Provide instream flows for fish attraction - moderate level

MANAGEMENT OF ANADROMOUS FISH
Fish Hatchery Operations
Improve hatchery operations - moderate level
Implement tagging of hatchery-bred fish - maximum level

Enhancing Anadromous And Bay-Delta Native Species Populations Emphasizing Upstream Operation And Management Actions That Reduce The Impacts Of Diversions (Alternative 324)

Identification of Theme, Subtheme, and Approach:

Theme:	Enhance fish populations by reducing diversion impacts
Subtheme:	Equally emphasize both anadromous and Bay-Delta native species
Approach:	Operation and management actions that could be implemented at upstream locations

Solution Overview

The emphasis of this alternative is to enhance all Bay-Delta native and anadromous fish populations by coordinating operational releases, habitat restoration actions, improved management of diversion/fish interactions, and system reliability actions. It emphasizes actions in upstream locations, but also includes in-Delta actions at some core level of implementation to ensure that the entire range of fisheries habitats of importance are addressed.

Actions Selected

Reduce Effects of Diversions

Better diversion management would emphasize the installation and improvement of fish screens on upstream and in-Delta diversions, and more rigid enforcement of screening requirements. The removal and control of aquatic predators, through predator harvest programs at pumping plants in upstream habitats would be emphasized, and coordinated with screening improvements in the Delta. Fish salvage design, operations, and procedures improvements would receive high priority. Improved Delta inflow management, through improved reservoir release timing and decreased surface water diversions in upstream regions would provide instream pulse flows for fish passage and fish attraction. Delta outflow/export management would use real-time monitoring and adaptive management to better control salinities at key monitoring locations in the west and south Delta areas.

Restore Upstream Habitats

Upstream anadromous fish habitat restoration would emphasize better management of flow and temperature regimes, the restoration and replenishment of spawning gravels, and improved passage both for adults migrating upstream, and for outmigrating juveniles. Actions encouraging improvements in gravel mining practices, both in-channel and off-channel, would be implemented in order to improve physical and biological conditions in upstream stream beds. Restricted livestock grazing and restoration actions (container plantings, erosion control seeding, etc) in upstream riparian corridors would also be important actions.

Manage Water Quality

Water quality improvements for beneficial fish uses would include upstream and in-Delta dredged material management actions. Actions would include limiting dredging to avoid

fish migration periods, techniques to localize sediment movement, disposal of dredged materials at nonaquatic sites, removal of contaminated sediments in critical habitat sites, and reporting requirements to ensure that material used for levee maintenance is not contaminated.

Restore Bay-Delta Habitats

Delta riverine, riparian, and wetland habitat restoration actions would be used to protect and improve existing aquatic habitat values, and to increase its extent. Restoration and improvement actions would extend to channel islands, degraded riparian habitats, and existing wetlands. Wetlands acquisition programs would be included in an effort to expand the extent of higher quality fisheries habitat.

Enhance Anadromous Fish Populations

Fish harvest management, including improved regulations and enforcement of commercial and recreational take regulations would enhance populations in the Bay-Delta and upstream habitats.

Increase System Reliability

System reliability increases benefiting all fish species using the Delta would result from several management, educational, legal, and funding actions. Water management actions would focus on improved interagency ground and surface water management coordination, the more sophisticated management of Delta water resources information, and a Delta watermaster to manage flows. Education programs would include increased public awareness and education regarding the benefits of desalination, conservation, reclamation, and pricing. Legal changes include modified water laws pertaining to instream rights establishment, transfers, and conjunctive use. Funding actions would include increased incentives for conjunctive use, the establishment of an export capacity market, and developing accounts that would let urban users fund mine cleanups to coordinate land use with water planning.

Preliminary Assessment

This alternative effectively affords greater priority for operational changes (flow release volumes, timing, and purposes) and management actions (new and better fish screens, habitat restoration, harvest management, predator control, etc.) for fish population and fisheries habitat protection than are now provided. In order for the benefits of these actions to be durable, increased water will need to be dedicated to them. Water supply augmentation is therefore needed in order to increase system reliability for those water users affected by operational changes resulting from this alternative's implementation. The equability of this alternative is therefore dependent upon the priority placed on establishing economically effective incentives for conjunctive use that provide a reasonable return on investment for those users that will be encouraged to replace surface water diversions with ground water pumping. Other public education, interagency management coordination, legal actions easing transfer terms and conditions, and innovative mitigation funding programs also will complement such incentives.

ALTERNATIVE 324 - ANNOTATED ACTION LIST

Actions Selected

2. **Restoration of Delta Riverine Habitat**
   - Restore/preserve channel islands
   - Modify maintenance designs to include riverine elements

3. **Restoration of Delta Riparian Habitat**
   - Improve and protect degraded riparian habitats
   - Modify levee maintenance practices
   - Protect existing riparian habitat

4. **Restoration of Delta Wetland Habitat**
   - Enhance existing wetlands
   - Expand wetland acquisition programs
   - Protect existing wetland habitat

9. **Restoration of Upstream Anadromous Fish Habitat**
   - Manage flows and temperatures in upstream habitats
   - Restore and replenish spawning gravels
   - Modify gravel mining practices

10. **Physical Improvements for Fish Passage**
    - Modify passage at upstream dams/other barriers
    - Modify natural barriers to improve passage

11. **Restoration of Upstream Riparian Habitat**
    - Restrict livestock grazing in riparian corridors
    - Revegetate degraded riparian habitats

13. **Delta Inflow Management**
    - Decrease upstream diversions
    - Modify upstream reservoir operations
    - Modify Delta inflow timing pattern
    - Provide instream pulse flows for fish passage
    - Provide instream flows for fish attraction

14. **Delta Outflow/Export Management**
    - Use real-time monitoring and adaptive management

18. **Installation and Improvement of Fish Screens**
    - Install screens on upstream diversions
    - Install screens on other in-Delta diversions
    - Enforce Screening requirements

20. **Improvement of Fish Salvage Operations**
    - Improve design of salvage facilities
    - Improve operation of salvage facilities
    - Improve fish hauling and release procedures

21. **Removal and Control of Aquatic Predators**
    - Harvest predators at Delta export pumps
    - Harvest predators in upstream habitats

23. Fish Harvest Management

Improve regulation of commercial take
Improve regulation of recreational take
Improve enforcement of harvest regulations

32. Groundwater Banking and Conjunctive Use

Establish conjunctive use programs

39. Institutions for Integrated Long-term Water Management

Establish long-term guarantees for management
Establish institution to implement guarantees
Coordinate multiagency roles in management
Coordinate groundwater/surface water management
Establish incentives for cooperation/coordination
Establish a public awareness/education program
Establish a Delta watermaster to manage flows
Modify water law to establish instream rights
Educate users about desalination feasibility
Educate users about conservation technologies
Educate public about water reclamation
Educate users about pricing feasibility
Remove legal obstacles to pricing incentive programs
Establish incentives for conjunctive use
Modify California Water Code to encourage conjunctive use
Modify California Water Code to ease transfers
Improve procedures for transfer permitting
Allow urban districts to fund mine cleanup in lieu of urban cleanup
Establishment of Export Capacity Market
Implement urban awareness/education programs
Enforce wastewater discharge requirements
Water Resources Data and Information Management

44. Dredged Material Management

Limit dredging to avoid fish migration periods
Use techniques to localize sediment movement
Dispose dredged materials at nonaquatic sites
Remove contaminated sediments in critical habitat sites
Ensure material used for levee maintenance is noncontaminated

45. Management of Mine Drainage

Manage discharges from abandoned mines
Remediate abandoned mining sites discharging pollutants

Enhancing Anadromous And Bay-Delta Native Species Populations Emphasizing In-Delta Operation And Management Actions That Reduce The Impacts Of Diversions (Alternative 325)

Identification of Theme, Subtheme, and Approach:

Theme: Enhance fish populations by reducing diversion impacts
Subtheme: Equally emphasize both anadromous and Bay-Delta native species
Approach: Operation and management actions that could be implemented at Delta locations

Solution Overview

The emphasis of this alternative is to enhance all Bay-Delta native and anadromous fish populations by coordinating operational releases, habitat restoration actions, improved management of diversion/fish interactions, and system reliability actions. It emphasizes actions in Delta locations, but also includes upstream actions at some core level of implementation to ensure that the entire range of fisheries habitats of importance are addressed.

Actions Selected

Reduce Effects of Diversions

Delta outflow/export management would place primary emphasis on real-time monitoring and adaptive management to better control salinities at key monitoring locations in the west and south Delta areas. Improved Delta inflow management, through improved reservoir release timing and decreased surface water diversions would provide instream pulse flows for fish passage and fish attraction. Diversion timing through Montezuma SCG would provide better management and achievement of Suisun Marsh salinity goals now being investigated. Better diversion management would emphasize the installation and improvement of fish screens on in-Delta and upstream diversions, and more rigid enforcement of screening requirements. Fish salvage design, operations, and procedures improvements would receive high priority. The removal and control of aquatic predators, through aggressive predator harvest programs at Delta and upstream pumping plants would be emphasized.

Restore Bay-Delta Habitats

Delta riverine, riparian, and wetland habitat restoration actions would be emphasized to protect and improve existing aquatic habitat values, and to increase its extent. Restoration and improvement actions would extend to channel islands, degraded riparian habitats, and existing wetlands. Wetlands acquisition programs would be included in an effort to substantially increase fisheries habitat.

Restore Upstream Habitats

Upstream anadromous fish habitat restoration would emphasize better management of flow and temperature regimes, the restoration and replenishment of

spawning gravels, and improved passage both for adults migrating upstream, and for outmigrating juveniles. Actions encouraging improvements in gravel mining practices, both in-channel and off-channel, would be implemented in order to improve physical and biological conditions in upstream stream beds. Restricted livestock grazing and restoration actions (container plantings, erosion control seeding, etc) in upstream riparian corridors would also be important actions focused on providing Delta fisheries improvements.

Manage Water Quality

Water quality improvements for beneficial fish uses would include Delta and upstream dredged material management actions. Actions would include limiting dredging to avoid fish migration periods, techniques to localize sediment movement, disposal of dredged materials at nonaquatic sites, removal of contaminated sediments in critical habitat sites, and reporting requirements to ensure that material used for levee maintenance is not contaminated.

Enhance Anadromous Fish Populations

Fish harvest management, including improved regulations and enforcement of commercial and recreational take would enhance populations in the Bay-Delta and upstream habitats.

Increase System Reliability

System reliability increases benefiting all fish species using the Delta would result from several management, educational, legal, and funding actions. Water management actions would focus on improved interagency ground and surface water management coordination, the more sophisticated management of Delta water resources information, and a Delta watermaster to manage flows. Education programs would include increased public awareness and education regarding the benefits of desalination, conservation, reclamation, and pricing. Legal changes include modified water laws pertaining to instream rights establishment, transfers, and conjunctive use. Funding actions would include increased incentives for conjunctive use, the establishment of an export capacity market, and developing accounts that would let urban users fund mine cleanups to coordinate land use with water planning.

Preliminary Assessment

This alternative effectively affords greater priority for operational changes (flow release volumes, timing, and purposes) and management actions (new and better fish screens, habitat restoration, harvest management, predator control, etc.) for fish population and fisheries habitat protection than are now provided. In order for the benefits of these actions to be durable, increased water will need to be dedicated to them. Water supply augmentation is therefore needed in order to increase system reliability for those water users affected by operational changes resulting from this alternative's implementation. The equability of this alternative is therefore dependent upon the priority placed on establishing economically effective incentives for conjunctive providing a reasonable return on investment for users encouraged to replace surface water diversions with ground water pumping.

ALTERNATIVE 325 - ANNOTATED ACTION LIST

Actions Selected

2. Restoration of Delta Riverine Habitat
- Restore/preserve channel islands
- Modify maintenance designs to include riverine elements

3. Restoration of Delta Riparian Habitat
- Improve and protect degraded riparian habitats
- Modify levee maintenance practices
- Protect existing riparian habitat

4. Restoration of Delta Wetland Habitat
- Enhance existing wetlands
- Expand wetland acquisition programs
- Protect existing wetland habitat

9. Restoration of Upstream Anadromous Fish Habitat
- Manage flows and temperatures in upstream habitats
- Restore and replenish spawning gravels
- Modify gravel mining practices

10. Physical Improvements for Fish Passage
- Modify passage at upstream dams/other barriers
- Modify natural barriers to improve passage

11. Restoration of Upstream Riparian Habitat
- Restrict livestock grazing in riparian corridors
- Revegetate degraded riparian habitats

13. Delta Inflow Management
- Decrease upstream diversions
- Modify upstream reservoir operations
- Modify Delta inflow timing pattern
- Provide instream pulse flows for fish passage
- Provide instream flows for fish attraction

14. Delta Outflow/Export Management
- Use real-time monitoring and adaptive management

15. Modification of Diversion Timing Patterns
- Modify diversion timing of in-Delta diversions
- Modify diversion timing through Montezuma SCG

17.2. Obtain shifts in diversion timing patterns

18. Installation and Improvement of Fish Screens
- Install screens on upstream diversions
- Install screens on other in-Delta diversions
- Enforce Screening requirements

20. Improvement of Fish Salvage Operations
- Improve design of salvage facilities

Improve operation of salvage facilities
Improve fish hauling and release procedures

21. **Removal and Control of Aquatic Predators**
Harvest predators at Delta export pumps
Harvest predators in upstream habitats

23. **Fish Harvest Management**
Improve regulation of commercial take
Improve regulation of recreational take
Improve enforcement of harvest regulations

32. **Groundwater Banking and Conjunctive Use**
Establish conjunctive use programs

39. **Institutions for Integrated Long-term Water Management**
Establish long-term guarantees for management
Establish institution to implement guarantees
Coordinate multiagency roles in management
Coordinate groundwater/surface water management
Establish incentives for cooperation/coordination
Establish a public awareness/education program
Establish a Delta watermaster to manage flows
Modify water law to establish instream rights
Educate users about desalination feasibility
Educate users about conservation technologies
Educate public about water reclamation
Educate users about pricing feasibility
Remove legal obstacles to pricing incentive programs
Establish incentives for conjunctive use
Modify California Water Code to encourage conjunctive use
Modify California Water Code to ease transfers
Improve procedures for transfer permitting
Allow urban districts to fund mine cleanup in lieu of urban cleanup
Establishment of Export Capacity Market
Implement urban awareness/education programs
Enforce wastewater discharge requirements
Water Resources Data and Information Management

44. **Dredged Material Management**
Limit dredging to avoid fish migration periods
Use techniques to localize sediment movement
Dispose dredged materials at nonaquatic sites
Remove contaminated sediments in critical habitat sites
Ensure material used for levee maintenance is noncontaminated

45. **Management of Mine Drainage**
Manage discharges from abandoned mines
Remediate abandoned mining sites discharging pollutants

IMPROVE CONDITIONS FOR ANADRAMOUS AND BAY-DELTA NATIVE FISH SPECIES BY REDUCING THE IMPACTS OF DIVERSION THROUGH THE INSTALLATION AND OPERATION OF UPSTREAM FISH SCREENS AND BARRIERS (ALTERNATIVE 326).

Identification of Theme, Subtheme, and Approach

Theme:	Enhance populations of anadramous and Bay-Delta native fish species through reduced diversion impacts.
Sub-theme:	Increase anadramous and Bay-Delta native fish populations.
Approach:	Installation and operation of upstream fish screens and barriers.

SOLUTION OVERVIEW

This alternative has been developed to enhance populations of both Delta native fishes and anadramous fish species, using upstream measures for improving fish passage. This action includes comprehensive screening actions to reduce entrainment of both anadramous species and other native Delta species that spawn upstream of the Delta. In addition, other measures (e.g. barriers and flow improvements) have been included to maximize migration success. This alternative includes upstream flow management measures to ensure benefits for Delta native species by controlling Suisun Bay salinity at key times to improve rearing habitat. These alterations of flow require some coordination and planning for increased water supply and improved operational flexibility to ensure exports for water users south of the Delta.

ACTIONS SELECTED

Upstream Habitat Restoration: While this alternative focuses on population increases by decreasing entrainment, flow management actions have been added to enhance fish passage, including pulse flows and attraction flows at a maximum level. In addition, upstream reservoir operations would be modified to improve instream flows for anadramous fish where necessary.

To reduce stranding and improve passage of Delta native fish species that spawn in the upstream floodways, drainage improvements would be implemented, focusing on areas where maximum benefits can be achieved. Upstream measures for Delta inflow management have been included to ensure benefits associated with maintaining favorable salinity levels in Suisun Bay for native Delta fishes. Actions to achieve improved levels of salinity include reoperation of existing reservoirs, modify Delta inflow timing, and obtaining shifts in upstream diversion timing.

Reduction in Diversion Effects: In addition to the core actions for the operation of the fish barrier on the Merced River, additional benefits for anadramous fish species would be achieved through implementation of actions to improve fish passage at wide-spread locations throughout the headwaters of Delta tribitaries, including installation of new fish ladders at key diversions, in combination with repair and reoperation of existing passage facilities. Special attention would be focused on high profile barrier problems in the Upper Sacramento River affecting special status species.

To increase the overall success of upstream and downstream migrations of anadramous fish species, several fish barriers (acoustical and physical) would be installed and operated, including barriers along the Mokelumne, San Joaquin, and Sacramento rivers. In addition, barriers would be placed in locations throughout the watershed to exclude or guide migrating fish away from gravel pits and other potentially detrimental situations.

To provide for the greatest possible upstream benefits for anadramous fish species several core actions would be implemented at a maximum level, including installation of new and improvement of existing fish screens (install screens on upstream diversions and comprehensive enforcement of existing screening regulations). High priority areas for fish screen improvements include historical spawning areas for Delta native species (Sacramento splittail), such as the Yolo and Sutter bypasses. These actions would be complemented by in-Delta improvements specified by other core actions (in-Delta actions would be implemented at the core level).

Reduction in Export Reliance: To partially balance losses in exports due to implementation of flow modifications for fisheries enhancement, a variety of actions have been included, such as increased water conservation, expansion of water reclamation, and land retirement and fallowing.

Water Supply Enhancement and Predictability: In part to buffer any losses in exports, but also to provide some level of equity to water users that may be indirectly affected by instream flow actions, measures to increase water supply and flexibility have also been included within this alternative. These actions are, in general, expansion of on-stream or off stream storage south of the Delta, implementation of groundwater banking and conjunctive use programs, and improvement of through Delta conveyance.

PRELIMINARY ASSESSMENT

This alternative has been designed to focus on the resolution of the fisheries and diversions conflict, with emphasis on anadramous and Delta native fish species. The inclusion of core actions and additional actions to balance potential export losses associated with improvements in stream flow conditions ensure equity in this solution. The actions included within this alternative are reasonably affordable and implementable. Physical enhancement as well as improvements in operation and management of existing facilities provide guarantees that this alternative is durable. Careful review of the actions selected in this alternative does not revel any significant redirected impacts.

Actions Selected:

In addition to the Core Actions, this alternative includes several other actions included in the following list:

Delta Inflow Management
Modify upstream reservoir operations
Modify Delta inflow timing
Restoration of Upstream Anadramous Fish Habitat
Improve floodway drainage to reduce fish standing
Acquire Water Supplies for Fish and Wildlife
Obtain shifts in diversion timing patterns
Physical Improvements for Fish Passage
Installation of fish ladders
Repair and improvement of existing fish ladders
Installation of Barriers to Guide Fish Movement
Install barriers to block fish movement on the San Joaquin, Mokelumne, and Sacramento Rivers
Reduction in Export Reliance
water conservation
water reclamation
land retirement and fallowing
New or Expanded On-Stream Storage
Enlarge existing on-stream storage reservoirs
New or Enlarged Off-Stream Storage
Enlarge existing off-stream storage reservoirs
Construct new off-stream storage in the Delta
Groundwater Banking and Conjunctive Use
Establish conjunctive use programs
Store groundwater south of the Delta
Implement techniques to increase groundwater recharge

IMPROVE CONDITIONS FOR ANADRAMOUS AND BAY-DELTA NATIVE FISH SPECIES BY REDUCING THE IMPACTS OF DIVERSION THROUGH THE INSTALLATION AND OPERATION OF IN-DELTA FISH SCREENS AND BARRIERS (ALTERNATIVE 327).

Identification of Theme, Subtheme, and Approach

Theme: Enhance populations of anadramous and Bay-Delta native fish species through reduced diversion impacts.
Sub-theme: Increase anadramous and Bay-Delta native fish populations.
Approach: Installation and operation of in-Delta fish screens and barriers.

SOLUTION OVERVIEW

The overall approach for this alternative is in-Delta improvements for both anadramous and Delta native fish species to reduce entrainment and improve fish passage. Beneficial actions for special status fishes have also been included to address declining populations of winter-run chinook salmon, Delta smelt, longfin smelt, and Sacramento splittail. Actions included in this alternative combine reductions in entrainment, more successful fish migration, improved flow conditions, with provisions for increased operational flexibility and additional storage south of the Delta. These actions in concert provide considerable improvement of existing fisheries resources.

ACTIONS SELECTED

Bay-Delta Habitat Restoration: Implementation of the core habitat restoration actions would provide benefits for anadramous fish populations, including resting, foraging, and nursery habitats. With the implementation of this alternative, habitat restoration within the Delta would focus on key habitat improvements for migrating fish populations, including restoration of shallow water habitat and shaded riverine aquatic habitat.

To minimize stranding effects on species such as Sacramento splittail, drainage improvements would be implemented in floodway areas to maximize the productivity of these spawning areas, resulting in a net increase of fish from these areas.

Reduction in Diversion Effects: In-Delta improvements for anadramous and Delta native fish include the following actions that minimize in-Delta entrainment, reduce predation, and improve to in-Delta fish movement through flow management and installation and operation of barriers.

High priority actions for immediate implementation include improvements to current Delta export operations. Improvement of existing fish screening facilities would include improved performance criteria, including reduced approach and sweeping velocities. To further lower existing levels of entrainment, actions to be implemented at a maximum level throughout the Bay-Delta system include: improvements to existing fish screens at the Delta export pumps and other existing facilities; consolidation and screening of existing (small) in-Delta diversions; and conversion of industrial water use for cooling towers. In addition, a comprehensive enforcement program would be implemented to ensure strict compliance with existing regulations.

Where entrainment can be minimized through the consolidation of agricultural diversions and/or the relocation of existing diversions from key habitat areas these actions should also be implemented. In addition, diversions designs should be improved when relocated.

Additional reductions in entrainment may also be achieved through the modification of diversion timing patterns and increased rates of diversion capacity. These actions would provide maximum benefits when implemented under a real-time monitoring and adaptive management program (at maximum levels).

To improve fish passage in the Delta, a system of barriers would be installed and operated for maximum benefit to fish, including the Old River fish barrier, a series of barriers at key points along the Sacramento River (designed to keep fish in the river), and barriers to divert fish from the Sacramento to the western islands. Where appropriate, existing barriers would be reevaluated and changes in operations would be implemented to improve fish passage.

Existing salvage operations may be enhanced through the implementation of predator control programs which remove predators and "predator friendly" habitats from key sites including Clifton Court Forebay, Rock Slough, Barker Slough, Montezuma Slough, and others. This program may also include small scale habitat development to provide resting and escape cover at these sites.

To provide maximum in-Delta benefits for Delta native fish species several core actions would be implemented at a maximum level, including Delta inflow management, Delta outflow/export management (pulse flows), installation and improvement of fish screens (in-Delta), and improvement of in-Delta fish salvage operations. Other core actions focusing on upstream diversion effects would also be implemented at the core level.

Water Supply Enhancement and Predictability: An integral part of this alternative is the development of a dual purpose in-Delta storage facility. While the primary focus of the facility would be for maintaining improved salinity conditions in Suisun Bay, a complementary mission could be salinity management for increased operational flexibility or enhanced export capacity.

In addition, this alternative includes south of the Delta storage (ground water banking [conjunctive use] and/or on-or off-stream reservoir enlargement) to maximize the benefits associated with in-Delta storage and to provide equity to water users south the Delta who may be adversely affected by the implementation of flow management measures that improve conditions for Delta native fish species.

PRELIMINARY ASSESSMENT

This alternative has been designed to focus on the resolution of the fisheries and diversions conflict, covering both declining Delta native species and anadramous fish species, including winter-run salmon. Equity is ensured in this solution with the inclusion of increased storage and improved operational flexibility to balance potential export losses associated with changes for in-stream flow conditions. The actions included within this alternative are reasonably affordable and implementable on a State-wide basis. Habitat improvements, greatly reduce entrainment, and improved flow conditions are combined in this alternative with improvements in operation and management of existing facilities to guarantee durability and long-lasting benefits. Careful review of the actions selected for this alternative does not revel any significant redirected impacts.

Actions Selected:

In addition to the Core Actions, this alternative includes several other actions included in the following list:

Restoration of Upstream Anadramous Fish Habitat
Improve floodway drainage to reduce fish standing
(to be implemented in all in-Delta floodways)
Installation and Improvement to Fish Screens
Improve screens at Delta export pumps
Improve other existing fish screen systems
Consolidate and screen existing small diversions
Changes in Location of Diversions
Relocate Delta export pumps from key habitats
Relocate other in-Delta diversions
Consolidate in-Delta agricultural diversions
Improve diversion design when relocating
Modification of Diversion Timing Patterns
Modify diversion timing of in-Delta diversions
Modify diversion timing through Montezuma SCD
Increased Rates of Diversion Capacity
Obtain approvals to fully unitize existing export capacity to generate yield and reduce diversion impacts
Enlarge export pumping and conveyance capacities to generate yield and to reduce diversion impacts.
Installation of Barriers to Guide Fish Movement
Install barriers to block fish movement into Old River
Install barriers to keep fish in the Sacramento River
Install barriers to divert fish from the Sacramento River to Western channels
Removal and Control of Aquatic Predators
Harvest predators at the Delta pumps
New or Expanded On-Stream Storage
Enlarge existing on-stream storage reservoirs
New or Enlarged Off-Stream Storage
Enlarge existing off-stream storage reservoirs
Construct new off-stream storage in the Delta
Groundwater Banking and Conjunctive Use
Establish conjunctive use programs
Store groundwater south of the Delta
Implement techniques to increase groundwater recharge

ALTERNATIVE 329: REDUCE DELTA DIVERSION IMPACTS TO ALL INDIGENOUS FISH BY CONSOLIDATED IN-DELTA DIVERSIONS AND FLOW MANAGEMENT

Theme: Enhance fishery population through reduced diversion impacts.
Sub-Theme: Enhancing all indigenous fishery.
Approach: Consolidating and relocating diversions with emphasis on measures taken in the Delta.

SOLUTION OVERVIEW

Alternative 329 focuses on enhancing the fishery by reducing the impacts resulting from in-Delta diversions. The principal focus of actions is consolidating diversions to minimize potential unscreened entrainment of migrating smolts and maximize their out-migration success. Coordinated flow management as mitigated by moderate export enhancements assures successful out-migration of smolts.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

All core actions without modification are included. Actions would be targeted to guide/attract fish migration away from the principal diversion site.

Upstream Habitat Restoration

Management of flows and temperatures would be targeted to retain and then initiate migration of fish past diversion points to the Delta at the minimum core level. All other core actions would be implemented without modification.

Reduction in Diversion Effects

Construct an eastside Delta isolated conveyance facility to consolidate all Delta diversions throughout the year. Timing of all diversions could be modified through adaptive management which would occasionally restrict diversion to avoid entrainment of monitored fish populations.

Pulse flows accentuating minimum instream pulses, timed for anadromous fishery population peaks in the Delta, would be provided to move fish past the principal Delta diversion site. To accomplish this, the pulse flow would be enhanced from the minimum core level of 20 percent to 70 percent of the AFRP suggested target for the Delta.

Management of Anadromous Fish

The core action for improved hatchery operation should target the introduction of smolts in coordination with pulse flow management.

10--Physical Improvement in Fish Passage
10.1--Modify passage at upstream dams/other barriers - maximum reasonable level
10.2--Modify natural barriers to improve passage - maximum reasonable level

11--Restoration of Upstream Riparian Habitat
11.1--Restrict livestock grazing in riparian corridors - maximum reasonable level
11.2--Revegetate degraded riparian habitats - maximum reasonable level
11.3--Protect riparian lands through purchase/easements - maximum reasonable level
11.4--Restore flows to dewatered riparian habitats - modest level

12--Restoration of Upstream Wetland Habitat
12.1--Modify floodways to support wetland habitats - moderate level
12.2--Reuse agricultural drainage to create wetlands - modest level
12.3--Reuse urban wastewater effluent to create wetlands - modest level

13--Delta Inflow Management
13.1--Decrease upstream diversions - maximum reasonable level
13.2--Modify upstream reservoir operations - maximum reasonable level
13.3--Modify Delta inflow timing pattern - maximum reasonable level
13.4--Provide instream pulse flows for fish passage - maximum reasonable level
13.5--Provide instream flows for fish attraction - maximum reasonable level

14--Delta Outflow/Export Management
14.1--Modify Central Delta channel operations - moderate level
14.2--Modify export operations criteria - moderate level

15--Modification of Diversion Timing Pattern
15.1--Modify diversion timing in in-Delta diversions - maximum reasonable level
15.2--Modify diversion timing through Montezuma SCG - maximum reasonable level

16--Increase Rates of Diversion Capacity
16.2--Obtain approvals to fully use existing export capacity to reduce diversion impacts - moderate level
16.4--Enlarge export pumping and conveyance capacity to reduce diversion impacts - modest level

17--Acquire Water Supplies for Fish and Wildlife
17.2--Obtain shifts in diversion timing patterns - maximum reasonable level
17.3--Improve flows at key times and places - maximum reasonable level

21--Removal and Control of Aquatic Predators
21.1--Harvest predators at Delta export pumps - maximum reasonable level
21.2--Harvest predators in upstream habitats - maximum reasonable level

22--Fish Hatchery Operations
22.4--Reduce hatchery effects on wild fish populations - maximum reasonable level
22.5--Implement tagging of hatchery-bred fish - maximum reasonable level
22.6--Establish new captive breeding programs - moderate level

29--Watershed Management
29.2--Manage riparian zones to protect water quality - moderate level
29.3--Manage landuse to protect water quality - moderate level

38--Long-Term Planning for Drought Contingencies
38.3--Develop alternate supplies for drought situations - maximum reasonable level

39--Institutions for Integrated Long-term Water Management
39.02--Establish institution to implement guarantees
39.07--Establish a Delta watermaster to manage flows
39.08--Modify water law to establish instream rights
39.21--Enforce wastewater discharge requirements
39.22--Water resources data and information management

42--Management of Agricultural Drainage
42.01--Implement source control regulations for pollutants - maximum reasonable level
42.02--Implement pollutant-load limits in San Joaquin River - maximum reasonable level
42.03--Reduce or control volume of agricultural discharges - moderate level
42.04--Modify cropping and irrigation practices - modest level
42.05--Export agricultural drainage to other watersheds - modest level
42.07--Improve pest-control practices - moderate level
42.08--Manage irrigation tailwater to reduce pesticides - maximum reasonable level
42.09--Manage drainage timing to reduce instream impacts - moderate level
42.10--Treat drainage to remove pollutants - moderate level
42.11--Dilute pollutants in Delta inflow from SJR using stored water - modest level

43--Management of Urban and Wastewater Discharge
43.2--Treat discharges to remove problem constituents - modest level
43.4--Increase key nutrient inputs to estuary - modest level

44--Dredged Material Management
44.1--Limit dredging to avoid fish migration periods - moderate level
44.2--Use techniques to localize sediment movement - moderate level
44.3--Dispose dredged materials at nonaquatic sites - moderate level
44.4--Remove contaminated sediments in critical habitat sites - modest level
44.5--Ensure material used for levee maintenance is noncontaminated - maximum reasonable level

45--Management of Mine Drainage
45.1--Manage discharges from abandoned mines - maximum reasonable level
45.2--Remediate abandoned mining sites discharging pollutants - maximum reasonable level

46--Levee Maintenance and Stabilization
46.1--Maintain and stabilize existing levees - moderate level

50--Integrated Habitat Management Programs
50.1--Establish integrated habitat management programs - full implementation

Preliminary Alternative EQ-342

Group — *Title*

ECOSYSTEM QUALITY — **Maximize Bay-Delta Fish Populations**

Increase populations of Bay-Delta native fish through habitat improvements, reduced diversions, isolated diversion facilities, improved water quality, improved water management, improved agricultural practices, and hatchery production.

Key Actions

Habitat Restoration---Restore riverine, riparian, wetland, and adjacent terrestrial habitat, and expand floodway habitat, channels, and meander belts in the Bay-Delta to restore fish spawning, rearing, feeding, and migrating habitats and improve fish survival. Isolate Delta export diversions to restore Delta habitat conditions.
Habitat Management---Establish comprehensive and integrated habitat management programs to maximize benefits to fish populations, and improve floodway drainage to reduce fish stranding.
Control Introduced/Nuisance/Predator Species---Reduce the numbers of nuisance and predator species from key habitat and modify habitat to limit introduced/nuisance species.
Hatcheries---Expand hatchery production of salmon and steelhead in Sacramento and San Joaquin river basin; construct hatchery facilities for delta smelt, sturgeon, and perhaps Sacramento perch.
Project Operations---Change reservoir operations and Delta inflow and export patterns to benefit fish habitat and production.
Reduce Diversions and Diversion Effects--Modify diversion timing, increase diversion capacity to allow less diversion during key periods, acquire water supplies for fish to improve flows, improve existing screens and install new screens, consolidate diversions, enforce screenng requirements, and convert industrial water use to cooling towers. Isolate Delta diversions by constructing conveyance facilities.

Supporting Actions

Fisheries Management---Tag/mark all hatchery fish to assess role of hatchery produced fish and to focus harvest on hatchery fish.
Flow Pulses---Provide flows for fish passage and attraction to the maximum extent reasonably possible.
Levee Maintenance and Stabilization--Protect levees from catastrophic failure to preserve Delta habitat conditions and minimize loss of fish and invertebrates to flooded islands.
Water Quality--Improve watershed management, and reduce pollutant inputs from agricultural and mine drainage, dredging, and urban and wastewater discharges.
Water Supply--Improve water supply for fish by acquiring water supply for fish, developing alternate supplies for drought situations, constructing new off-stream storage upstream of the Delta, providing institutional mechanisms for long-term water management, and providing in-Delta storage on Delta islands converted to storage within cross Delta conveyance system.

Preliminary Alternative EQ-342

Core Actions

Bay-Delta Habitat Restoration—Core actions to improve and protect existing aquatic, riparian, and wetland habitats in the Bay-Delta compliment key actions to restore habitat in the Bay-Delta.

Upstream Habitat Restoration— Core actions to improve and protect existing aquatic, riparian, and wetland habitats upstream of the Delta compliment key actions to restore upstream habitats.

Reduction in Diversion Effects— Core actions to reduce diversion effects compliment key actions to diversion effects.

Management of Anadromous Fish—Core-level implementation of actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement would supplement key actions to improve conditions for anadromous fish.

Reductions in Diversion/Export Reliance—This alternative would rely on core-level implementation of actions such as educating users about reclamation, conservation, water pricing and desalination feasibility, as well as encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement—Core-level implementation of actions such as incentives for conjunctive use would supplement supplemental actions to enhance water supply.

Increasing Water Supply Predictability—This alternative would rely on the core-level implementation of actions such as improving the ability to implement water transfers, long-term drought planning, institutions for water management, and coordination of land use and water supply planning.

Management of Water Quality—This alternative would increase the core level of implementation of actions to manage Delta water quality such as implementing source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, industrial, and mine discharges and runoff.

Improvement to System Reliability/Vulnerability—This alternative would increase the core level of implementation of actions to improve system reliability such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality—This alternative would substantially improve ecosystem quality in the Bay-Delta through habitat restoration, direct fish population enhancements via hatcheries, reduced diversion effects, and increased water for fish and wildlife. While quality would remain limited by water exports, the existing level of loss of habitat and small fish from the Delta would be reduced by isolated Delta transfer facilities. Actions to improve and protect existing aquatic, riparian, and

wetland habitats within the Delta would greatly enhance anadromous and Bay-Delta native fish populations.

Water Supply Reliability—This alternative would result in improved water supply reliability because of improved water conveyance facilities, greater storage capacity, greater diversion capacity, and additional water supply development. Core actions involving water transfers, long-term planning and management, and intergrated land-use and water supply planning would help to limit the reduction in reliability of the water supply.

Water Quality—Key actions provide for major reductions in water quality problems in the Bay-Delta through implementating source controls and regulations for pollutants in agricultural drainage and urban and wastewater discharge, limiting mine drainage and restoration of wetland habitats. These actions along with core actions that would make modest efforts to manage urban and wastewater discharge, and dredged material would be sufficient to alleviate many existing water quality problems.

System Reliability—This preliminary alternative achieves considerable improvements in system reliability through the implementation of key and core actions. Moderate levels of maintaining and stabilizing high priority levees, providing an isolated through Delta transfer facility, modifying agricultural practices to reduce subsidence, implementing levee maintenance standards, and providing funding for levee maintenance and stabilization would provide for moderate improvements in reliability. Improvement in reliability is obtained from more expansive improvements in the levee system, reduced reliance on the Delta for water supply, and improved water quality of the water supply..

ALTERNATIVE 342 ACTIONS

SPECIFIC ACTION PACKAGE

1--Restoration of Delta Shallow Water Habitat
1.1--Convert existing leveed lands to tidal action - maximum reasonable level
1.2--Protect existing shallow water habitat from erosion - maximum reasonable level
1.3--Restore tidal action to existing diked wetlands - maximum reasonable level
1.4--Reconstruct levees to include shallow water habitat - maximum reasonable level
1.5--Fill deep water to produce shallow water habitat - maximum reasonable level

2--Restoration of Delta Riverine Habitat
2.1--Reconstruct river banks and shallow areas - maximum reasonable level
2.2--Restore/preserve channel islands - maximum reasonable level
2.3--Restore natural channel configuration - maximum reasonable level
2.4--Modify maintenance designs to include riverine elements - maximum reasonable level

3--Restoration of Delta Riparian Habitat
3.1--Improve and protect degraded riparian habitats - maximum reasonable level
3.2--Establish new areas of riparian habitat - maximum reasonable level
3.3--Reestablish historic riparian areas - maximum reasonable level
3.4--Modify levee maintenance practices - maximum reasonable level
3.5--Protect existing riparian habitat - maximum reasonable level

4--Restoration of Delta Wetland Habitat
4.1--Enhance existing wetlands - moderate level
4.2--Expand wetland acquisition programs - moderate level
4.3--Convert agricultural lands to wetlands - modest level
4.4--Protect existing wetland habitat - moderate level

5--Restoration of Delta Terrestrial Habitat
5.1--Protect existing upland habitat - modest level
5.2--Establish upland habitat - modest level
5.3--Preserve the habitat values of agricultural land uses - modest level
5.4--Clean-up sites containing toxic substances - maximum reasonable level

6--Establishment of Floodways and Meander Belts
6.1--Relocate levees to widen floodways - modest level
6.2--Allow river channels to meander - modest level
6.4--Restore floodways as habitat corridors - modest level

7--Control of Introduced/Nuisance Species
7.1--Remove or reduce nuisance species in key habitats - maximum reasonable level
7.4--Inspect for invasion of nuisance species - maximum reasonable level
7.5--Modify habitat to favor native species - maximum reasonable level

9--Restoration of Upstream Anadromous Fish Habitat
9.6--Improve floodway drainage to reduce fish stranding - modest level

13--Delta Inflow Management
13.1--Decrease upstream diversions - modest level
13.2--Modify upstream reservoir operations - modest level

13.3--Modify Delta inflow timing pattern - maximum reasonable level
13.4--Provide instream pulse flows for fish passage - moderate level
13.5--Provide instream flows for fish attraction - moderate level

14--Delta Outflow/Export Management
14.1--Modify Central Delta channel operations - moderate level
14.2--Modify export operations criteria - moderate level

15--Modification of Diversion Timing Pattern
15.1--Modify diversion timing in in-Delta diversions - maximum reasonable level
15.2--Modify diversion timing through Montezuma SCG - maximum reasonable level

16--Increase Rates of Diversion Capacity
16.2--Obtain approvals to fully use existing export capacity to reduce diversion impacts - moderate level
16.4--Enlarge export pumping and conveyance capacity to reduce diversion impacts - modest level

17--Acquire Water Supplies for Fish and Wildlife
17.2--Obtain shifts in diversion timing patterns - moderate level
17.3--Improve flows at key times and places - moderate level

18-Installation and Improvement of Fish Screens
18.1--Improve screens at Delta export pumps - modest level
18.2--Improve other existing fish screen systems - maximum reasonable level
18.3--Install screens on other in-Delta diversions - maximum reasonable level
18.5--Consolidate and screen existing small diversions - maximum reasonable level
18.6--Enforce screening requirements - moderate level
18.7--Convert industrial water use to cooling towers - maximum reasonable level

35--Construction & Improvement of Conveyance Facilities
35.8--Convert Delta islands to storage conveyance system

36--Changes in Locations of Diversions
36.2--Relocate other in-Delta diversions - moderate level
36.3--Consolidate in-Delta agricultural diversions - moderate level
36.5--Improve diversion design when relocating - maximum reasonable level

38--Long-Term Planning for Drought Contingencies
38.3--Develop alternate supplies for drought situations - maximum reasonable level

39--Institutions for Integrated Long-term Water Management
39.02--Establish institution to implement guarantees
39.07--Establish a Delta watermaster to manage flows
39.08--Modify water law to establish instream rights
39.21--Enforce wastewater discharge requirements
39.22--Water resources data and information management

42--Management of Agricultural Drainage
42.01--Implement source control regulations for pollutants - maximum reasonable level
42.02--Implement pollutant-load limits in San Joaquin River - maximum reasonable level
42.03--Reduce or control volume of agricultural discharges - moderate level
42.04--Modify cropping and irrigation practices - modest level
42.05--Export agricultural drainage to other watersheds - modest level
42.07--Improve pest-control practices - moderate level
42.08--Manage irrigation tailwater to reduce pesticides - maximum reasonable level

42.09--Manage drainage timing to reduce instream impacts - moderate level
42.10--Treat drainage to remove pollutants - moderate level
42.11--Dilute pollutants in Delta inflow from SJR using stored water - modest level

43--Management of Urban and Wastewater Discharge
43.2--Treat discharges to remove problem constituents - modest level
43.4--Increase key nutrient inputs to estuary - modest level

44--Dredged Material Management
44.1--Limit dredging to avoid fish migration periods - moderate level
44.2--Use techniques to localize sediment movement - moderate level
44.3--Dispose dredged materials at nonaquatic sites - moderate level
44.4--Remove contaminated sediments in critical habitat sites - modest level
44.5--Ensure material used for levee maintenance is noncontaminated - maximum reasonable level

46--Levee Maintenance and Stabilization
46.1--Maintain and stabilize existing levees - moderate level

50--Integrated Habitat Management Programs
50.1--Establish integrated habitat management programs - full implementation

B-004182

Preliminary Alternative EQ-343

Group — *Title*

ECOSYSTEM QUALITY — **Modest Enhancement of Native Fish Populations**

Increase populations of native anadromous and Bay-Delta resident fish through modest levels of habitat improvements, reduced diversions, isolated diversion facilities, improved water quality, improved water management, improved agricultural practices, and supportive hatchery activities.

Key Actions

Habitat Restoration---Restore riverine, riparian, wetland, and adjacent terrestrial habitat, and expand floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries to restore fish spawning, rearing, feeding, and migrating habitats and improve fish survival. Isolate Delta export diversions to restore Delta habitat conditions.
Habitat Management---Establish comprehensive and integrated habitat management programs to maximize benefits to fish populations, and improve floodway drainage to reduce fish stranding.
Control Introduced/Nuisance/Predator Species---Reduce the numbers of nuisance and predator species from key habitat and modify habitat to limit introduced/nuisance species.
Hatcheries---Expand hatchery production of salmon and steelhead in Sacramento and San Joaquin river basin; construct hatchery facilities for delta smelt, sturgeon, and perhaps Sacramento perch.
Project Operations---Change reservoir operations and Delta inflow and export patterns to benefit fish habitat and production.
Reduce Diversions and Diversion Effects--Modify diversion timing, increase diversion capacity to allow less diversion during key periods, acquire water supplies for fish to improve flows, improve existing screens and install new screens, consolidate diversions, enforce screening requirements, and convert industrial water use to cooling towers. Isolate Delta, Sacramento River, and San Joaquin River diversions by constructing conveyance facilities.

Supporting Actions

Fisheries Management---Tag/mark all hatchery fish to assess role of hatchery produced fish and to focus harvest on hatchery fish.
Hatcheries---Improve hatchery operations to maximize production, improve genetics, and limit effects on wild salmon and steelhead populations to the maximum extent possible.
Fish Passage Improvements---Improve passage of anadromous fish at all feasible small dams and other barriers in the Sacramento and San Joaquin rivers and their tributaries.
Flow Pulses---Provide flows for fish passage and attraction to the maximum extent reasonably possible.
Levee Maintenance and Stabilization--Protect levees from catastrophic failure to preserve Delta habitat conditions and minimize loss of fish and invertebrates to flooded islands.
Water Quality--Improve watershed management, and reduce pollutant inputs from agricultural and mine drainage, dredging, and urban and wastewater discharges.
Water Supply--Improve water supply for fish by acquiring water supply for fish, developing alternate supplies for drought situations, constructing new off-stream storage upstream of the Delta, providing institutional mechanisms for long-term water management, and providing in-Delta storage on Delta islands converted to storage within cross Delta conveyance system.

Preliminary Alternative EQ-343

Core Actions

Bay-Delta Habitat Restoration—Core actions to improve and protect existing aquatic, riparian, and wetland habitats in the Bay-Delta compliment key actions to restore habitat in the Bay-Delta.

Upstream Habitat Restoration— Core actions to improve and protect existing aquatic, riparian, and wetland habitats upstream of the Delta compliment key actions to restore upstream habitats.

Reduction in Diversion Effects— Core actions to reduce diversion effects compliment key actions to diversion effects.

Management of Anadromous Fish—Core-level implementation of actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement would supplement key actions to improve conditions for anadromous fish.

Reductions in Diversion/Export Reliance—This alternative would rely on core-level implementation of actions such as educating users about reclamation, conservation, water pricing and desalination feasibility, as well as encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement—Core-level implementation of actions such as incentives for conjunctive use would supplement supplemental actions to enhance water supply.

Increasing Water Supply Predictability—This alternative would rely on the core-level implementation of actions such as improving the ability to implement water transfers, long-term drought planning, institutions for water management, and coordination of land use and water supply planning.

Management of Water Quality—This alternative would increase the core level of implementation of actions to manage Delta water quality such as implementing source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, industrial, and mine discharges and runoff.

Improvement to System Reliability/Vulnerability—This alternative would increase the core level of implementation of actions to improve system reliability such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality—This alternative would modestly improve ecosystem quality through habitat restoration, direct fish population enhancements via hatcheries, reduced diversion effects, and increased water for fish and wildlife. While quality would remain limited by water exports the existing level of loss of habitat and small fish would be reduced by isolated water transfer facilities. Modest levels of actions to improve and protect existing aquatic, riparian, and wetland

habitats within and upstream of the Delta would enhance anadromous and Bay-Delta native fish populations.

Water Supply Reliability—This alternative would result in improved water supply reliability because of improved water conveyance facilities, greater storage capacity, greater diversion capacity, and additional water supply development. Core actions involving water transfers, long-term planning and management, and integrated land-use and water supply planning would help to limit the reduction in reliability of the water supply.

Water Quality—Key actions provide for major reductions in water quality problems in the Bay-Delta and rivers through implementing source controls and regulations for pollutants in agricultural drainage and urban and wastewater discharge, limiting mine drainage and restoration of wetland habitats. These actions along with core actions that would make modest efforts to manage urban and wastewater discharge, and dredged material would be sufficient to alleviate many existing water quality problems.

System Reliability—This preliminary alternative achieves considerable improvements in system reliability through the implementation of key and core actions. Moderate levels of maintaining and stabilizing high priority levees, providing an isolated through Delta transfer facility, modifying agricultural practices to reduce subsidence, implementing levee maintenance standards, and providing funding for levee maintenance and stabilization would provide for moderate improvements in reliability. Improvement in reliability is obtained from more expansive improvements in the levee system, reduced reliance on the Delta for water supply, and improved water quality of the water supply..

ALTERNATIVE 343 ACTIONS

SPECIFIC ACTION PACKAGE

1--Restoration of Delta Shallow Water Habitat
1.1--Convert existing leveed lands to tidal action - modest level
1.3--Restore tidal action to existing diked wetlands - modest level

3--Restoration of Delta Riparian Habitat
3.2--Establish new areas of riparian habitat - modest level
3.3--Reestablish historic riparian areas - modest level

6--Establishment of Floodways and Meander Belts
6.1--Relocate levees to widen floodways - modest level
6.4--Restore floodways as habitat corridors - modest level

9--Restoration of Upstream Anadromous Fish Habitat
9.4--Restore shoreline habitat conditions - modest level
9.6--Improve floodway drainage to reduce fish stranding - modest level

10--Physical Improvement in Fish Passage
10.1--Modify passage at upstream dams/other barriers - moderate level

12--Restoration of Upstream Wetland Habitat
12.1--Modify floodways to support wetland habitats - modest level

13--Delta Inflow Management
13.1--Decrease upstream diversions - modest level
13.2--Modify upstream reservoir operations - modest level
13.3--Modify Delta inflow timing pattern - modest level

14--Delta Outflow/Export Management
14.1--Modify Central Delta channel operations - modest level
14.2--Modify export operations criteria - modest level

15--Modification of Diversion Timing Pattern
15.1--Modify diversion timing in in-Delta diversions - modest level
15.2--Modify diversion timing through Montezuma SCG - modest level

16--Increase Rates of Diversion Capacity
16.2--Obtain approvals to fully use existing export capacity to reduce diversion impacts - moderate level
16.4--Enlarge export pumping and conveyance capacity to reduce diversion impacts - modest level

17--Acquire Water Supplies for Fish and Wildlife
17.2--Obtain shifts in diversion timing patterns - modest level
17.3--Improve flows at key times and places - modest level

18-Installation and Improvement of Fish Screens
18.1--Improve screens at Delta export pumps - modest level
18.2--Improve other existing fish screen systems - modest level
18.3--Install screens on other in-Delta diversions - modest level
18.4--Install screens on upstream diversions - moderate level

18.5--Consolidate and screen existing small diversions - modest level

22--Fish Hatchery Operations
22.4--Reduce hatchery effects on wild fish populations - maximum reasonable level
22.5--Implement tagging of hatchery-bred fish - maximum reasonable level

29--Watershed Management
29.2--Manage riparian zones to protect water quality - modest level
29.3--Manage landuse to protect water quality - modest level

35--Construction & Improvement of Conveyance Facilities
35.5--Construct isolated Sacramento Valley Conveyance - westside

36--Changes in Locations of Diversions
36.4--Relocate upstream diversions from key habitats - modest level
36.5--Improve diversion design when relocating - maximum reasonable level

38--Long-Term Planning for Drought Contingencies
38.3--Develop alternate supplies for drought situations - maximum reasonable level

39--Institutions for Integrated Long-term Water Management
39.02--Establish institution to implement guarantees
39.07--Establish a Delta watermaster to manage flows
39.08--Modify water law to establish instream rights
39.21--Enforce wastewater discharge requirements
39.22--Water resources data and information management

42--Management of Agricultural Drainage
42.01--Implement source control regulations for pollutants - maximum reasonable level
42.02--Implement pollutant-load limits in San Joaquin River - maximum reasonable level
42.03--Reduce or control volume of agricultural discharges - moderate level
42.04--Modify cropping and irrigation practices - modest level
42.05--Export agricultural drainage to other watersheds - modest level
42.07--Improve pest-control practices - moderate level
42.08--Manage irrigation tailwater to reduce pesticides - maximum reasonable level
42.09--Manage drainage timing to reduce instream impacts - modest level
42.10--Treat drainage to remove pollutants - modest level
42.11--Dilute pollutants in Delta inflow from SJR using stored water - modest level

43--Management of Urban and Wastewater Discharge
43.2--Treat discharges to remove problem constituents - modest level
43.4--Increase key nutrient inputs to estuary - modest level

44--Dredged Material Management
44.1--Limit dredging to avoid fish migration periods - moderate level
44.2--Use techniques to localize sediment movement - moderate level
44.3--Dispose dredged materials at nonaquatic sites - moderate level
44.4--Remove contaminated sediments in critical habitat sites - modest level
44.5--Ensure material used for levee maintenance is noncontaminated - maximum reasonable level

45--Management of Mine Drainage
45.1--Manage discharges from abandoned mines - maximum reasonable level
45.2--Remediate abandoned mining sites discharging pollutants - maximum reasonable level

Preliminary Alternative EQ-345

Group — **ECOSYSTEM QUALITY**

Title — **Optimize Ecosystem Health**

Optimize ecosystem health through improvements in water quality, habitat, water conservation, and flows throughout the basin.

Key Actions

Habitat Restoration---Restore riverine, riparian, wetland, and adjacent terrestrial habitat, and expand floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries to restore fish spawning, rearing, feeding, and migrating habitats and improve fish survival. Improve flows in the basin to better emulate the natural flows of the system. Isolate a portion of the Delta export diversions to restore Delta habitat conditions.
Habitat Management---Establish comprehensive and integrated habitat management programs to maximize benefits to fish populations, and improve floodway drainage to reduce fish stranding.
Control Introduced/Nuisance/Predator Species---Reduce the numbers of nuisance and predator species from key habitat and modify habitat to limit introduced/nuisance species.
Water Quality--Improve watershed management, and reduce pollutant inputs from agricultural and mine drainage, dredging, and urban and wastewater discharges.
Water Conservation--Reduce demands of water in and out of basin by promoting water conservation, land retirement and fallowing, water pricing reforms, groundwater banking and conjuctive use, and institutional changes in water management.
Project Operations---Change reservoir operations and Delta inflow and export patterns to benefit fish habitat and production, and water quality.
Reduce Diversions and Diversion Effects--Modify diversion timing, increase diversion capacity to allow less diversion during key periods, and acquire water supplies for fish to improve flows. Isolate Delta diversions by constructing a small isolated transfer facility.

Supporting Actions

Fisheries Management---Tag/mark all hatchery fish to assess role of hatchery produced fish and to focus harvest on hatchery fish.
Fish Passage Improvements---Improve passage of anadromous fish at all feasible small dams and other barriers in the Sacramento and San Joaquin rivers and their tributaries.
Flow Pulses---Provide flows for fish passage and attraction.
Water Supply--Improve water supply for fish by acquiring water supply for fish, developing alternate supplies for drought situations, providing institutional mechanisms for long-term water management, and promoting water conservation and reclamation.

Preliminary Alternative EQ-344

Group — *Title*

ECOSYSTEM QUALITY — **Maximum Diversion Impacts Reduction**

Reduce direct and indirect impacts of upstream and in-Delta diversions using operations and management strategies, fish screens, barriers, diversion consolidations, and water quality improvements while maintaining or augmenting water supply delivery capacity.

Key Actions

Manage Delta Inflow/Outflow/Exports —Operate Sacramento and San Joaquin reservoirs to provide increased instream flows, reduced stranding, and reduced temperatures. Create a Delta watermaster's office to manage inflows, central channel operations, and outflows.

Manage Diversions and Fish Screens —Consolidate and relocate all diversions to less sensitive environmental areas, with improved designs to reduce potential entrainment. Adjust the timing for in-Delta and Montezuma Salinity Control Gates diversions, and relocate Delta pumping plants away from key habitat. Improve fish screen mesh sizes and protection performance, and install more fish screens.

Install Barriers to Guide Fish Movement/Control Salinity—Install barriers to keep upstream migrants in the Sacramento River, and to block fish movement into Old River. Construct barriers diverting outmigrants from the Sacramento River directly into western Delta channels to minimize their vulnerability to either existing or relocated export pumps. Install salinity control barriers.

Increase Rates of Diversion Capacity—Obtain approvals for fully utilizing existing export capacity during less environmentally sensitive times, and enlarge export pumping and conveyance capacities.

Supporting Actions

Control Predators—Harvest predators at Delta and upstream diversions, holding areas, or other environmentally sensitive areas in the Sacramento and San Joaquin systems.

ManageDrainage/Discharges—Impose In-Delta and upstream cropping and irrigation practices to increase the effectiveness of chemical applications to reduce nonpoint source leaching volumes and concentrations. Improve drainage timing for dilution during high flow periods to reduce instream impacts. Treat point source drainage to remove pollutants, and set pollutant load limits in the San Joaquin and Sacramento Rivers. Toxic discharges from industrial plants would be prevented using stronger enforcement, especially during environmentally sensitive periods.

Restore Shallow Habitat—Shallow water habitat would be reconstructed to compensate for historic losses that have reduced accessible spawning and rearing habitat for Delta native species.

Core Actions

Bay-Delta Habitat Restoration—Shallow water and wetland habitat would be protected and restored to improve Delta native species' spawning and rearing habitat.

Upstream Habitat Restoration—Restore physical upstream aquatic habitat to accomodate increased flows and reduced temperatures, including more riffle/run/glide/pool diversity and increased shading. Improve passage conditions for anadromous species life cycle completion at dams and other barriers.

Reduction in Effects of Diversions—Provide instream pulse flows for anadromous fish passage and attraction, and for smelt transport to rearing habitat using real-time monitoring and adaptive management. Improve and install fish screens at the core level for in-Delta and upstream diversions. Install a barrier on the San Joaquin R. at Merced R. in the fall. Improve salvage facility design, hauling and release procedures.

Management of Anadromous Fish—Improve hatchery operations and increased regulation of commercial and recreational take at the core levels.

Reduction in Export Reliance—Increase the use of agricultural, municipal and industrial water conservation practices, and educate users about conservation technologies. Encourage land fallowing during drought periods, and develop incentive programs for land retirement.

Water Supply Enhancement—Establish incentives for conjunctive use, and Modify the California Water Code to encourage conjunctive use.

Increasing Water Supply Predictability—Coordinate groundwater and surface water management at the regional planning level. Coordinate land use planning with water supply forecasts

Management of Water Quality—Implement source control regulations for pollutants by reducing volumes of agricultural discharges, retiring lands with drainage disposal problems, improving pest-control practices, and managing irrigation tailwater to reduce pesticides. Retain and manage urban and wastewater and stormwater runoff.

Improvements to System Reliability—Levee maintenance and improvements to infrastructure routing would be implemented at the core level.

Preliminary Assessment

Ecosystem Quality—Better inflow management, diversion timing, and increased shallow water habitat would improve aquatic habitat conditions for Sacramento splittail, longfin smelt, Delta smelt, and other natives, and feeding and migration conditions for anadromous species.

Water Supply—Increased export and conveyance capacity would allow more flows to be diverted during environmentally less sensitive periods, effectively improving supply reliability.

Water Quality—Point and nonpoint discharge reductions, land retirement, improved drainage management, and runoff retention would achieve quality improvements across all beneficial uses.

System Reliability—Affordable levee maintenance and infrastructure routing improvements would provide only core level reliability risk management to facilities, operations, and water quality from inundation or long-term degradation. Additional system reliability improvement actions are needed.

ALTERNATIVE 344 ACTIONS

Key Actions

Delta Inflow Management
-Decrease upstream diversions - moderate level
-Modify upstream reservoir operations - maximum level
-Modify Delta inflow timing pattern - maximum level

Delta Outflow/Export Management
-Modify Central Delta channel operations - maximum level
-Modify export operations criteria - maximum level

Modification of Diversion Timing Patterns
-Modify diversion timing of in-Delta diversions - maximum level
-Modify diversion timing through Montezuma SCG- moderate level

Increased Rates of Diversion Capacity
-Obtain approvals to fully utilize existing export capacity-to reduce diversion impacts - maximum level
-Enlarge export pumping and conveyance capacities-to reduce diversion impacts - maximum level

Installation and Improvement of Fish Screens
-Improve screens at Delta export pumps - maximum level
-Improve other existing fish screen systems - maximum level
-Consolidate and screen existing small diversions - maximum level

Installation of Barriers to Guide Fish Movement
-Install barriers to block fish movement into Old River - maximum level
-Install barriers to keep fish in Sacramento River - maximum level
-Install barriers to divert fish from Sacramento to western channels - maximum level

Improvement of Fish Salvage Operations
-Improve design of salvage facilities- moderate level

Removal and Control of Aquatic Predators
-Harvest predators at Delta export pumps - maximum level
-Harvest predators in upstream habitats - maximum level

Changes in Locations of Diversions
-Relocate Delta export pumps from key habitats- moderate level (optional)
-Relocate other in-Delta diversions - maximum level
-Consolidate in-Delta agricultural diversions - maximum level
-Relocate upstream diversions from key habitats- moderate level
-Improve diversion designs when relocating - maximum level
-Establish a Delta watermaster to manage flows - maximum level
-Modify water law to establish instream rights - maximum level

Installation and Operation of Flow Barriers

-Install flow barriers to manage South Delta quality - maximum level
-Install weirs to control salinity intrusion - modest level

Supporting Actions

Management of Agricultural Drainage
-Implement pollutant-load limits in San Joaquin R. - maximum level
-Modify cropping and irrigation practices - maximum level
-Manage drainage timing to reduce instream impacts- moderate level
-Treat drainage to remove pollutants- moderate level

Management of Urban and Wastewater Discharge
-Treat discharges to remove problem constituents- moderate level
-Prevent toxic discharges from industrial plants- moderate level

Core Actions

Delta Inflow Management
-Provide instream pulse flows for fish passage - core level
-Provide instream flows for fish attraction - core level

Delta Outflow/Export Management
-Use real-time monitoring and adaptive management - core level

Installation and Improvement of Fish Screens
-Install screens on other in-Delta diversions - core level
-Install screens on upstream diversions - core level
-Enforce screening requirements - core level

Installation of Barriers to Guide Fish Movement
-Operate fish barrier on San Joaquin R. at Merced R. in fall - core level

Improvement of Fish Salvage Operations
-Improve operation of salvage facilities - core level
-Improve fish hauling and release procedures - core level

Preliminary Alternative EQ-345

Core Actions

Bay-Delta Habitat Restoration—Core actions to improve and protect existing aquatic, riparian, and wetland habitats in the Bay-Delta compliment key actions to restore habitat in the Bay-Delta.

Upstream Habitat Restoration— Core actions to improve and protect existing aquatic, riparian, and wetland habitats upstream of the Delta compliment key actions to restore upstream habitats.

Reduction in Diversion Effects— This alternative would rely primarily on core actions to reduce diversion effects.

Management of Anadromous Fish—Core-level implementation of actions such as improving hatchery operations, and improving fish harvest regulations and their enforcement would supplement key actions to improve conditions for anadromous fish.

Reductions in Diversion/Export Reliance—This alternative would supplement core-level actions such as educating users about reclamation, conservation, water pricing and desalination feasibility with actions that would encourage land fallowing and retirement to reduce water demand.

Water Supply Enhancement—Core-level implementation of actions would supplement incentives for conjunctive and other actions to enhance water supply.

Increasing Water Supply Predictability—This alternative would rely on the core-level implementation of actions such as improving the ability to implement water transfers, to supplement key actions for long-term drought planning, institutions for water management, and coordination of land use and water supply planning.

Management of Water Quality—This alternative would increase the core level of implementation of actions to manage Delta water quality such as implementing source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, industrial, and mine discharges and runoff.

Improvement to System Reliability/Vulnerability—This alternative would increase the core level of implementation of actions to improve system reliability such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality—This alternative would substantially improve ecosystem quality through habitat restoration, improved water quality, reduce water demands, and more natural flows. While quality would remain limited by water exports, the existing level of loss of habitat and small fish would be reduced by a small isolated water transfer facility. Actions to improve and protect existing aquatic, riparian, and wetland habitats within and upstream of the Delta would greatly enhance anadromous and Bay-Delta native fish populations, and basic ecological functions on which they depend.

Preliminary Alternative EQ-345

Water Supply Reliability—This alternative would result in improved water supply reliability because of improved water conveyance facilities, conjunctive use programs, and additional water supply development. Other actions involving water transfers, long-term planning and management, and intergrated land-use and water supply planning would help to limit the reduction in reliability of the water supply.

Water Quality—Key actions provide for major reductions in water quality problems in the Bay-Delta and rivers through implementating source controls and regulations for pollutants in agricultural drainage and urban and wastewater discharge, limiting mine drainage and restoration of wetland habitats. Other actions that would improve efforts to manage urban and wastewater discharge, and dredged material.

System Reliability—This preliminary alternative achieves improvements in system reliability through the implementation of key and core actions. Core levels of maintaining and stabilizing high priority levees, providing an small isolated Delta transfer facility, modifying agricultural practices to reduce subsidence, implementing levee maintenance standards, and providing funding for levee maintenance and stabilization would provide for modest improvements in reliability. Improvement in reliability is obtained from limited improvements in the levee system, reduced reliance on the Delta for water supply, and improved water quality of the water supply..

ALTERNATIVE 345 ACTIONS

SPECIFIC ACTION PACKAGE

1--Restoration of Delta Shallow Water Habitat
1.1--Convert existing leveed lands to tidal action - maximum reasonable level
1.2--Protect existing shallow water habitat from erosion - maximum reasonable level
1.3--Restore tidal action to existing diked wetlands - maximum reasonable level

2--Restoration of Delta Riverine Habitat
2.1--Reconstruct river banks and shallow areas - maximum reasonable level
2.2--Restore/preserve channel islands - maximum reasonable level
2.3--Restore natural channel configuration - maximum reasonable level
2.4--Modify maintenance designs to include riverine elements - maximum reasonable level

3--Restoration of Delta Riparian Habitat
3.1--Improve and protect degraded riparian habitats - maximum reasonable level
3.2--Establish new areas of riparian habitat - maximum reasonable level
3.3--Reestablish historic riparian areas - maximum reasonable level
3.4--Modify levee maintenance practices - maximum reasonable level
3.5--Protect existing riparian habitat - maximum reasonable level

4--Restoration of Delta Wetland Habitat
4.1--Enhance existing wetlands - maximum reasonable level
4.2--Expand wetland acquisition programs - maximum reasonable level
4.3--Convert agricultural lands to wetlands - maximum reasonable level
4.4--Protect existing wetland habitat - maximum reasonable level

5--Restoration of Delta Terrestrial Habitat
5.1--Protect existing upland habitat - maximum reasonable level
5.2--Establish upland habitat - maximum reasonable level
5.3--Preserve the habitat values of agricultural land uses - moderate level
5.4--Clean-up sites containing toxic substances - maximum reasonable level

6--Establishment of Floodways and Meander Belts
6.1--Relocate levees to widen floodways - maximum reasonable level
6.2--Allow river channels to meander - maximum reasonable level
6.3--Acquire Delta islands as overflow areas - maximum reasonable level
6.4--Restore floodways as habitat corridors - maximum reasonable level

7--Control of Introduced/Nuisance Species
7.1--Remove or reduce nuisance species in key habitats - maximum reasonable level
7.4--Inspect for invasion of nuisance species - maximum reasonable level
7.5--Modify habitat to favor native species - maximum reasonable level

9--Restoration of Upstream Anadromous Fish Habitat
9.1--Manage flows and temperatures in upstream habitats - maximum reasonable level
9.2--Restore and replenish spawning gravels - maximum reasonable level
9.3--Restore channel configuration - maximum reasonable level
9.4--Restore shoreline habitat conditions - maximum reasonable level
9.6--Improve floodway drainage to reduce fish stranding - maximum reasonable level

10--Physical Improvement in Fish Passage
10.1--Modify passage at upstream dams/other barriers - maximum reasonable level

11--Restoration of Upstream Riparian Habitat
11.1--Restrict livestock grazing in riparian corridors - maximum reasonable level
11.2--Revegetate degraded riparian habitats - maximum reasonable level
11.3--Protect riparian lands through purchase/easements - maximum reasonable level
11.4--Restore flows to dewatered riparian habitats - moderate level

12--Restoration of Upstream Wetland Habitat
12.1--Modify floodways to support wetland habitats - maximum reasonable level
12.2--Reuse agricultural drainage to create wetlands - moderate level
12.3--Reuse urban wastewater effluent to create wetlands - moderate level

13--Delta Inflow Management
13.1--Decrease upstream diversions - maximum reasonable level
13.2--Modify upstream reservoir operations - maximum reasonable level
13.3--Modify Delta inflow timing pattern - maximum reasonable level
13.4--Provide instream pulse flows for fish passage - maximum reasonable level
13.5--Provide instream flows for fish attraction - maximum reasonable level

14--Delta Outflow/Export Management
14.1--Modify Central Delta channel operations - moderate level
14.2--Modify export operations criteria - moderate level

15--Modification of Diversion Timing Pattern
15.1--Modify diversion timing in in-Delta diversions - maximum reasonable level
15.2--Modify diversion timing through Montezuma SCG - maximum reasonable level

17--Acquire Water Supplies for Fish and Wildlife
17.2--Obtain shifts in diversion timing patterns - maximum reasonable level
17.3--Improve flows at key times and places - maximum reasonable level

22--Fish Hatchery Operations
22.4--Reduce hatchery effects on wild fish populations - maximum reasonable level
22.5--Implement tagging of hatchery-bred fish - maximum reasonable level
22.6--Establish new captive breeding programs - moderate level

25--Water Conservation
25.1--Increase agricultural water conservation - maximum reasonable level
25.2--Increase municipal and industrial water conservation - maximum reasonable level

26--Water Reclamation
26.1--Recharge ground water with reclaimed water - modest level
26.2--Use reclaimed water for agricultural irrigation - modest level
26.3--Reclaim saline agricultural drainage water - modest level
26.4--Recycle and treat water for potable reuse - modest level
26.5--Use reclaimed water for non-potable municipal and industrial use - modest level
26.6--Use reclaimed water to repel salinity intrusion - modest level

27--Land Retirement and Fallowing
27.1--Encourage land fallowing during drought periods - moderate level
27.2--Develop incentive programs for land retirement - moderate level
27.3--Purchase lands or easements - modest level

28--Water Pricing
28.1--Establish incentives for pricing to reduce demand - modest level

29--Watershed Management
29.2--Manage riparian zones to protect water quality - maximum reasonable level
29.3--Manage landuse to protect water quality - maximum reasonable level

32--Groundwater Banking and Conjuctive Use
32.1--Establish conjunctive use programs - modest levels
32.2--Store groundwater south of the Delta - modest levels
32.3--Store groundwater north of the Delta - modest levels
32.4--Implement techniques to increase groundwater recharge - modest levels

35--Construction & Improvement of Conveyance Facilities
35.1--Construct small isolated transfer facility

38--Long-Term Planning for Drought Contingencies
38.3--Develop alternate supplies for drought situations - maximum reasonable level

39--Institutions for Integrated Long-term Water Management
39.02--Establish institution to implement guarantees
39.07--Establish a Delta watermaster to manage flows
39.08--Modify water law to establish instream rights
39.09--Educate users about desalination feasibility
39.10--Educate users about conservation technologies
39.11--Educate public about water reclamation
39.12--Educate users about pricing feasibility
39.15--Modify California Water Code to encourage conjunctive use
39.21--Enforce wastewater discharge requirements
39.22--Water resources data and information management

42--Management of Agricultural Drainage
42.01--Implement source control regulations for pollutants - maximum reasonable level
42.02--Implement pollutant-load limits in San Joaquin River - maximum reasonable level
42.03--Reduce or control volume of agricultural discharges - moderate level
42.04--Modify cropping and irrigation practices - modest level
42.05--Export agricultural drainage to other watersheds - moderate level
42.07--Improve pest-control practices - maximum reasonable level
42.08--Manage irrigation tailwater to reduce pesticides - maximum reasonable level
42.09--Manage drainage timing to reduce instream impacts - maximum reasonable level
42.10--Treat drainage to remove pollutants - maximum reasonable level
42.11--Dilute pollutants in Delta inflow from SJR using stored water - modest level

43--Management of Urban and Wastewater Discharge
43.2--Treat discharges to remove problem constituents - maximum reasonable level
43.4--Increase key nutrient inputs to estuary - modest level

44--Dredged Material Management
44.1--Limit dredging to avoid fish migration periods - moderate level
44.2--Use techniques to localize sediment movement - maximum reasonable level
44.3--Dispose dredged materials at nonaquatic sites - maximum reasonable level
44.4--Remove contaminated sediments in critical habitat sites - maximum reasonable level
44.5--Ensure material used for levee maintenance is noncontaminated - maximum reasonable level

45--Management of Mine Drainage
45.1--Manage discharges from abandoned mines - maximum reasonable level
45.2--Remediate abandoned mining sites discharging pollutants - maximum reasonable level

50--Integrated Habitat Management Programs
50.1--Establish integrated habitat management programs - full implementation

Preliminary Alternative EQ-346

Ecosystem Quality — *Title*

ECOSYSTEM QUALITY — **Isolate/Reduce Diversion Impacts**

Construct an isolated Delta facility and coordinate with strategic releases and barrier operations to increase Delta fisheries without reducing export supply capacity.

Key Actions

Construction & Improvement of Conveyance Facilities—Construct an eastside isolated transfer system/conveyance facility to avoid entrainment of resident and anadromous fisheries. Dedicate capacity as feasible overland service to Delta agriculture to reduce entrainment. Install barriers at environmentally sensitive small diversions, and screens and barriers at larger diversions.

Increase Rates of Diversion Capacity—Obtain approvals for fully utilizing existing export capacity during less environmentally sensitive times, and enlarge export pumping and conveyance capacities.

Manage Delta Inflow—Coordinate water temperature and pulse flow releases to encourage the movement of various species to target locations. Schedule enhanced pulse flow releases and modified export operations using extensive adaptive management. Assure positive flow with appropriate salinity gradients for improved ecosystem health.

Supporting Actions

Restoration of Upstream Habitat—Manage flows and temperatures in upstream habitats using both timed releases (above) and restored channel configurations and shoreline habitat to provide enhanced velocity relationships and shading. Restrict livestock grazing in riparian corridors, and revegetate degraded riparian habitats.

Changes in Locations of Diversions—Relocate upstream diversions from key rearing habitats.

Installation and Improvement of Fish Screens—Improve fish screen mesh sizes and protection performance, and install more fish screens. Emphasize screening locations posing the greatest hazards to candidate and listed species, either in-Delta or upstream.

Core Actions

Bay-Delta Habitat Restoration—Emphasize resting areas and shaded riparian habitat restoration to guide/attract fish migration away from diversion sites. Include restoration/creation of Delta islands.

Upstream Habitat Restoration—Restore and replenish spawning gravels as a complement to enhanced flows and temperatures to encourage increased spawning downstream of diversions.

Reduction in Effects of Diversions—Operate a fish barrier on the San Joaquin River at the Merced River in the fall to reduce entrainment and complement with pulse flows as needed.

Management of Anadromous Fish—Improve the enforcement of harvest regulations as a complement to better and more fish screening, and to discourage increased take with increased populations.

Fish Hatchery Operations—Revise core hatchery management actions and smolt release timing to coincide with reservoir releases for flow and temperature benefits to anadromous and Delta fishes.

Reduction in Export Reliance—Educate users about desalination feasibility, conservation technologies, and pricing feasibility. Increase the use of agricultural, municipal, and industrial water conservation practices. Encourage land fallowing during drought periods, and develop incentive programs for land retirement.

Water Supply Enhancement—Establish conjunctive use programs, and provide better economic incentives to convert from surface to ground water in areas not facing overdraft conditions.

Increasing Water Supply Predictability—Coordinate groundwater and surface water management at the regional planning level. Coordinate land use planning with water supply forecasts.

Management of Water Quality—Implement source control regulations for pollutants by reducing volumes of agricultural discharges, retiring lands with drainage disposal problems, improving pest-control practices, and managing irrigation tailwater to reduce pesticides. Retain and manage urban and wastewater and stormwater runoff.

Improvements to System Reliability—Implement levee maintenance improvements and infrastructure routing at the core level.

Preliminary Assessment

Ecosystem Quality—Barrier operation would be coordinated with pulse flows to assist in avoiding entrainment, and to increase aquatic habitat quality by improving the seasonal location of the low-salinity habitat in Suisun Bay and Suisun Marsh.

Water Supply—The isolated diversion/conveyance facility and increased export capacity would allow water supply capacity to be maintained. Pumping rates and timing would be adjusted to accommodate vulnerable life stages of resident and anadromous species.

Water Quality—The full-sized isolated Delta transfer facility east of the Delta would produce positive flow gradients in the eastern and southern Delta and supply higher quality water to both the ecosystem and export facilities.

System Reliability—Totally isolated conveyance from the Sacramento River around the Delta channels nearly assures a full export supply and a potential for ecosystem maintenance in the event of a Delta catastrophe. Coupled with core-level levee maintenance, the isolated Delta facility would very significantly reduce system vulnerability.

ALTERNATIVE 346 ACTIONS

Key Actions

Construction & Improvement of Conveyance Facilities
Construct eastside isolated transfer system - maximum level

Increased Rates of Diversion Capacity
Obtain approvals to fully utilize existing export capacity to reduce diversion impacts - maximum level

Delta Inflow Management
Provide instream pulse flows for fish passage - maximum level
Provide instream flows for fish attraction - maximum level

Supporting Actions

Restoration of Upstream Habitat
Manage flows and temperatures in upstream habitats - moderate level
Restore channel configurations - moderate level
Restore shoreline habitat conditions - moderate level

Changes in Locations of Diversions
Relocate upstream diversions from key habitats - moderate level

Installation and Improvement of Fish Screens
Consolidate and screen existing small diversions - maximum level
Enforce screening requirements - maximum level
Restrict livestock grazing in riparian corridors - moderate level
Revegetate degraded riparian habitats - moderate level
Installation and Improvement of Fish Screens
Install screens on other in-Delta diversions - maximum level
Install screens on upstream diversions - maximum level

Core Actions

Bay-Delta Habitat Restoration
Restore/preserve channel islands - core level
Protect existing riparian habitat - core level

Upstream Habitat Restoration
Modify passage at upstream dams/other barriers - core level
Modify natural barriers to improve passage - core level

Reduction in Effects of Diversions
Installation of Barriers to Guide Fish Movement
Install barriers to keep fish in Sacramento River - core level

Management of Anadromous Fish
Fish Harvest Management
Improve enforcement of harvest regulations - core level
Fish Hatchery Operations
Improve hatchery operations - core level

Reduction in Export Reliance
Desalination
Educate users about desalination feasibility - core level
Water Conservation
Increase use of agricultural water conservation practices - core level
Increase use of municipal and industrial water conservation practices - core level
Educate users about conservation technologies - core level
Water Reclamation
Educate users about conservation technologies - core level
Land Retirement and Fallowing
Encourage land fallowing during drought periods - core level
Develop incentive programs for land retirement - core level
Water Pricing
Educate users about pricing feasibility - core level

Water Supply Enhancement
Groundwater Banking and Conjunctive Use
Establish conjunctive use programs - core level
Establish incentives for conjunctive use - core level

Preliminary Alternative EQ-347

Ecosystem Quality *Title*

ECOSYSTEM QUALITY Improved Flows, Habitat, Quality, and Stability

Maximize Delta inflows and in-Delta and upstream aquatic, riparian, and wetland habitat improvements, water quality, and levee stability to benefit fish populations without new in-water construction, conveyance, or other major infrastructure modifications.

Key Actions

Manage Delta Inflow/Outflow/Exports —Operate Sacramento and San Joaquin reservoirs to provide increased instream flows, reduced stranding, and reduced temperatures. Create a Delta watermaster's office to manage inflows, central channel operations, and outflows.

Manage Diversions and Fish Screens —Adjust the timing for in-Delta and Montezuma Salinity Control Gates diversions to optimize control of the 2ppt isohaline and low-salinity habitat zone.

Improve Flooding & Seismic Protections—Reconstruct levees to higher design and seismic standards, and relocate unstable levees to more stable sites.

Supporting Actions

Restore Delta Habitat—Restore tidal action to existing diked wetlands and reconstruct levees to include shallow water habitat. Fill deep water to produce shallow habitat, reconstruct river banks and shallow areas, restore natural channel configurations, and convert agricultural lands to wetlands. Aggressively implement integrated habitat management programs, establish floodways and meander- , belts, relocate levees to widen floodways, allow river channels to meander, acquire Delta islands as overflow areas, and floodways as habitat corridors. Control introduced species by removing reducing nuisance species in key habitats, increased regulation of ballast-water releases, improved border inspection practices, and habitat modifications to encourage native species populations.

Restore Upstream Habitat—Improve upstream anadromous habitat by managing flows and temperatures in coordination with upstream reservoir releases, restoring and replenishing spawning gravels, and restoring channel configurations and shoreline habitat conditions. Modify gravel mining practices to minimize disruption to benthic populations and reduce sedimentation, and improve floodway drainage to reduce fish stranding. Improve passage conditions at upstream dams/other barriers, including natural barrier removal. Restore upstream habitat by restricting livestock grazing in riparian corridors, and revegetating degraded riparian habitats. Protect riparian lands through purchase/easements, and restore flows to dewatered riparian habitats. Restore upstream wetland habitat by modifying floodways to support wetland habitats, reusing agricultural drainage and wastewater effluent to create wetlands, and managing groundwater recharge for wetland habitat

Acquire Water Supplies for Fish and Wildlife—Acquire water for refuge habitat use, and obtain shifts in diversion timing patterns to maximize benefits to aquatic and riparian terrestrial habitat.

Water Supply Enhancement—Manage Sacramento and San Joaquin Valley system tributary watersheds vegetation cover to increase yield, and modify water law to establish instream rights

Core Actions

Upstream Habitat Restoration—Manage flows and temperatures in upstream habitats and restore and replenish spawning gravels.

Reduction in Effects of Diversions—Provide instream pulse flows for fish passage and instream flows for fish attraction. -use real-time monitoring and adaptive management.

Water Supply Enhancement— Manage tributary watershed riparian zones and land uses to protect water quality.

Management of Water Quality— Manage agricultural drainage by implementing source control regulations for pollutants, reducing volumes of agricultural discharges, retiring lands with drainage disposal problems, and improving pest-control practices. Manage irrigation tailwater to reduce pesticide leaching into ground and surface waters. Manage urban and wastewater discharge by retaining and managing stormwater runoff, implementing urban awareness/education programs, enforcing wastewater discharge requirements, and preventing toxic discharges from industrial plants. Manage dredged materials by limiting dredging to avoid fish migration periods, using techniques to localize sediment movement, disposing of dredged materials at nonaquatic sites, and ensuring that nontoxic material is used for levee maintenance. Manage mine drainage reducing or eliminating discharges from abandoned mines and by remediating abandoned mining sites discharging pollutants.

Improvements to System Reliability—Maintain and stabilize levees by modifying agricultural practices to reduce subsidence, providing funding for maintenance and stabilization, and implementing uniform maintenance standards. Protect and reroute infrastructure by maintaining and reconstructing levees around infrastructure.

Preliminary Assessment

Ecosystem Quality—The primary emphasis on Delta and upstream habitat restoration would improve and increase aquatic habitats so that they can support sustainable native and desirable populations to a much greater extent than current conditions. Important wetland habitats are also increased to improve cover diversity in shallow aquatic habitats and riparian zones to the benefit of Delta natives and anadromous species.

Water Supply—Water supply conditions remain unchanged from the present, and would probably be improved with more coordinated operational releases and management of Delta inflows, central channel operations, and export/outflow.

Water Quality—Substantial water quality improvements would result for all beneficial uses from improved agricultural drainage management, more effective urban stormwater runoff and wastewater effluent controls, dredged material management, and mine drainage reduction and remediation.

System Reliability—The reconstruction and design of levees to higher seismic standards, relocation to more stable sites, improved maintenance, and infrastructure routing would increase system reliability.

ALTERNATIVE 347 ACTIONS

Key Actions

Delta Inflow Management
Decrease upstream diversions - moderate level
Modify upstream reservoir operations - maximum level
Modify Delta inflow timing pattern - maximum level
Provide instream pulse flows for fish passage - maximum level
Provide instream flows for fish attraction - maximum level
Delta Outflow/Export Management
Modify Central Delta channel operations - maximum level
Modify export operations criteria - moderate level
Use real-time monitoring and adaptive management - moderate level
Modification of Diversion Timing Patterns
Modify diversion timing of in-Delta diversions - maximum level
Modify diversion timing through Montezuma SCG - maximum level
Manage flows and temperatures in upstream habitats - maximum level
Improvement of Flooding & Seismic Protections
Reconstruct levees to higher design standards - maximum level
Reconstruct levees to higher seismic standards - maximum level
Relocate levees to more stable sites - moderate level

Supporting Actions

Restore tidal action to existing diked wetlands - maximum level
Reconstruct levees to include shallow water habitat - moderate level
Fill deep water to produce shallow habitat - maximum level
Reconstruct river banks and shallow areas - maximum level
Restore natural channel configurations - maximum level
Restore natural channel configurations - maximum level
Convert agricultural lands to wetlands - maximum level
Integrated Habitat Management Programs
Establishment of Floodways and Meander Belts
Relocate levees to widen floodways - maximum level
Allow river channels to meander - maximum level
Acquire Delta islands as overflow areas - maximum level
Restore floodways as habitat corridors - maximum level
Control of Introduced Species
Remove or reduce nuisance species in key habitats - maximum level
Improve regulation of ballast-water releases - maximum level
Improve border inspection practices - maximum level
Inspect for invasions of nuisance species - maximum level
Modify habitat to favor native species - maximum level

Restoration of Upstream Anadromous Fish Habitat
Manage flows and temperatures in upstream habitats - maximum level
Restore and replenish spawning gravels - maximum level
Restore channel configurations - maximum level
Restore shoreline habitat conditions - maximum level
Modify gravel mining practices - moderate level
Improve floodway drainage to reduce fish stranding - maximum level
Physical Improvements for Fish Passage
Modify passage at upstream dams/other barriers - maximum level
Modify natural barriers to improve passage - maximum level
Restoration of Upstream Riparian Habitat
Restrict livestock grazing in riparian corridors - maximum level
Revegetate degraded riparian habitats - maximum level
Protect riparian lands through purchase/easements - moderate level
Restore flows to dewatered riparian habitats - moderate level
Restoration of Upstream Wetland Habitat
Modify floodways to support wetland habitats - moderate level
Reuse agricultural drainage to create wetlands - maximum level
Reuse urban wastewater effluent to create wetlands - maximum level
Manage groundwater recharge for wetland habitat - maximum level

Acquire Water Supplies for Fish and Wildlife
Acquire water for refuge habitat use - moderate level
Obtain shifts in diversion timing patterns - maximum level

WATER SUPPLY ENHANCEMENT
Watershed Management
Manage vegetation cover to increase yield - maximum level
Modify water law to establish instream rights - maximum level
Remove contaminated sediments in critical habitat sites - maximum level

Core Actions

Restoration of Upstream Anadromous Fish Habitat
Manage flows and temperatures in upstream habitats - core level
Restore and replenish spawning gravels - core level
Modify gravel mining practices - core level
Physical Improvements for Fish Passage
Modify passage at upstream dams/other barriers - core level
Modify natural barriers to improve passage - core level
Restoration of Upstream Riparian Habitat
Restrict livestock grazing in riparian corridors - core level
Revegetate degraded riparian habitats - core level

REDUCTION IN EFFECTS OF DIVERSIONS
Delta Inflow Management

Provide instream pulse flows for fish passage - core level
Provide instream flows for fish attraction - core level

Delta Outflow/Export Management
Use real-time monitoring and adaptive management - core level

WATER SUPPLY ENHANCEMENT

Watershed Management
Manage riparian zones to protect water quality - core level
Manage land uses to protect water quality - core level

MANAGEMENT OF WATER QUALITY

Management of Agricultural Drainage
Implement source control regulations for pollutants - core level
Reduce or control volume of agricultural discharges - core level
Retire lands with drainage disposal problems - core level
Improve pest-control practices - core level
Manage irrigation tailwater to reduce pesticides - core level

Management of Urban and Wastewater Discharge
Retain and manage stormwater runoff - core level
Implement urban awareness/education programs - core level
Enforce wastewater discharge requirements - core level
Prevent toxic discharges from industrial plants - core level

Dredged Material Management
Limit dredging to avoid fish migration periods - core level
Use techniques to localize sediment movement - core level
Dispose dredged materials at nonaquatic sites - core level
Ensure nontoxic material used for levee maintenance - core level

Management of Mine Drainage
Manage discharges from abandoned mines - core level
Remediate abandoned mining sites discharging pollutants - core level

IMPROVEMENTS TO SYSTEM RELIABILITY

Levee Maintenance and Stabilization
Maintain and stabilize existing levees - core level
Modify agricultural practices to reduce subsidence - core level
Provide funding for maintenance and stabilization - core level
Implement uniform maintenance standards - core level

Rerouting and Protection of Infrastructure
Maintain/reconstruct levees around infrastructure - core level

Preliminary Alternative EQ-348

Ecosystem Quality — *Title*

ECOSYSTEM QUALITY — **Improved Operations, Conveyance, and Storage**

Improve fish populations by emphasizing operational releases, construction of a small eastside transfer facility, and expanded off-stream storage to increase flexibility in providing water for Delta and anadromous species.

Key Actions

Manage Delta Inflow/Outflow/Exports —Operate upstream reservoirs for increased instream flows, and reduced temperatures. Create a Delta watermaster's office to manage inflows, central channel operations, and outflows

Construct Conveyance Facility—Construct small eastside isolated transfer facility for balanced inflow and conveyance benefits.

Expand Off-Stream Storage—Enlarge existing off-stream storage reservoirs, increase flows from the Sacramento River to the central Delta by increasing the capacities of existing east-side channels. Modify Delta levees to increase flow cross-sections for more effective. Construct small new off-stream storage reservoirs for export areas.

Improve Flooding & Seismic Protections—Reconstruct levees to higher design and seismic standards.

Supporting Actions

Delta and Upstream Habitat Restoration and Protection—-Protect riparian lands using purchases and easements, and convert agricultural lands to wetlands where feasible. Reuse agricultural drainage and wastewater effluent to create new wetlands. Clean-up sites containing toxic substances and implement pollutant-load limits in the San Joaquin River.

Water Supply Enhancement and Reliability—Establish conjunctive use programs, and provide incentives for users to shift reliance from surface water to ground water. Modify California Water Code to ease transfers. Coordinate transfers, and establish brokerage for. Develop long-term drought contingency plans by increasing water storage capacities at user locations.

Core Actions

Bay-Delta Habitat Restoration—Protect existing shallow habitat from erosion , restore and preserve channel islands, and modify levee maintenance practices to include riverine elements. Protect and improve degraded riparian habitats, and protect existing riparian habitats of higher quality.

Upstream Habitat Restoration—Manage upstream temperature and flow regimes by reoperating upstream reservoirs for increased cold-water releases.

Reduction in Effects of Diversions—Provide instream pulse flows to the Delta for anadromous upstream passage, and to transport eggs and larvae into the low salinity zone. Install state-of-the-art fish screens on Delta and upstream diversions, and strengthen screening requirements enforcement. Operate a fish barrier on the San Joaquin River at the Merced River in the fall.

Management of Anadromous Fish—Improve fish salvage operations and fish hauling and releases. Improve fish hatchery operations and hatchery effects on wild fish populations. Implement tagging of hatchery-bred fish, and establish new captive breeding programs. Improve take regulations.

Reduction in Export Reliance—Increase the use of agricultural, municipal, and industrial conservation practices and educate users regarding conservation, reclamation, and pricing. Retire and/or fallow lands during droughts.

Water Supply Enhancement—Modify the California Water Code to encourage conjunctive use. Coordinate groundwater/surface water management at the regional level.

Increasing Water Supply Predictability—Improve procedures for transfer permitting, and coordinate diversion and conveyance of transfers. Manage water resources data and information, and conduct integrated resources planning. Coordinate land use approvals with water supply provision.

Management of Water Quality—Control pollutants at the source, retire lands with drainage problems, enforce wastewater discharge requirements, limit dredging to avoid fish migration periods, and remediate abandoned mine sites discharging pollutants.

Improvements to System Reliability—Implement uniform levee maintenance standards.

Preliminary Assessment

Ecosystem Quality—Key actions to improve Delta and upstream flow and temperature regimes directly improve cumulative aquatic habitat. Supporting Delta and upstream riparian habitat protection and restoration, land conversions to wetlands, and site cleanups provide the basis for stronger regulation of critical determinants of habitat quality. Core Delta and upstream habitat quality, pulse flow provisions, fish salvage improvements and harvest regulations provide a strong basis for long-term aquatic habitat quality and quantity increases.

Water Supply—Key construction of a small eastside isolated transfer facility, combined with increases in small offstream storage reservoirs increases operational flexibility. Channel capacity increases and levee improvements facilitate improved conveyance. Supporting conjunctive use incentives, groundwater banking, and drought contingency planning increase long-term supply reliability.

Water Quality—Core agricultural and mining source control, including pollutant load limits in the San Joaquin River, land retirement, wastewater discharge enforcement, dredging limitations, and remediation actions will directly improve water quality along with increased dilution from inflows.

System Reliability—Improved levee design standards accommodate increased inflows and complement habitat restoration actions.

ALTERNATIVE 348 ACTIONS

Key Actions

Reduce Effects of Diversions
Delta Inflow Management
Modify upstream reservoir operations - maximum level
Decrease upstream diversions - moderate level
Modify Delta inflow timing pattern - maximum level
Establish a Delta watermaster to manage flows - maximum level
Implement pollutant-load limits in San Joaquin R. - maximum level
Modification of Diversion Timing Patterns
Modify diversion timing of in-Delta - maximum level
Modify diversion timing through Montezuma SCG - maximum level
Delta Outflow/Export Management
Modify Central Delta channel operations - maximum level
Modify export operations criteria - maximum level
Construction & Improvement of Conveyance Facilities
Construct small eastside isolated transfer facility - maximum level
New or Expanded Off-Stream Storage
Enlarge existing off-stream storage reservoirs - moderate level
Increase flows from the Sacramento R. to the Central Delta - maximum level
Increase capacities of existing east-side channels - moderate level
Modify Delta levees to increase flow cross-sections - moderate level
Construct new off-stream storage for export areas - moderate level
Construct new off-stream storage upstream of Delta - moderate level
Improvement of Flooding & Seismic Protections
Reconstruct levees to higher design standards - maximum level
Reconstruct levees to higher seismic standards - maximum level

Supporting Actions

Bay-Delta and Upstream Habitat Restoration
Convert agricultural lands to wetlands - moderate level
Clean-up sites containing toxic substances - maximum level
Installation and Improvement of Fish Screens
Improve screens at Delta export pumps - moderate level
Improve other existing fish screen systems - moderate level
Protect riparian lands through purchase/easements - moderate level
Restoration of Upstream Wetland Habitat
Reuse agricultural drainage to create wetlands - maximum level
Reuse urban wastewater effluent to create wetlands - maximum level

Water Supply Enhancement
Groundwater Banking and Conjunctive Use
Establish conjunctive use programs - maximum level
Store groundwater south of Delta - moderate level

Store groundwater north of Delta - moderate level
Water Transfers
Coordinate diversion and conveyance of transfers - moderate level
Establish brokerage for water transfers - moderate level
Long-Term Planning for Drought Contingencies
Increase water storage capacities at user locations - maximum level
Develop alternate supplies for drought situations - maximum level
Establish incentives for conjunctive use - maximum level
Modify California Water Code to encourage conjunctive use - moderate level
Modify California Water Code to ease transfers - moderate level
Establish a statewide water utility surcharge - moderate level

Core Actions

Bay-Delta Habitat Restoration
Restoration of Delta Shallow Water (Tidal) Habitat
Protect existing shallow habitat from erosion - core level

Restoration of Delta Riverine Habitat
Restore/preserve channel islands - core level
Modify maintenance designs to include riverine elements - core level
Restoration of Delta Riparian Habitat
Improve and protect degraded riparian habitats - core level
Modify levee maintenance practices - core level
Protect existing riparian habitat - core level
Control of Introduced Species
Improve regulation of ballast-water releases - core level
Improve border inspection practices - core level
Restoration of Delta Wetland Habitat
Expand wetland acquisition programs - core level

Upstream Habitat Restoration
Restoration of Upstream Anadromous Fish Habitat
Manage flows and temperatures in upstream habitats - core level

Reduction in Effects of Diversions
Delta Inflow Management
Provide instream pulse flows for fish passage - core level
Provide instream flows for fish attraction - core level
Delta Outflow/Export Management
Use real-time monitoring and adaptive management - core level
Installation and Improvement of Fish Screens
Install screens on other in-Delta diversions - core level
Install screens on upstream diversions - core level
Enforce screening requirements - core level
Installation of Barriers to Guide Fish Movement
Operate fish barrier on San Joaquin R. at Merced R. in fall - core level

Improvement of Fish Salvage Operations
Improve operation of salvage facilities - core level
Improve fish hauling and release procedures - core level

Management of Anadromous Fish
Fish Hatchery Operations
Improve hatchery operations - core level
Reduce hatchery effects on wild fish populations - core level
Implement tagging of hatchery-bred fish - core level
Establish new captive breeding programs - core level
Fish Harvest Management
Improve regulation of commercial take - core level
Improve regulation of recreational take - core level
Improve enforcement of harvest regulations - core level

Reduction in Export Reliance
Water Conservation
Increase use of agricultural water conservation practices - core level
Increase use of municiple and industrial water conservation practices - core level
Educate users about conservation technologies - core level
Water Reclamation
Educate users about reclamation technologies - core level
Land Retirement and Fallowing
Encourage land fallowing during drought periods - core level
Develop incentive programs for land retirement - core level
Water Pricing
Educate users about pricing feasibility - core level

Water Supply Enhancement
Groundwater Banking and Conjunctive Use
Establish incentives for conjunctive use - core level
Modify Water Code to encourage conjunctive use - core level

Increasing Water Supply Predictability
Water Transfers
Modify California Water Code to ease transfers - core level
Improve procedures for transfer permitting - core level
Coordinate diversion and conveyance of transfers - core level
Establish transfer broker mechanism - core level
Long-Term Planning for Drought Contingencies
Manage water resources data and information - core level
Conduct Integrated Resources Planning - core level
Integration of Land-Use and Water-Supply Planning
Coordinate land uses with water supplies - core level

Management of Water Quality
Management of Agricultural Drainage

Implement source control regulations for pollutants - core level
Retire lands with drainage disposal problems - core level
Enforce wastewater discharge requirements - core level
Limit dredging to avoid fish migration periods
Remediate abandoned mining sites discharging pollutants - core level

Improvements to System Reliability
Implement uniform maintenance standards - core level

Reduction in Export Reliance

Unmodified or qualified core actions are appropriate for this alternative.

Water Supply Enhancement and Predictability

A fully screened eastside isolated Delta transfer facility coupled with allowance for timely use of full export capacity would almost completely alleviate Delta conveyance problems and would fully mitigate pulse flow losses.

Management of Water Quality

An eastside isolated Delta transfer facility would supply water to develop positive flow gradients in the eastern and southern Delta and supply higher quality water for all beneficial uses in the Delta. This complements the minimum core actions for this alternative.

Improvements to System Reliability/Vulnerability

Enhanced conveyance from the Sacramento River around the Delta channels assures a nearly full supply for exports and potential for mitigation of environmental losses in the event of a Delta calamity. Coupled with core-level levee maintenance, the isolated facility would significantly reduce system vulnerability.

PRELIMINARY ASSESSMENT

Fish losses in the Delta have been significant enough to measurably impact export operations in the Delta; accordingly, as a lasting solution to this diversion impact, the focus of this alternative is a screened eastside Delta isolated transfer facility. The consolidation of all Delta diversions and strategically targeted core-level Bay-Delta habitat enhancement effectively eliminate unnatural migration of smolts into the central and southern Delta. Water supply losses due to pulse flows would be fully mitigated and central Delta/export quality enhanced through positive flow gradients and timely allowance of full pumping capacity at existing Delta export facilities. With a significant reduction of vulnerability to the export supply, the alternative provides a very significant and durable solution to each area of Bay-Delta conflicts.

ALTERNATIVE 329: ANNOTATED ACTION LIST

ACTIONS SELECTED

Bay-Delta Habitat Restoration

1.-8. Core level.

Upstream Habitat Restoration

9.-12. Core level.

Reduction in Diversion Effects

13.4 Enhanced to 70 percent of AFRP recommendation. Water supply coordinated to with core level of 9.1 to minimize duplicating losses.

35.1 Construction of a fully screened isolated Delta transfer system would eliminate migration of smolts from the northern to the southern Delta and avoid diversion entrainment of Bay-Delta species.

Management of Anadromous Fish

22.-23. Core actions emphasizing timing of actions.

Reduction in Export Reliance

Core actions only.

Water Supply Enhancement and Predictability

14.2.3
15.1.2 Allow for shifts in diversion locations
18.4
16.1 and 16.2 Maximum action to both complements the small facility of 35.1.
35.1

Management of Water Quality

13.4 At 50 percent of AFRP.
35.1 Capacity allowance for this.

Improvements to System Reliability/Vulnerability

16.1 and 16.2
35.1

DECEMBER 14, 1995

PRELIMINARY Alternative 330

TITLE: Enhance Anadromous Fish Populations by Increasing Natural and Hatchery Production.

SOLUTION OVERVIEW

Theme. This alternative is designed to enhance anadromous fish populations by increasing hatchery production and improving Delta and upstream productivity. Emphasize is placed on increasing winter-run chinook salmon and other salmon and steelhead populations by improving habitat and supplementing populations with hatchery production.

Key Actions. The unique character of this alternative is represented by the combination of the following actions:

- Expand hatchery capacities for winter run salmon and other anadromous species including other runs of chinook salmon, steelhead, and striped bass.
- Construct new salmon and steelhead hatcheries on the San Joaquin River.
- Construct production hatchery facilities for sturgeon.
- Implement tagging of hatchery-bred fish to allow (1) assessment of effects on wild fish, and (2) selective fisheries that would protect wild fish from overharvest.
- Restore modest levels of shallow water, riverine, riparian, and wetland habitats in the Delta.
- Restore modest levels of of channel, riparian, and wetland habitat in upstream areas of Sacramento and San Joaquin rivers and tributaries.
- Change upstream reservoir operations and Delta inflow timing pattern.

ACTIONS SELECTED FOR THE ALTERNATIVE

Management of Anadromous Fish. This alternative places emphasis on increasing hatchery production to enhance anadromous fish populations. Hatchery operations would be improved and expanded to increase salmon, steelhead, sturgeon, and striped bass populations. New hatcheries would be constructed on the San Joaquin River tributaries to increase salmon and steelhead runs in that watershed. Efforts to reduce conflicts of hatcheries with wild population restoration would be enhanced above the core action level by tagging all hatchery reared fish.

Bay-Delta Habitat Restoration. Bay-Delta habitats for anadromous fish would be restored through specific actions and increasing the level of application of core actions. The specific action package includes modest levels of actions to restore Delta shallow water, riverine, riparian, and terrestrial habitat, to establish floodways and meander belts in the Delta, to control introduced and nuisance species, and to improve timing and quantity of Delta inflow. Core actions in the Delta would be enhanced to provide moderate level of restoration of riverine, riparian, and wetland habitat, and moderate levels of pulsed flows for anadromous fish passage and attraction.

Upstream Habitat Restoration. Upstream habitats for anadromous fish and native resident fish would be restored through specific actions and increasing the level of application of core actions. The specific action package includes modest levels of actions to restore upstream shallow water, riverine, and riparian habitat, to establish floodways and meander belts, to control introduced and nuisance species. Core actions in the upper watershed would be enhanced to provide a moderate level of upstream spawning and rearing habitat restoration through improvements in restoring and replenishing spawning gravels, in restoring riparian vegetation, and managing mine drainage.

Reduction in Diversion Effects. Core actions would be relied upon to reduce diversion effects on anadromous fish populations. Such actions include real-time monitoring and adaptive management, installing screens on high priority diversions in the Delta and upstream of the Delta, enforcing screening requirements at diversions, and improving fish salvage operations at the south Delta pumping plants.

Reduction in Diversion/Export Reliance. This alternative would rely on core actions to manage demand in the export service areas. Reliance on Delta exports would remain unchanged and actions above those identified as core actions would not be included.

Water Supply Enhancement. This alternative would rely on core actions involving groundwater banking and conjunctive use to enhance existing water supplies.

Management of Water Quality. This alternative would rely on core actions involving management of agricultural drainage, urban and wastewater discharge, and dredged material to protect and enhance water quality in the basin. Enhancement of core action to manage mine drainage in the upper Sacramento River would provide additional improvements in water quality. Improved controls on pollutant discharges in the Bay and Delta through better controls on agricultural, municipal, and industrial discharges would achieve important benefits for anadromous populations living within or passing through the Bay-Delta.

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Improvement to System Reliability/Vulnerability. This alternative would rely on core actions involving levee maintenance and stabilization to improve the water transport system reliability and to reduce the vulnerability of water supplies to levee failures in the rivers and Delta. Some actions restoring Delta riverine, riparian, and wetland habitat would provide some additional levee stabilization that would improve system reliability.

PRELIMINARY ASSESSMENT

Ecosystem Quality. This alternative emphasizes direct improvements to anadromous fish populations through hatchery production and additional improvements in Delta and upstream habitat substantially above those provided by core actions. Delta habitat improvements will also benefit native resident Bay-Delta fish. Increased hatchery production of anadromous fish could place more competitive and predator pressures on wild (naturally produced) populations of anadromous fishes. Habitat improvements in the Delta and upstream, and tagging of hatchery fish should help minimize effects on wild populations. Enhanced population abundance of hatchery produced fish would help bring recovery of populations in decline and lead to improvements of harvests in commercial or sport fisheries of selected species and runs.

Water Supply. This alternative would result in a long-term reduction in the reliability that existing diverters have on surface supplies. It is for this reason that conjunctive use programs and incentives would be developed with terms and conditions that are economically attractive to surface water diverters, and which can effectively provide a better economic return for replacing surface water use with ground water use, especially in those regions where otherwise diverted surface waters will instead be dedicated to habitat and population improvements. Water supplies predictability would be increased through core actions involving water transfers, long-term planning for drought contingencies, establishing institutions for long-term water management, and integrated land-use and water-supply planning.

Water Quality. Existing water quality problems in the Bay-Delta and its watershed will be reduced to a limited extent by implementing core actions such as management of agricultural drainage, urban and wastewater discharge, and dredged material. Additional enhancement in the upper Sacramento River through management of mine drainage will substantially improve water quality in this portion of the basin. Large improvements in wetland and riparian habitats in the basin would also improve water quality.

Reliability of Delta Functions. System reliability would be improved above the core level actions by stabilizing levees associated with riparian, riverine, and wetland Delta and upstream habitat restoration, and by providing floodways and meander belts in the Delta.

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ALTERNATIVE 330 ACTIONS

SPECIFIC ACTION PACKAGE

HABITAT RESTORATION

Restoration of Delta Shallow Water Habitat
Convert existing leveed lands to tidal action - modest level
Restore tidal action to existing diked wetlands - modest level
Reconstruct levees to include shallow water habitat - modest level
Fill deep water to produce shallow water habitat - modest level

Restoration of Delta Riverine Habitat
Reconstruct river banks and shallow areas - modest level
Restore natural channel configuration - modest level

Restoration of Delta Riparian Habitat
Establish new areas of riparian habitat - modest level
Reestablish historic riparian areas - modest level

Restoration of Delta Terrestrial Habitat
Protect existing upland habitat - modest level
Establish upland habitat - modest level
Clean-up sites containing toxic substances - moderate level

Integrated Habitat Management Programs
Establish integrated habitat management programs - full implementation

Establishment of Floodways and Meander Belts
Relocate levees to widen floodways - modest level
Allow river channels to meander - modest level
Restore floodways as habitat corridors - moderate level

Control of Introduced/Nuisance Species
Remove or reduce nuisance species in key habitats - modest level
Modify habitat to favor native species - modest level

Restoration of Upstream Anadromous Fish Habitat
Restore channel configuration - modest level
Restore shoreline habitat conditions - modest level
Improve floodway drainage to reduce fish stranding - moderate level

Restoration of Upstream Riparian Habitat
Protect riparian lands through purchase/easements - moderate level
Restore flows to dewatered riparian habitats - modest level

Restoration of Upstream Wetland Habitat
Modify floodways to support wetland habitats - modest level

Delta Inflow Management
Decrease upstream diversions - modest level
Modify upstream reservoir operations - moderate level

Modify Delta inflow timing pattern - moderate level

MANAGEMENT OF ANADROMOUS FISH

Fish Hatchery Operations
Expand hatchery capacities - modest level
Construct new hatcheries on the San Joaquin R. - moderate level

ENHANCED CORE ACTIONS

HABITAT RESTORATION
Restoration of Upstream Anadromous Fish Habitat
Manage flows and temperatures in upstream habitats - moderate level
Restore and replenish spawning gravels - moderate level
Modify gravel mining practices - moderate level

Physical Improvements for Fish Passage
Modify passage at upstream dams/other barriers - moderate level
Modify natural barriers to improve passage - moderate level

Restoration of Upstream Riparian Habitat
Restrict livestock grazing in riparian corridors - moderate level
Revegetate degraded riparian habitats - moderate level

Management of Mine Drainage
Manage discharges from abandoned mines - moderate level
Remediate abandoned mining sites discharging pollutants - moderate level

Restoration of Delta Riverine Habitat
Restore/preserve channel islands - moderate level
Modify maintenance designs to include riverine elements - moderate level

Restoration of Delta Riparian Habitat
Improve and protect degraded riparian habitats - moderate level
Modify levee maintenance practices - moderate level
Protect existing riparian habitat - moderate level

Restoration of Delta Wetland Habitat
Enhance existing wetlands - moderate level
Expand wetland acquisition programs - moderate level
Protect existing wetland habitat - moderate level

Delta Inflow Management
Provide instream pulse flows for fish passage - moderate level
Provide instream flows for fish attraction - moderate level

MANAGEMENT OF ANADROMOUS FISH
Fish Hatchery Operations
Improve hatchery operations - moderate level
Implement tagging of hatchery-bred fish - maximum level

PRELIMINARY Alternative 331

TITLE: Enhance Bay-Delta Native Fish Populations by Increasing Natural and Hatchery Production.

SOLUTION OVERVIEW

Theme. This alternative is designed to enhance Bay-Delta native fish populations by increasing hatchery production and improving Delta productivity. Emphasize is placed on increasing delta smelt populations by improving habitat and supplementing populations with hatchery production.

Key Actions. The unique character of this alternative is represented by the combination of the following actions:

- Construct production hatchery facilities for delta smelt, sturgeon, and perhaps Sacramento perch.
- Implement tagging (some type of marking) of hatchery-bred fish to allow (1) assessment of effects on wild fish, and (2) selective fisheries (not for delta smelt) that would protect wild fish from overharvest.
- Restore modest levels of shallow water, riverine, riparian, and wetland habitats in the Delta.
- Change upstream reservoir operations and Delta inflow timing pattern.

ACTIONS SELECTED FOR THE ALTERNATIVE

Management of Native Bay-Delta Resident Fish. This alternative places emphasis on restoring Delta habitat and supplementing populations with hatchery production to enhance Bay-Delta native resident fish populations. Emphasis would be placed on restoring Delta riverine, riparian, and wetland habitat, establishing floodways and meander belts, control of introduced and nuisance species, and Delta inflow management. Hatchery operations would be expanded to increase delta smelt, sturgeon, and perhaps Sacramento perch populations. Efforts to reduce conflicts of hatcheries with wild population restoration would be enhanced above the core action level by tagging/marking all hatchery reared fish. Core actions providing additional fish screening, improved salvage operations, and real-time monitoring and adaptive management would provide additional benefits.

Management of Anadromous Fish. This alternative relies on core actions and Delta habitat improvements to manage populations of anadromous fish. Delta habitat

improvements that would benefit anadromous fishes include restoration of shallow water, riverine, riparian, and wetland habitats. Ancillary benefits to anadromous fish would also be derived from establishing floodways and meander belts, control of introduced/nuisance species, and Delta inflow management. Core actions to benefit anadromous fish include manage flows and temperatures in upstream habitats, restore and replenish spawning gravels, modify gravel mining practices, modify passage at upstream dams and barriers, modify natural barriers to improve passage, restore upstream anadromous riparian habitat, provide pulsed and attraction flows, real-time monitoring and adaptive management, improved salvage and fish screening, and improved hatchery operations.

Bay-Delta Habitat Restoration. Bay-Delta habitats for native resident fish would be restored through specific actions and increasing the level of application of core actions. The specific action package includes modest levels of actions to restore Delta shallow water, riverine, riparian, and terrestrial habitat, to establish floodways and meander belts in the Delta, to control introduced and nuisance species, and to improve timing and quantity of Delta inflow. Core actions in the Delta would be enhanced to provide moderate level of restoration of riverine, riparian, and wetland habitat, and moderate levels of pulsed flows for fish movement and fish attraction.

Upstream Habitat Restoration. Upstream habitats for anadromous fish would be improved through core actions. Core actions in the upper watershed would provide a modest level of upstream spawning and rearing habitat restoration through restoring and replenishing spawning gravels, restoring riparian vegetation, and managing mine drainage.

Reduction in Diversion Effects. Core actions would be relied upon to reduce diversion effects on anadromous and Bay-Delta native resident fish populations. Such actions include real-time monitoring and adaptive management, installing screens on high priority diversions in the Delta and upstream of the Delta, enforcing screening requirements at diversions, and improving fish salvage operations at the south Delta pumping plants.

Reduction in Diversion/Export Reliance. This alternative would rely on core actions to manage demand in the export service areas. Reliance on Delta exports would remain unchanged and actions above those identified as core actions would not be included.

Water Supply Enhancement. This alternative would rely on core actions involving groundwater banking and conjunctive use to enhance existing water supplies.

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Management of Water Quality. This alternative would rely on core actions involving management of agricultural drainage, urban and wastewater discharge, and dredged material to protect and enhance water quality in the basin. Improved controls on pollutant discharges in the Bay and Delta through better controls on agricultural, municipal, and industrial discharges would achieve important water quality benefits for fish populations living within or passing through the Bay-Delta.

Improvement to System Reliability/Vulnerability. This alternative would rely on core actions involving levee maintenance and stabilization to improve the water transport system reliability and to reduce the vulnerability of water supplies to levee failures in the rivers and Delta. Some actions restoring Delta riverine, riparian, and wetland habitat would provide some additional levee stabilization that would improve system reliability.

PRELIMINARY ASSESSMENT

Ecosystem Quality. This alternative emphasizes direct improvements to anadromous fish and native resident Delta fish populations through hatchery production and additional improvements in Delta and upstream habitat substantially above those provided by core actions. Increased hatchery production of anadromous fish could place more competitive and predator pressures on wild (naturally produced) populations of anadromous fishes. Habitat improvements in the Delta and upstream, and tagging of hatchery fish should help minimize effects on wild populations. Enhanced population abundance of hatchery produced fish would help bring recovery of populations in decline and lead to improvements of harvests in commercial or sport fisheries of selected species and runs.

Water Supply. This alternative would result in a long-term reduction in the reliability that existing diverters have on surface supplies. It is for this reason that conjunctive use programs and incentives would be developed with terms and conditions that are economically attractive to surface water diverters, and which can effectively provide a better economic return for replacing surface water use with ground water use, especially in those regions where otherwise diverted surface waters will instead be dedicated to habitat and population improvements. Water supplies predictability would be increased through core actions involving water transfers, long-term planning for drought contingencies, establishing institutions for long-term water management, and integrated land-use and water-supply planning.

Water Quality. Existing water quality problems in the Bay-Delta and its watershed will be reduced to a limited extent by implementing core actions such as

management of agricultural drainage, urban and wastewater discharge, and dredged material. Additional enhancement in the upper Sacramento River through management of mine drainage will substantially improve water quality in this portion of the basin. Large improvements in wetland and riparian habitats in the basin would also improve water quality.

Reliability of Delta Functions. System reliability would be improved above the core level actions by stabilizing levees associated with riparian, riverine, and wetland Delta and upstream habitat restoration, and by providing floodways and meander belts in the Delta.

ALTERNATIVE 331 ACTIONS

SPECIFIC ACTION PACKAGE

HABITAT RESTORATION

Restoration of Delta Shallow Water Habitat
Convert existing leveed lands to tidal action - modest level
Restore tidal action to existing diked wetlands - modest level
Reconstruct levees to include shallow water habitat - modest level
Fill deep water to produce shallow water habitat - modest level

Restoration of Delta Riverine Habitat
Reconstruct river banks and shallow areas - modest level
Restore natural channel configuration - modest level

Restoration of Delta Riparian Habitat
Establish new areas of riparian habitat - modest level
Reestablish historic riparian areas - modest level

Restoration of Delta Terrestrial Habitat
Protect existing upland habitat - modest level
Establish upland habitat - modest level
Clean-up sites containing toxic substances - moderate level

Integrated Habitat Management Programs
Establish integrated habitat management programs - full implementation

Establishment of Floodways and Meander Belts
Relocate levees to widen floodways - modest level
Allow river channels to meander - modest level
Restore floodways as habitat corridors - moderate level

Control of Introduced/Nuisance Species
Remove or reduce nuisance species in key habitats - modest level
Modify habitat to favor native species - modest level

Delta Inflow Management
Decrease upstream diversions - modest level
Modify upstream reservoir operations - moderate level
Modify Delta inflow timing pattern - moderate level

MANAGEMENT OF ANADROMOUS FISH

Fish Hatchery Operations
Expand hatchery capacities - modest level
Construct new hatcheries on the San Joaquin R. - moderate level

ENHANCED CORE ACTIONS

HABITAT RESTORATION
Restoration of Delta Riverine Habitat

Restore/preserve channel islands - moderate level
Modify maintenance designs to include riverine elements - moderate level

Restoration of Delta Riparian Habitat
Improve and protect degraded riparian habitats - moderate level
Modify levee maintenance practices - moderate level
Protect existing riparian habitat - moderate level

Restoration of Delta Wetland Habitat
Enhance existing wetlands - moderate level
Expand wetland acquisition programs - moderate level
Protect existing wetland habitat - moderate level

Delta Inflow Management
Provide instream pulse flows for fish passage - moderate level
Provide instream flows for fish attraction - moderate level

MANAGEMENT OF ANADROMOUS FISH
Fish Hatchery Operations
Improve hatchery operations - moderate level
Implement tagging of hatchery-bred fish - maximum level

Preliminary Alternative EQ-332

Group **ECOSYSTEM QUALITY**

Title **Enhance Fish Production**

Increase populations of anadromous and Bay-Delta native fish through habitat improvements and hatchery production.

Key Actions

Hatcheries---Expand hatchery production of salmon and steelhead in Sacramento and San Joaquin river basin; construct hatchery facilities for delta smelt, sturgeon, and perhaps Sacramento perch.
Habitat Restoration---Restore riverine, riparian, wetland, and adjacent terrestrial habitat, and expand floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries to restore fish spawning, rearing, and feeding habitats and improve fish survival.
Habitat Management---Establish comprehensive and integrated habitat management programs to maximize benefits to fish populations.
Control Introduced/Nuisance Species---Reduce the numbers of nuisance species from key habitat and modify habitat to limit introduced/nuisance species.
Project Operations---Change reservoir operations and Delta inflow patterns to benefit fish habitat and production.

Supporting Actions

Fisheries Management---Tag/mark all hatchery fish to assess role of hatchery produced fish and to focus harvest on hatchery fish.
Hatcheries---Improve hatchery operations to maximize production, improve genetics, and limit effects on wild salmon and steelhead populations to the maximum extent possible.
Fish Passage Improvements---Improve passage of anadromous fish at all feasible small dams and other barriers in the Sacramento and San Joaquin rivers and their tributaries.
Mine Drainage Problems---Remediate discharges from abandoned mines in tributaries of the upper Sacramento River below Shasta Dam to the maximum extent reasonably possible.
Flow Pulses---Provide flows for fish passage and attraction to the maximum extent reasonably possible.

Core Actions

Bay-Delta Habitat Restoration—Core actions to improve and protect existing aquatic, riparian, and wetland habitats in the Bay-Delta compliment key actions to restore habitat in the Bay-Delta.

Upstream Habitat Restoration— Core actions to improve and protect existing aquatic, riparian, and wetland habitats upstream of the Delta compliment key actions to restore upstream habitats.

Reduction in Diversion Effects—Diversion effects would be reduced by implementing core-level actions such as implementing fish screens, installing fish barriers, improving fish salvage operations, and managing inflow and export using real-time monitoring and adaptive management.

Management of Anadromous Fish—Core-level implementation of actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement would supplement key actions to improve conditions for anadromous fish.

Reductions in Diversion/Export Reliance—This alternative would rely on core-level implementation of actions such as educating users about reclamation, conservation, water pricing and desalination feasibility, as well as encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement—Core-level implemntation of actions such as incentives for conjunctive use would enhance available water supplies.

Increasing Water Supply Predictability—This alternative would rely on the core-level implementation of actions such as improving the ability to implement water transfers, long-term drought planning, institutions for water management, and coordination of land use and water supply planning.

Management of Water Quality—This alternative would rely on core-level implmentation of actions to manage Delta water quality such as implementing source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, industrial, and mine discharges and runoff.

Improvement to System Reliability/Vulnerability—This alternative would rely on core-level implementation of actions to improve system reliability such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality—This alternative would substantially improve ecosystem quality through habitat restoration and direct fish population enhancements via hatcheries. While quality would remain limited by water exports and the associated loss of habitat and small fish, core actions would limit the extent of these effects, such that expansion of fish anadromous and Bay-Delta native fish populations would be possible. Additional reductions in the export of small fish and improvements in aquatic habitat in the Bay-Delta may be necessary to achieve full recovery of anadromous and Bay-Delta native fish populations.

Water Supply Reliability—This alternative would result in a long-term reduction in water supply reliability because of further commitments of supplies for fish production purposes. Core actions involving water transfers, long-term planning and management, and intergrated land-use and water supply planning would help to limit the reduction in reliability of the water supply. Some water supply development would be needed to provide sufficient reliability.

Water Quality—Key actions provide for only minor reductions in water supply problems in the Bay-Delta and rivers through limiting mine drainage and restoration of wetland habitats. Core actions that would make modest efforts to manage agricultural drainage, urban and wastewater discharge, and dredged material would not be sufficient to alleviate existing problems. Some

additional water quality actions would be needed to produce substantial improvement of water quality particularly in the Bay-Delta and San Joaquin River.

System Reliability—This preliminary alternative achieves minimal improvements in system reliability through the implementation of core actions. Modest levels of maintaining and stabilizing high priority levees, modifying agricultural practices to reduce subsidence, implementing levee maintenance standards, and providing funding for levee maintenance and stabilization would provide for modest improvements in reliability. For substantial improvement in reliability, more expansive improvements in the levee system or reduced reliance on the Delta for water supply or protection of landuses would be necessary.

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ALTERNATIVE 332 ACTIONS

SPECIFIC ACTION PACKAGE

HABITAT RESTORATION

Restoration of Delta Shallow Water Habitat
Convert existing leveed lands to tidal action - modest level
Restore tidal action to existing diked wetlands - modest level
Reconstruct levees to include shallow water habitat - modest level
Fill deep water to produce shallow water habitat - modest level

Restoration of Delta Riverine Habitat
Reconstruct river banks and shallow areas - modest level
Restore natural channel configuration - modest level

Restoration of Delta Riparian Habitat
Establish new areas of riparian habitat - modest level
Reestablish historic riparian areas - modest level

Restoration of Delta Terrestrial Habitat
Protect existing upland habitat - modest level
Establish upland habitat - modest level
Clean-up sites containing toxic substances - moderate level

Integrated Habitat Management Programs
Establish integrated habitat management programs - full implementation

Establishment of Floodways and Meander Belts
Relocate levees to widen floodways - modest level
Allow river channels to meander - modest level
Restore floodways as habitat corridors - moderate level

Control of Introduced/Nuisance Species
Remove or reduce nuisance species in key habitats - modest level
Modify habitat to favor native species - modest level

Restoration of Upstream Anadromous Fish Habitat
Restore channel configuration - modest level
Restore shoreline habitat conditions - modest level
Improve floodway drainage to reduce fish stranding - moderate level

Restoration of Upstream Riparian Habitat
Protect riparian lands through purchase/easements - moderate level
Restore flows to dewatered riparian habitats - modest level

Restoration of Upstream Wetland Habitat
Modify floodways to support wetland habitats - modest level

Delta Inflow Management
Decrease upstream diversions - modest level
Modify upstream reservoir operations - moderate level

Modify Delta inflow timing pattern - moderate level

MANAGEMENT OF ANADROMOUS FISH

Fish Hatchery Operations
Expand hatchery capacities - modest level
Construct new hatcheries on the San Joaquin R. - moderate level

ENHANCED CORE ACTIONS

HABITAT RESTORATION
Restoration of Upstream Anadromous Fish Habitat
Manage flows and temperatures in upstream habitats - moderate level
Restore and replenish spawning gravels - moderate level
Modify gravel mining practices - moderate level

Physical Improvements for Fish Passage
Modify passage at upstream dams/other barriers - moderate level
Modify natural barriers to improve passage - moderate level

Restoration of Upstream Riparian Habitat
Restrict livestock grazing in riparian corridors - moderate level
Revegetate degraded riparian habitats - moderate level

Management of Mine Drainage
Manage discharges from abandoned mines - moderate level
Remediate abandoned mining sites discharging pollutants - moderate level

Restoration of Delta Riverine Habitat
Restore/preserve channel islands - moderate level
Modify maintenance designs to include riverine elements - moderate level

Restoration of Delta Riparian Habitat
Improve and protect degraded riparian habitats - moderate level
Modify levee maintenance practices - moderate level
Protect existing riparian habitat - moderate level

Restoration of Delta Wetland Habitat
Enhance existing wetlands - moderate level
Expand wetland acquisition programs - moderate level
Protect existing wetland habitat - moderate level

Delta Inflow Management
Provide instream pulse flows for fish passage - moderate level
Provide instream flows for fish attraction - moderate level

MANAGEMENT OF ANADROMOUS FISH
Fish Hatchery Operations
Improve hatchery operations - moderate level
Implement tagging of hatchery-bred fish - maximum level

ALTERNATIVE 333: REDUCE ANADROMOUS FISH DIVERSION IMPACTS ALONG ALL MIGRATION ROUTES BY CONSOLIDATING DIVERSIONS AND INSTALLING BARRIERS

Theme: Enhance fishery population through reduced diversion impacts.
Sub-Theme: Enhancing winter run and other anadromous fishery.
Approach: Consolidate diversions and install barriers along principal migration.

SOLUTION OVERVIEW

Alternative 333 focuses on enhancing the anadromous fishery by reducing diversion impacts along the entire migration route. The principal focus of actions is combined use of consolidated diversions, screens, and barriers to minimize potential unscreened entrainment of migrating smolts and maximize their out-migration success. An isolated conveyance around rearing habitats and export areas both minimizes diversion impacts and mitigates pulse flow losses. Delta agricultural diversions would be consolidated to less deleterious locations with both screens and barriers to avoid entrainment losses. Export vulnerability would be reduced, and water quality would be improved. Coordinated pulse flow management as mitigated by moderate export enhancements assures successful out-migration of smolts.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

Some enhancements to core actions would emphasize resting areas and shaded riparian habitat along principal migration channels. Actions would be focused to guide/attract fish migration away from diversion sites. Principal enhancements include restoration/ creation of Delta islands in conjunction with levee maintenance with the above-referenced focus.

Upstream Habitat Restoration

Riverine and riparian habitat would be strategically enhanced to encourage migration along stream banks without diversions. Channel and shoreline enhancements to 20 percent of maximum as focused on guiding fish from hazards. Shoreline vegetation would be protected and improved at strategic locations by enhancing efforts to 30 percent. Management of flows and temperatures would be targeted to retain and then initiate migration of fish past diversion points to the Delta. Pulse flows would be enhanced from the minimum core level of 20 percent to 40 percent of AFRP amounts, subject to verifiable efficacy of this action.

Reduction in Diversion Effects

Construction of an eastside Sacramento Valley isolated facility with sufficient capacity to deliver supplies prior to completion of the out-migration cycle would alleviate diversion of smolts. Diversions along migratory routes with over 10 cfs capacity would employ barriers; those over 100 cfs would include both barriers and screens with screening enforcement enhanced to 40 percent. Where feasible, groundwater capacity

would be substituted to reduce instream diversions during migration periods. All diversions within one-quarter mile of each other would be consolidated. Careful scheduling between a small (3,000 cfs) eastside Delta isolated conveyance facility and existing conveyance would substantially avoid entrainment of smolts.

Pulse flows enhanced from 20 to 50 percent of the AFRP amounts would be scheduled to coincide with instream pulses for coordinated management of migration patterns.

Management of Anadromous Fish

The core action for improved hatchery operation should be enhanced to 30 percent with emphasis on the introduction of smolts in coordination with pulse flow management.

Reduction in Export Reliance

Unmodified or qualified core actions are appropriate for this alternative.

Water Supply Enhancement and Predictability

A fully screened small eastside isolated Delta transfer facility would moderately increase Delta conveyance and export capacity and would mitigate pulse flow losses and uncertainty of export diversion restrictions during fish migrations.

Management of Water Quality

A small eastside isolated Delta transfer facility would supply reduced reverse flow gradients in the eastern and southern Delta and supply higher quality water to the export facilities. This complements the minimum core actions for this alternative.

Improvements to System Reliability/Vulnerability

Enhanced conveyance from the Sacramento River around the Delta channels nearly assures some minimum level of export supply in the event of a Delta calamity. Coupled with core-level levee maintenance, the small isolated facility would significantly reduce system vulnerability.

PRELIMINARY ASSESSMENT

As a lasting solution to diversion impacts to anadromous fish, this alternative focuses on screened isolated transfer facilities which consolidate out-migration season diversions away from critical habitats. The consolidation of Delta agricultural diversions, barriers, and strategically targeted core-level Bay-Delta habitat enhancement would guide smolts away from diversion sites. Water supply losses due to pulse flows would be mitigated and central Delta/export quality enhanced through reduced reverse flow gradients and timely allowance of full pumping capacity at existing Delta export facilities. With a significant reduction of vulnerability to the export supply, the alternative provides a fairly significant solution to each area of Bay-Delta conflicts.

December 15, 1995

ALTERNATIVE 333: ANNOTATED ACTION LIST

ACTIONS SELECTED

Bay-Delta Habitat Restoration

2.2 Develop islands to 70 percent with the focus on guiding fish away from diversions.
3.4 Enhance to 30 percent in conjunction with 2.2.

Upstream Habitat Restoration

9.1 Enhanced to 40 percent of AFRP flows.
9.3 and 9.4 Channel and shoreline restoration to guide fish with 20 percent implementation.
11.1 and 11.2 Enhance efforts to limit grazing and revegetate shorelines to 20 percent.

Reduction in Diversion Effects

13.4 Enhanced to 50 percent of AFRP recommendation. Water supply coordinated to with core level of 9.1 to minimize duplicating losses.
14.3 Enhance adaptive management to schedule diversion location and timing.
18.3 and 18.4 Enhance Delta and upstream screen to 40 percent.
18.5 Consolidate diversions within one-quarter mile of each other and above 5 cfs
18.6 Enhance enforcement to 40 percent.
19.1 and 19.2 Fully implement barriers to minimize Sacramento River smolt conveyance into central Delta and smolt migration through Old River
35.2 A fully screened small isolated Delta transfer system would allow reduce migration of smolts from the northern to the southern Delta and avoid diversion entrainment of eastside and southern stream smolts during the spring out-migration.
35.5 An isolated westside Sacramento Valley system sized for spring demands.

Management of Anadromous Fish

22.3 Enhanced for timing and/or transporting smolts.

Reduction in Export Reliance
Core actions only.

Water Supply Enhancement and Predictability

16.1 and 16.2 Maximum action to both complements the small facility of 35.2.

Management of Water Quality

13.4 At 50 percent of AFRP.

Improvements to System Reliability/Vulnerability
16.1 and 16.2 See above.
35.2 See above.

December 15, 1995

ALTERNATIVE 334: REDUCE BAY-DELTA RESIDENT FISHERY DIVERSION IMPACTS BY CONSOLIDATING DIVERSIONS AND INSTALLATION OF BARRIERS

Theme: Enhance indigenous Bay-Delta resident fishery population through reduced diversion impacts.
Sub-Theme: Enhancing all indigenous Bay-Delta resident fisheries.
Approach: Consolidate diversions and install barriers.

SOLUTION OVERVIEW

Alternative 334 focuses on enhancing the Bay-Delta resident fisheries with the principal focus of actions being combined use of consolidated diversions, screens, and barriers. Isolated conveyance around the Delta both minimizes diversion impacts and mitigates pulse flow water supply losses. This facility would also serve Delta upland agricultural diversions. Both export and ecosystem water quality would be assured by dedicated capacity in the facility. Vulnerability of ecosystem and export supplies to a Delta calamity would be nearly completely eliminated by isolating conveyance east of the Delta. Pulse flow enhancements as fully mitigated by increased export capacity assure successful regulation of salinity gradients.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

Enhancements to core actions would emphasize resting areas and shaded riparian habitat along principal rearing channels. Actions would be focused to guide/attract fish migration away from diversion sites. Under this premise, the principal enhancements include restoration/creation of Delta islands in conjunction with levee maintenance.

Upstream Habitat Restoration

Riverine and riparian habitat would be limited to core levels.

Reduction in Diversion Effects

An extensively barriered and screened large westside Delta isolated conveyance facility would avoid entrainment of Bay-Delta resident species. Capacity dedicated to feasible overland service to Delta agriculture would reduce entrainment. Diversions along migratory routes with over 10 cfs capacity would employ barriers; those over 100 cfs would include both barriers and screens with screening enforcement enhanced to 40 percent. Barriers and screens would be the focus of upstream efforts.

Pulse flows enhanced from 20 to 40 percent of the AFRP amounts would be scheduled to coincide with core instream pulses for coordinated management of migration patterns.

Management of Anadromous Fish

Unmodified or qualified core actions are appropriate for this alternative.

Reduction in Export Reliance

Unmodified or qualified core actions are appropriate for this alternative.

Water Supply Enhancement and Predictability

The above-described isolated Delta transfer facility, coupled with allowance for timely exercise of full export capacity, would alleviate Delta conveyance problems and would mitigate both pulse flow losses and uncertainty of export diversion restrictions during fish migrations.

Management of Water Quality

The full-sized isolated Delta transfer facility east of the Delta would produce positive flow gradients in the eastern and southern Delta and supply higher quality water to both the ecosystem and export facilities. This complements the minimum core actions for this alternative.

Improvements to System Reliability/Vulnerability

Totally isolated conveyance around the Delta channels nearly assures a full export supply and a potential for ecosystem maintenance in the event of a Delta calamity. Coupled with core-level levee maintenance, the isolated Delta facility would very significantly reduce system vulnerability.

PRELIMINARY ASSESSMENT

Isolating principal Delta diversion coupled with barriers provides a durable solution for Bay-Delta resident fisheries. Properly timed pulse flow releases, as scheduled by extensive adaptive management, would be conveyed through dedicated capacity in the Delta facility to assure positive flow with appropriate salinity gradients for improved ecosystem health. Water supply losses resulting from pulse flows would be mitigated and central Delta/export quality enhanced through positive flow gradients. With reduced vulnerability to the export and ecosystem supply, the alternative provides a significant solution to most aspects of Bay-Delta conflicts.

December 15, 1995

ALTERNATIVE 334: ANNOTATED ACTION LIST

ACTIONS SELECTED

Bay-Delta Habitat Restoration

2.2 Develop islands to 50 percent.
3.4 Enhance to 30 percent in conjunction with 2.2.

Upstream Habitat Restoration

Unmodified or qualified core actions are appropriate for this alternative.

Reduction in Diversion Effects

13.4 Enhanced to 40 percent of AFRP recommendation. Water supply coordinated to with core level of 9.1 to minimize duplicating losses.
18.3 and 18.4 Enhance Delta and upstream screening to 40 percent.
18.5 Consolidate diversions within one-quarter mile of each other and above 5 cfs
18.6 Enhance enforcement to 40 percent.
19.2 Fully implement barriers to minimize Sacramento River smolt conveyance into central Delta.
35.1 A fully screened eastside isolated Delta transfer system would reduce migration of smolts from the northern to the southern Delta and avoid diversion entrainment of eastside and southern stream fisheries.

Management of Anadromous Fish

22.3 Enhanced for timing and/or transporting smolts.

Reduction in Export Reliance

Core actions only.

Water Supply Enhancement and Predictability

16.1 and 16.2 Maximum action to both complements the small facility of 35.1.

Management of Water Quality

13.4 At 40 percent of AFRP.
35.1 In addition to improved export quality, the inclusion of dedicated capacity for salinity and flow gradients would improve ecosystem health.

Improvements to System Reliability/Vulnerability

16.1 and 16.2 See above.
35.1 See above.

December 15, 1995

ALTERNATIVE 335: REDUCE ALL FISH DIVERSION IMPACTS ALONG ALL CRITICAL REGIONS BY CONSOLIDATING DIVERSIONS AND INSTALLING BARRIERS

Theme: Enhance fishery population through reduced diversion impacts.
Sub-Theme: Enhancing all indigenous Bay-Delta dependent fisheries.
Approach: Consolidate diversions and install barriers along principal migration.

SOLUTION OVERVIEW

Alternative 335 focuses on enhancing the anadromous and other Bay-Delta fisheries by reducing diversion impacts along the entire migration route. The principal focus of actions is combined use of consolidated diversions, isolated facilities, screens, and barriers. Isolated conveyance around rearing habitats and the Delta both minimizes diversion impacts and mitigates pulse flow water supply losses. This facility would also serve Delta upland agricultural diversions. Both export and ecosystem water quality would be assured by dedicated capacity in the facility. Vulnerability of ecosystem and export supplies to a Delta calamity would be nearly completely eliminated by isolating the conveyance east of the Delta. Coordinated pulse flow enhancements as fully mitigated by export enhancements assure successful out-migration of smolts and changes in isohine location.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

Enhancements to core actions would emphasize resting areas and shaded riparian habitat along principal migration and rearing channels. Actions would be focused to guide/attract fish migration away from diversion sites. Under this premise, the principal enhancements include restoration/creation of Delta islands in conjunction with levee maintenance.

Upstream Habitat Restoration

Riverine and riparian habitat would be strategically enhanced in the upstream reaches to encourage migration along stream banks without diversions. Channel and shoreline enhancements to 20 percent of maximum are focused on guiding fish from hazards. Shoreline vegetation would be protected and improved at strategic locations by enhancing efforts to 30 percent. Management of flows and temperatures would be targeted to retain and then initiate migration of fish past diversion points to the Delta. Pulse flows would be enhanced from the minimum core level of 20 percent to 30 percent of AFRP amounts, subject to verifiable efficacy of this action.

Reduction in Diversion Effects

An extensively barriered and screened large westside Delta isolated conveyance facility would avoid entrainment of Bay-Delta resident species and with adaptive management scheduling would substantially avoid anadromous smolt entrainment. Capacity dedicated to feasible overland service to Delta agriculture would reduce entrainment.

Construction of an eastside isolated facility from Keswick to the Glenn-Colusa Canal with sufficient capacity to deliver supplies prior to completion of the out-migration cycle. Diversions along migratory routes with over 10 cfs capacity would employ barriers; those over 100 cfs would include both barriers and screens with screening enforcement enhanced to 40 percent. Where feasible, groundwater capacity would be substituted to reduce instream diversions during migration periods. All diversions within one-quarter mile of each other would be consolidated. Careful scheduling between 11 and existing conveyance substantially avoid entrainment of smolts.

Pulse flows enhanced from 20 to 40 percent of the AFRP amounts would be scheduled to coincide with instream pulses for coordinated management of migration patterns.

Management of Anadromous Fish

The core action for improved hatchery operation should be enhanced to 30 percent with emphasis on the introduction of smolts in coordination with pulse flow management.

Reduction in Export Reliance

Unmodified or qualified core actions are appropriate for this alternative.

Water Supply Enhancement and Predictability

The above-described isolated Delta transfer facility, coupled with allowance for timely exercise of full export capacity, would alleviate Delta conveyance problems and would mitigate both pulse flow losses and uncertainty of export diversion restrictions during fish migrations.

Management of Water Quality

The full-sized isolated Delta transfer facility east of the Delta would produce positive flow gradients in the eastern and southern Delta and supply higher quality water to both the ecosystem and export facilities. This complements the minimum core actions for this alternative.

Improvements to System Reliability/Vulnerability

Totally isolated conveyance from the Sacramento River around the Delta channels assures nearly a full export supply and a potential for ecosystem maintenance in the event of a Delta calamity. Coupled with core-level levee maintenance, the small isolated facility would very significantly reduce system vulnerability.

PRELIMINARY ASSESSMENT

The solution of isolating principal diversions from rearing areas and the Delta, coupled with barriers, provides long-term protection for fisheries dependent on the Bay-Delta. Properly timed pulse flow releases as scheduled by extensive adaptive management would minimize diversions at the remaining screened and barriered sites. Dedicated

capacity in the Delta facility would be provided to assure positive flow with appropriate salinity gradients. Strategically targeted habitat enhancements above core levels would guide smolts away from diversion sites. Water supply losses resulting from pulse flows would be mitigated and central Delta/export quality enhanced through positive flow gradients and timely allowance of full pumping capacity at existing Delta export facilities. With reduction of vulnerability to the export supply, the alternative provides a very significant solution to each aspect of Bay-Delta conflicts.

December 14, 1995

ALTERNATIVE 335: ANNOTATED ACTION LIST

ACTIONS SELECTED

Bay-Delta Habitat Restoration

2.2 Develop islands to 70 percent with the focus on guiding fish away from diversions.
3.4 Enhance to 30 percent in conjunction with 2.2.

Upstream Habitat Restoration

9.1 Enhanced to 40 percent of AFRP flows.
9.3 and 9.4 Channel and shoreline restoration to guide fish with 20 percent implementation.
11.1 and 11.2 Enhance efforts to limit grazing and revegetate shorelines to 20 percent.

Reduction in Diversion Effects

13.4 Enhanced to 40 percent of AFRP recommendation. Water supply coordinated to with core level of 9.1 to minimize duplicating losses.
14.3 Extensive adaptive management to schedule diversion location and timing.
18.3 and 18.4 Enhance Delta and upstream screen to 40 percent.
18.5 Consolidate diversions within one-quarter mile of each other and above 5 cfs
18.6 Enhance enforcement to 40 percent.
19.1 and 19.2 Fully implement barriers to minimize Sacramento River smolt conveyance into central Delta and smolt migration through Old River.
35.1 A fully screened eastside isolated Delta transfer system would reduce migration of smolts from the northern to the southern Delta and avoid diversion entrainment of eastside and southern stream fisheries.
35.5 An isolated westside Sacramento Valley system sized for spring demands.

Management of Anadromous Fish

22.3 Enhanced for timing and/or transporting smolts.

Reduction in Export Reliance

Core actions only.

Water Supply Enhancement and Predictability

16.1 and 16.2 Maximum action to both complements the small facility of 35.1.

Management of Water Quality

13.4 At 40 percent of AFRP.
35.1 In addition to improved export quality, the inclusion of dedicated capacity for salinity and flow gradients would improve ecosystem health.

December 14, 1995

Improvements to System Reliability/Vulnerability

16.1 and 16.2 See above.
35.1 See above.

December 14, 1995

ALTERNATIVE 336: REDUCE ANADROMOUS FISHERY DIVERSION IMPACTS BY CONSOLIDATING DIVERSIONS AND OPERATIONAL MODIFICATIONS

Theme: Enhance fishery population through reduced diversion impacts.
Sub-Theme: Enhancing anadromous fisheries.
Approach: Consolidate diversions and modify operations.

SOLUTION OVERVIEW

Alternative 336 is directed at anadromous fisheries actions emphasizing consolidated diversions and particularly modifying operations. Relocated diversions in the upper Sacramento River, coupled with strategically managed barriers and flow modifications, offer promise for anadromous fishery management. A small isolated westside Delta conveyance partially mitigates pulse flow water supply losses to exports while removing export diversions from critical habitat during migration periods. Conjunctive use in the upper basin and timely allowance for full use of export capacity would mitigate water supply losses resulting from pulse flows. Adaptive management of pulse flows would allow strategic triggers for out-migration of smolts. Attractive flows would be used to guide spawning migration. Vulnerability of export supplies to a Delta calamity would bepartially alleviated by isolating a portion of the conveyance west of the Delta.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

Core actions would emphasize resting areas and shaded riparian habitat to guide/ attract fish migration away from diversion sites and into channels leading to spawning areas. Under this premise, the principal enhancements include core-level restoration/ creation of Delta islands in conjunction with levee maintenance.

Upstream Habitat Restoration

Shoreline vegetation and grazing limits, coupled with small channel modifications, would be used to guide fish from diversions. These efforts would be boosted to 50 percent implementation. Pulse flows of up to 50 percent would be used to attract spawners and assist in out-migration. Water temperature releases would target rapid growth and triggering smolt migration as well as insuring spawning success.

Reduction in Diversion Effects

A small eastside Delta isolated conveyance facility would avoid entrainment of Bay-Delta resident and anadromous fisheries. Diversions along anadromous migratory routes with over 10 cfs capacity would employ barriers; those over 100 cfs would include both barriers and screens with screening enforcement enhanced to 40 percent. Water temperature regulation, both warming and cooling, would be coupled with pulse flows to consolidate the movement of various species to target locations. Barrier operation would be coordinated with pulses to assist in avoiding entrainment. Old

River barriers would be employed to reduce entrainment of early and late migrating fish.

Pulse flows to assist out-migration and spawning runs would be enhanced from 20 to 50 percent of the AFRP instream pulses.

Management of Anadromous Fish

Core hatchery management actions would be guided as to timing and locations of smolt releases to the system.

Reduction in Export Reliance

Unmodified or qualified core actions are appropriate for this alternative.

Water Supply Enhancement and Predictability

The small westside isolated Delta transfer facility, coupled with allowance for timely exercise of full export capacity, would partially alleviate Delta conveyance problems and mitigate pulse flow losses to exports. Conjunctive use and water transfer would be needed to mitigate loss of upstream supplies resulting from pulse flow releases.

Management of Water Quality

The isolated Delta transfer facility west of the Delta would reduce reverse flow gradients in the southern Delta and supply higher quality water to export facilities. This complements the minimum core actions for this alternative.

Improvements to System Reliability/Vulnerability

A small isolated conveyance from the Sacramento River around the Delta channels assures a partial export supply in the event of a Delta calamity. Coupled with core-level levee maintenance, this Delta facility would address system vulnerability.

PRELIMINARY ASSESSMENT

Concerted use of maximum flows with protected and relocated diversion facilities in the upper river basins reduces diversion impacts at the most vulnerable stage of anadromous life cycle. A small isolated Delta export diversion during migratory periods, coupled with strategically operated barriers, would relieve migratory confusion. Properly timed pulse flow releases and modified export operations would be scheduled by extensive adaptive management. These flows would bypass to reduce confusing gradients during fish migrations. Export water supply losses resulting from pulse flows would be partially mitigated by additional conveyance and timely allowance of full existing export capacity. Conjunctive operation in upstream areas in lieu of direct diversion during critical periods would offset lost water supply to upper basin diverters and complete the export mitigation. With reduced vulnerability to the export and

ecosystem supply, the alternative provides a solution to most aspects of Bay-Delta conflicts.

December 15, 1995

ALTERNATIVE 336: ANNOTATED ACTION LIST

ACTIONS SELECTED

Bay-Delta Habitat Restoration

2.2 Develop islands to 50 percent.
3.4 Modify 40 percent of levee maintenance practice to complement 2.2.

Upstream Habitat Restoration

9.1 Utilize adaptive management to increase water dedicated for flow and temperature to 50 percent of the AFRP amounts.
9.3 and 9.4 Restoration of channels and shoreline to 50 percent of maximum.
11.1 and 11.2 Revegetate and limit grazing access along shorelines to 50 percent of maximum.

Reduction in Diversion Effects

13.4 Enhanced to 50 percent of AFRP recommendation. Water supply coordinated to with core level of 9.1 to minimize duplicating losses.
18.3 and 18.4 Enhance Delta and upstream screening to 60 percent with emphasis upstream.
18.5 Consolidate diversions within one-quarter mile of each other and above 5 cfs
18.6 Enhance enforcement to 60 percent emphasizing upstream habitats.
19.2 Utilize barriers to retain and initiate anadromous out-migration.
35.3 A small westside isolated Delta transfer system would reduce entrainment during primary migratory periods.
36.4 To 70 percent with focus on anadromous fisheries.

Management of Anadromous Fish

19.2 See above.
22.3 Enhanced for timing and/or transporting smolts to 60 percent.

Reduction in Export Reliance

Core actions only.

Water Supply Enhancement and Predictability

16.1 and 16.2 Maximum action to both complements the facility of 35.1.
32.1 Extensive conjunctive use required for equity to upstream and export water supply losses and as an in-lieu source during rearing and out-migration periods.
35.3 The small facility allows modified export operations that are the farthest removed from the Delta.

December 15, 1995

Management of Water Quality

13.4 At 40 percent of AFRP.
35.3 Improved export quality and reduced occurrence of reverse flow patterns.

Improvements to System Reliability/Vulnerability

16.1 and 16.2 See above.
35.1 See above.

December 15, 1995

ALTERNATIVE 337: REDUCE BAY-DELTA RESIDENT FISHERY DIVERSION IMPACTS BY CONSOLIDATING DIVERSIONS AND OPERATIONAL MODIFICATIONS

Theme: Enhance Indigenous Bay-Delta Resident fishery population through reduced diversion impacts.
Sub-Theme: Enhancing all indigenous Bay-Delta resident fisheries.
Approach: Consolidate diversions and Modify operations.

SOLUTION OVERVIEW

Alternative 337 focuses on enhancing the Bay-Delta resident fisheries with the principal focus of actions being combined use of consolidated diversions and modifying operations. An Isolated conveyance around the Delta both minimizes diversion impacts and mitigates pulse flow water supply losses. This facility would also serve Delta upland agricultural diversions. A dedicated portion of capacity in the facility combined with adaptive management of pulse flows would allow strategic delivery of the pulse for ecosystem water management. Vulnerability of ecosystem and export supplies to a Delta calamity would almost be eliminated by isolating conveyance east of the Delta. Pulse flow enhancements as fully mitigated by increased export capacity assures successful regulation of salinity gradients.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

Actions emphasizing resting areas and shaded riparian habitat would be focused to guide/attract fish migration away from diversion sites. Under this premise, the principal enhancements include core level restoration/creation of Delta islands in conjunction with levee maintenance.

Upstream Habitat Restoration

Riverine and riparian habitat would be limited to core levels.

Reduction in Diversion Effects

A screened large west-side Delta isolated conveyance facility would avoid entrainment of Bay-Delta resident species. Capacity dedicated to feasible overland service to Delta agriculture would reduce entrainment. Diversions along migratory routes with over 10 cfs capacity would employ barriers; those over 100 cfs would include both barriers and screens with screening enforcement enhanced to 40 percent. Water temperature regulation, both warming and cooling would be employed as coupled with pulse flows to consolidate the movement of various species to target locations. Barriers operation would be coordinated with pulses to assist in avoiding entrainment.

Pulse flows for Delta species regulation would be enhanced from 20 to 60 percent of the AFRP amounts would be scheduled to coincide with instream pulses.

December 15, 1995

Management of Anadromous Fish

Unmodified or qualified the core actions are appropriate for this alternative.

Reduction in Export Reliance

Unmodified or qualified core actions are appropriate for this alternative.

Water Supply Enhancement and Predictability

The above-described isolated Delta transfer facility, coupled with allowance for timely exercise of full export capacity, would alleviate Delta conveyance problems and would mitigate both pulse flow losses to exports and uncertainty of export diversion restrictions during fish migrations. Conjunctive use and water transfer would be needed to mitigate loss of upstream supplies resulting from pulse flow releases.

Management of Water Quality

The full-sized isolated Delta transfer facility east of the Delta would produce positive flow gradients in the eastern and southern Delta and supply higher quality water to both the ecosystem and export facilities. This complements the minimum core actions for this alternative.

Improvements to System Reliability/Vulnerability

Totally isolated conveyance from the Sacramento River around the Delta channels nearly assures a full export supply and a potential for ecosystem maintenance in the event of a Delta calamity. Coupled with core-level levee maintenance, the isolated Delta facility would very significantly reduce system vulnerability.

Preliminary Assessment

Isolating principal Delta diversion coupled with barriers provides a durable long-term solution for Bay-Delta resident fisheries. Properly timed enhanced pulse flow releases, as scheduled by extensive adaptive management, would be conveyed through dedicated capacity in the Delta facility to assure positive flow with appropriate salinity gradients for improved ecosystem health. Water supply losses resulting from pulse flows would be mitigated and central Delta/export quality enhanced through positive flow gradients. With reduced vulnerability to the export and ecosystem supply, the alternative provides a significant solution to most aspects of Bay-Delta conflicts.

December 15, 1995

ALTERNATIVE 337: ANNOTATED ACTION LIST

ACTIONS SELECTED

Bay-Delta Habitat Restoration

2.2--Develop islands to 50 percent.
3.4--Modify 30 percent of levee maintenance practice to complement 2.2.

Upstream Habitat Restoration

Unmodified or qualified the core actions are appropriate for this alternative.

Reduction in Diversion Effects

13.4-- Enhanced to 60 percent of AFRP recommendation. Water supply coordinated to with core level of 9.1 to minimize duplicating losses.
18.3,.4--Enhance Delta and upstream screening to 40 percent.
18.5--Consolidate diversions within one-quarter mile of each other and above 5 cfs
18.6--Enhance enforcement to 40 percent.
19.2--Utilize barriers to retain and initiate Anadromous out-migration.
35.1-- A fully screened 20,000 cfs east-side isolated Delta transfer system would reduce migration of smolts from the northern to the southern Delta and avoid diversion entrainment of east-side and southern stream fisheries.
36.4--To 30 percent with focus on anadromous fisheries for equity.

Management of Anadromous Fish

19.2--See above.
22.3--Enhanced for timing and/or transporting smolts.

Reduction in Export Reliance

Core actions only.

Water Supply Enhancement and Predictability

16.1 and 16.2--Maximum action to both complements the facility of 35.1.
32.1 required for equity to upstream water supply losses.

Management of Water Quality

13.4-- at 40 percent of AFRP.
35.1--In addition to improved export quality, the inclusion of dedicated capacity for salinity and flow gradients would improve ecosystem health.

Improvements to System Reliability/Vulnerability
16.1 and 16.2--See above.

December 15, 1995

35.1--See above.

December 15, 1995

ALTERNATIVE 338: REDUCE ALL FISHERY DIVERSION IMPACTS BY CONSOLIDATING DIVERSIONS AND OPERATIONAL MODIFICATIONS

Theme: Enhance fishery population through reduced diversion impacts.
Sub-Theme: Enhancing all Bay-Delta dependant fisheries.
Approach: Consolidate diversions and Modify operations.

SOLUTION OVERVIEW

Alternative 338 addresses the needs of all Bay-Delta dependant fisheries with the actions focused on consolidated diversions and modifying operations. Relocated Diversions in the upper Sacramento River coupled with strategically managed barriers and flow modifications offers promise for anadromous fishery management. An isolated conveyance around the Delta both minimizes Delta diversion impacts and mitigates pulse flow water supply losses to exports. Conjunctive use in the upper basin would mitigate upper basin water supply losses resulting from pulse flows. The isolated Delta facility would remove impacts resulting from Delta agricultural diversions. A dedicated portion of capacity in the facility combined with adaptive management of pulse flows would allow strategic delivery of the pulse for ecosystem water management. Pulse flow enhancements as fully mitigated by increased export capacity assures successful regulation of salinity gradients. Vulnerability of ecosystem and export supplies to a Delta calamity would almost be eliminated by isolating conveyance east of the Delta.

ACTIONS SELECTED

Bay-Delta Habitat Restoration

Actions emphasizing resting areas and shaded riparian habitat would be focused to guide/attract fish migration away from diversion sites. Under this premise, the principal enhancements include core level restoration/creation of Delta islands in conjunction with levee maintenance.

Upstream Habitat Restoration

Shoreline Vegetation and grazing limits coupled with small channel modifications would be used to guide fish from diversions. these efforts would be boosted to 50 percent implementation. Pulse flows of up to 50 percent would be used to attract spawners and assist in out-migration. Water temperature releases would target rapid growth and triggering smolt migration as well as insuring spawning success.

Reduction in Diversion Effects

A large west-side Delta isolated conveyance facility would avoid entrainment of Bay-Delta resident and anadromous fisheries. Capacity dedicated to feasible overland service to Delta agriculture would reduce entrainment. Diversions along anadromous migratory routes with over 10 cfs capacity would employ barriers; those over 100 cfs would include both barriers and screens with screening enforcement enhanced to 40

percent. Water temperature regulation, both warming and cooling, would be employed as coupled with pulse flows to consolidate the movement of various species to target locations. Barrier operation would be coordinated with pulses to assist in avoiding entrainment.

Pulse flows for Delta species regulation would be enhanced from 20 to 60 percent of the AFRP amounts would be scheduled to coincide with instream pulses.

Management of Anadromous Fish

Core hatchery management actions would be guided as to timing an locations of smolt releases to the system.

Reduction in Export Reliance

Unmodified or qualified core actions are appropriate for this alternative.

Water Supply Enhancement and Predictability

The above-described isolated Delta transfer facility, coupled with allowance for timely exercise of full export capacity, would alleviate Delta conveyance problems and would mitigate both pulse flow losses to exports and uncertainty of export diversion restrictions during fish migrations. Conjunctive use and water transfer would be needed to mitigate loss of upstream supplies resulting from pulse flow releases.

Management of Water Quality

The full-sized isolated Delta transfer facility east of the Delta would produce positive flow gradients in the eastern and southern Delta and supply higher quality water to both the ecosystem and export facilities. This complements the minimum core actions for this alternative.

Improvements to System Reliability/Vulnerability

Totally isolated conveyance from the Sacramento River around the Delta channels nearly assures a full export supply and a potential for ecosystem maintenance in the event of a Delta calamity. Coupled with core-level levee maintenance, the isolated Delta facility would very significantly reduce system vulnerability.

PRELIMINARY ASSESSMENT

Isolating principal Delta diversion coupled with strategically operated barriers provides a long-term solution for Bay-Delta dependent fisheries. Properly timed enhanced pulse flow releases and modified export operations would be scheduled by extensive adaptive management. These flows would both by-pass and be partially rediverted and conveyed through dedicated capacity in the Delta facility to assure positive flow with appropriate salinity gradients for improved ecosystem health. Export water supply losses resulting from pulse flows would be mitigated and central Delta/export quality

enhanced through positive flow gradients. Conjunctive operation upstream in lieu of direct diversion during critical periods would off-set lost water supply to upper basin diverters. With reduced vulnerability to the export and ecosystem supply, the alternative provides a significant solution to most aspects of Bay-Delta conflicts.

December 15, 1995

ALTERNATIVE ~~337~~ 338 ? ANNOTATED ACTION LIST

ACTIONS SELECTED

Bay-Delta Habitat Restoration

2.2--Develop islands to 50 percent.
3.4--Modify 40 percent of levee maintenance practice to complement 2.2.

Upstream Habitat Restoration

9.1--Utilize adaptive management to increase water dedicated for flow and temperature to 60 percent of the AFRP amounts.
9.3,.4--Restoration of channels and shoreline to 50 percent of maximum.
11.1,.2--Revegetate and limit gazing access along shore lines to 50 percent of maximum.

Reduction in Diversion Effects

13.4-- Enhanced to 50 percent of AFRP recommendation. Water supply coordinated to with core level of 9.1 to minimize duplicating losses.
18.3,.4--Enhance Delta and upstream screening to 60 percent with emphasis upstream.
18.5--Consolidate diversions within one-quarter mile of each other and above 5 cfs
18.6--Enhance enforcement to 60 percent emphasizing upstream habitats.
19.2--Utilize barriers to retain and initiate anadromous out-migration.
35.1-- A fully screened 20,000 cfs east-side isolated Delta transfer system would reduce migration of smolts from the northern to the southern Delta and avoid diversion entrainment of east-side and southern stream fisheries.
36.4--To 50 percent with focus on anadromous fisheries.

Management of Anadromous Fish

19.2--See above.
22.3--Enhanced for timing and/or transporting smolts to 60 percent.

Reduction in Export Reliance

Core actions only.

Water Supply Enhancement and Predictability

16.1 and 16.2--Maximum action to both complements the facility of 35.1.
32.1-- Conjunctive use required for equity to upstream water supply losses and as an in lieu source during rearing and out-migration periods.

Management of Water Quality

13.4-- at 40 percent of AFRP.

December 15, 1995

35.1--In addition to improved export quality, the inclusion of dedicated capacity for salinity and flow gradients would improve ecosystem health.

Improvements to System Reliability/Vulnerability
16.1 and 16.2--See above.
35.1--See above.

December 15, 1995

CALFED
TEN ALTERNATIVES SUBMITTED FOR CALFED STAFF SUBMITTAL
DECEMBER 20, 1995

The ten alternatives submitted for subsequent CALFED staff submittal and consideration were developed by Don Wagenet and Tom Cannon of the original "A" team. They differ from alternatives 300 through 339 because additional actions have been added to further achieve the solution principles of equitability, durability, affordability, implementability, and avoidance of a redirection of impacts.

The matrix submitted with alternative numbers 300-339 was again used for selecting these ten alternatives. Combinations of natural production, hatchery production, diversion reduction, and habitat/ecosystem quality actions were included. In addition, realistic insertions of water supply and conveyance actions, including isolated Delta transfer facilities, off stream storage, and improved through-Delta conveyance were made to achieve balance among actions, and to focus on compensating suppliers for several core actions that require more water in the Delta for a longer time in order to protect, restore, and improve aquatic, riverine, riparian, shallow water, and wetland habitats.

These actions and strategies were assembled in order to achieve realistic alternatives that still could encompass a very wide range of strategies for fish production. One alternative even focuses primarily on ecosystem health. Another independently developed alternative maximizes Delta and upstream habitat improvements, inflows, water quality, and levee system reliability without any major construction. The remaining alternatives either maximize fish production using natural production, natural production and diversion reduction actions, or maximum in-Delta actions. Additional minimum alternatives adopting the same strategies are provided for balance/moderation.

Preliminary Alternative EQ-340

Group — *Title*

ECOSYSTEM QUALITY — **Maximum Fish Populations**

Increase populations of anadromous and Bay-Delta native fish through habitat improvements, reduced diversions, isolated diversion facilities, improved water quality, improved water management, improved agricultural practices, and hatchery production.

Key Actions

Habitat Restoration---Restore riverine, riparian, wetland, and adjacent terrestrial habitat, and expand floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries to restore fish spawning, rearing, feeding, and migrating habitats and improve fish survival. Isolate Delta export diversions to restore Delta habitat conditions.
Habitat Management---Establish comprehensive and integrated habitat management programs to maximize benefits to fish populations, and improve floodway drainage to reduce fish stranding.
Control Introduced/Nuisance/Predator Species---Reduce the numbers of nuisance and predator species from key habitat and modify habitat to limit introduced/nuisance species.
Hatcheries---Expand hatchery production of salmon and steelhead in Sacramento and San Joaquin river basin; construct hatchery facilities for delta smelt, sturgeon, and perhaps Sacramento perch.
Project Operations---Change reservoir operations and Delta inflow and export patterns to benefit fish habitat and production.
Reduce Diversions and Diversion Effects--Modify diversion timing, increase diversion capacity to allow less diversion during key periods, acquire water supplies for fish to improve flows, improve existing screens and install new screens, consolidate diversions, enforce screenng requirements, and convert industrial water use to cooling towers. Isolate Delta, Sacramento River, and San Joaquin River diversions by constructing conveyance facilities.

Supporting Actions

Fisheries Management---Tag/mark all hatchery fish to assess role of hatchery produced fish and to focus harvest on hatchery fish.
Hatcheries---Improve hatchery operations to maximize production, improve genetics, and limit effects on wild salmon and steelhead populations to the maximum extent possible.
Fish Passage Improvements---Improve passage of anadromous fish at all feasible small dams and other barriers in the Sacramento and San Joaquin rivers and their tributaries.
Flow Pulses---Provide flows for fish passage and attraction to the maximum extent reasonably possible.
Levee Maintenance and Stabilization--Protect levees from catastrophic failure to preserve Delta habitat conditions and minimize loss of fish and invertebrates to flooded islands.
Water Quality--Improve watershed management, and reduce pollutant inputs from agricultural and mine drainage, dredging, and urban and wastewater discharges.
Water Supply--Improve water supply for fish by acquiring water supply for fish, developing alternate supplies for drought situations, constructing new off-stream storage upstream of the Delta, providing institutional mechanisms for long-term water management, and providing in-Delta storage on Delta islands converted to storage within cross Delta conveyance system.

Preliminary Alternative EQ-340

Core Actions

Bay-Delta Habitat Restoration—Core actions to improve and protect existing aquatic, riparian, and wetland habitats in the Bay-Delta compliment key actions to restore habitat in the Bay-Delta.

Upstream Habitat Restoration— Core actions to improve and protect existing aquatic, riparian, and wetland habitats upstream of the Delta compliment key actions to restore upstream habitats.

Reduction in Diversion Effects— Core actions to reduce diversion effects compliment key actions to diversion effects.

Management of Anadromous Fish—Core-level implementation of actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement would supplement key actions to improve conditions for anadromous fish.

Reductions in Diversion/Export Reliance—This alternative would rely on core-level implementation of actions such as educating users about reclamation, conservation, water pricing and desalination feasibility, as well as encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement—Core-level implementation of actions such as incentives for conjunctive use would supplement supplemental actions to enhance water supply.

Increasing Water Supply Predictability—This alternative would rely on the core-level implementation of actions such as improving the ability to implement water transfers, long-term drought planning, institutions for water management, and coordination of land use and water supply planning.

Management of Water Quality—This alternative would increase the core level of implementation of actions to manage Delta water quality such as implementing source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, industrial, and mine discharges and runoff.

Improvement to System Reliability/Vulnerability—This alternative would increase the core level of implementation of actions to improve system reliability such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality—This alternative would substantially improve ecosystem quality through habitat restoration, direct fish population enhancements via hatcheries, reduced diversion effects, and increased water for fish and wildlife. While quality would remain limited by water exports the existing level of loss of habitat and small fish would be reduced by isolated water transfer facilities. Actions to improve and protect existing aquatic, riparian, and wetland habitats within

and upstream of the Delta would greatly enhance anadromous and Bay-Delta native fish populations.

Water Supply Reliability—This alternative would result in improved water supply reliability because of improved water conveyance facilities, greater storage capacity, greater diversion capacity, and additional water supply development. Core actions involving water transfers, long-term planning and management, and intergrated land-use and water supply planning would help to limit the reduction in reliability of the water supply.

Water Quality—Key actions provide for major reductions in water quality problems in the Bay-Delta and rivers through implementating source controls and regulations for pollutants in agricultural drainage and urban and wastewater discharge, limiting mine drainage and restoration of wetland habitats. These actions along with core actions that would make modest efforts to manage urban and wastewater discharge, and dredged material would be sufficient to alleviate many existing water quality problems.

System Reliability—This preliminary alternative achieves considerable improvements in system reliability through the implementation of key and core actions. Moderate levels of maintaining and stabilizing high priority levees, providing an isolated through Delta transfer facility, modifying agricultural practices to reduce subsidence, implementing levee maintenance standards, and providing funding for levee maintenance and stabilization would provide for moderate improvements in reliability. Improvement in reliability is obtained from more expansive improvements in the levee system, reduced reliance on the Delta for water supply, and improved water quality of the water supply..

ALTERNATIVE 340 ACTIONS

SPECIFIC ACTION PACKAGE

1--Restoration of Delta Shallow Water Habitat
1.1--Convert existing leveed lands to tidal action - maximum reasonable level
1.2--Protect existing shallow water habitat from erosion - maximum reasonable level
1.3--Restore tidal action to existing diked wetlands - maximum reasonable level
1.4--Reconstruct levees to include shallow water habitat - maximum reasonable level
1.5--Fill deep water to produce shallow water habitat - maximum reasonable level

2--Restoration of Delta Riverine Habitat
2.1--Reconstruct river banks and shallow areas - maximum reasonable level
2.2--Restore/preserve channel islands - maximum reasonable level
2.3--Restore natural channel configuration - maximum reasonable level
2.4--Modify maintenance designs to include riverine elements - maximum reasonable level

3--Restoration of Delta Riparian Habitat
3.1--Improve and protect degraded riparian habitats - maximum reasonable level
3.2--Establish new areas of riparian habitat - maximum reasonable level
3.3--Reestablish historic riparian areas - maximum reasonable level
3.4--Modify levee maintenance practices - maximum reasonable level
3.5--Protect existing riparian habitat - maximum reasonable level

4--Restoration of Delta Wetland Habitat
4.1--Enhance existing wetlands - moderate level
4.2--Expand wetland acquisition programs - moderate level
4.3--Convert agricultural lands to wetlands - modest level
4.4--Protect existing wetland habitat - moderate level

5--Restoration of Delta Terrestrial Habitat
5.1--Protect existing upland habitat - modest level
5.2--Establish upland habitat - modest level
5.3--Preserve the habitat values of agricultural land uses - modest level
5.4--Clean-up sites containing toxic substances - maximum reasonable level

6--Establishment of Floodways and Meander Belts
6.1--Relocate levees to widen floodways - maximum reasonable level
6.2--Allow river channels to meander - maximum reasonable level
6.4--Restore floodways as habitat corridors - maximum reasonable level

7--Control of Introduced/Nuisance Species
7.1--Remove or reduce nuisance species in key habitats - maximum reasonable level
7.4--Inspect for invasion of nuisance species - maximum reasonable level
7.5--Modify habitat to favor native species - maximum reasonable level

9--Restoration of Upstream Anadromous Fish Habitat
9.1--Manage flows and temperatures in upstream habitats - maximum reasonable level
9.2--Restore and replenish spawning gravels - maximum reasonable level
9.3--Restore channel configuration - maximum reasonable level
9.4--Restore shoreline habitat conditions - maximum reasonable level
9.6--Improve floodway drainage to reduce fish stranding - maximum reasonable level

10--Physical Improvement in Fish Passage
10.1--Modify passage at upstream dams/other barriers - maximum reasonable level
10.2--Modify natural barriers to improve passage - maximum reasonable level

11--Restoration of Upstream Riparian Habitat
11.1--Restrict livestock grazing in riparian corridors - maximum reasonable level
11.2--Revegetate degraded riparian habitats - maximum reasonable level
11.3--Protect riparian lands through purchase/easements - maximum reasonable level
11.4--Restore flows to dewatered riparian habitats - modest level

12--Restoration of Upstream Wetland Habitat
12.1--Modify floodways to support wetland habitats - moderate level
12.2--Reuse agricultural drainage to create wetlands - modest level
12.3--Reuse urban wastewater effluent to create wetlands - modest level

13--Delta Inflow Management
13.1--Decrease upstream diversions - maximum reasonable level
13.2--Modify upstream reservoir operations - maximum reasonable level
13.3--Modify Delta inflow timing pattern - maximum reasonable level
13.4--Provide instream pulse flows for fish passage - maximum reasonable level
13.5--Provide instream flows for fish attraction - maximum reasonable level

14--Delta Outflow/Export Management
14.1--Modify Central Delta channel operations - moderate level
14.2--Modify export operations criteria - moderate level

15--Modification of Diversion Timing Pattern
15.1--Modify diversion timing in in-Delta diversions - maximum reasonable level
15.2--Modify diversion timing through Montezuma SCG - maximum reasonable level

16--Increase Rates of Diversion Capacity
16.2--Obtain approvals to fully use existing export capacity to reduce diversion impacts - moderate level
16.4--Enlarge export pumping and conveyance capacity to reduce diversion impacts - modest level

17--Acquire Water Supplies for Fish and Wildlife
17.2--Obtain shifts in diversion timing patterns - maximum reasonable level
17.3--Improve flows at key times and places - maximum reasonable level

18-Installation and Improvement of Fish Screens
18.1--Improve screens at Delta export pumps - modest level
18.2--Improve other existing fish screen systems - maximum reasonable level
18.3--Install screens on other in-Delta diversions - maximum reasonable level
18.4--Install screens on upstream diversions - maximum reasonable level
18.5--Consolidate and screen existing small diversions - maximum reasonable level
18.6--Enforce screening requirements - maximum reasonable level
18.7--Convert industrial water use to cooling towers - maximum reasonable level

19--Installation of Fish Barriers to Guide Fish Movement
Core actions adequate.

20--Improvement of Fish Salvage Operations
Core actions adequate.

21--Removal and Control of Aquatic Predators
21.2--Harvest predators in upstream habitats - maximum reasonable level

22--Fish Hatchery Operations
22.1--Expand hatchery capacities - maximum reasonable level
22.2--Construct new hatcheries on the San Joaquin R. - maximum reasonable level
22.3--Improve hatchery operations - maximum reasonable level
22.4--Reduce hatchery effects on wild fish populations - maximum reasonable level
22.5--Implement tagging of hatchery-bred fish - maximum reasonable level
22.6--Establish new captive breeding programs - moderate level

23--Fish Harvest Management
Core actions adequate.

29--Watershed Management
29.2--Manage riparian zones to protect water quality - moderate level
29.3--Manage landuse to protect water quality - moderate level

31--New or Expanded Off-Stream Storage
31.2--Construct new off-stream storage upstream of Delta - modest level
31.3--C:onstruct new off-stream storage facilities in Delta - moderate level

35--Construction & Improvement of Conveyance Facilities
35.4--Construct isolated Sacramento Valley Conveyance - eastside
35.5--Construct isolated Sacramento Valley Conveyance - westside
35.6--Construct isolated San Joaquin Valley Converyance - eastside
35.7--Construct isolated San Joaquin Valley Conveyance - westside
35.8--Convert Delta islands to storage conveyance system

36--Changes in Locations of Diversions
36.2--Relocate other in-Delta diversions - moderate level
36.3--Consolidate in-Delta agricultural diversions - moderate level
36.4--Relocate upstream diversions from key habitats - moderate level
36.5--Improve diversion design when relocating - maximum reasonable level

38--Long-Term Planning for Drought Contingencies
38.3--Develop alternate supplies for drought situations - maximum reasonable level

39--Institutions for Integrated Long-term Water Management
39.02--Establish institution to implement guarantees
39.07--Establish a Delta watermaster to manage flows
39.08--Modify water law to establish instream rights
39.21--Enforce wastewater discharge requirements
39.22--Water resources data and information management

42--Management of Agricultural Drainage
42.01--Implement source control regulations for pollutants - maximum reasonable level
42.02--Implement pollutant-load limits in San Joaquin River - maximum reasonable level
42.03--Reduce or control volume of agricultural discharges - moderate level
42.04--Modify cropping and irrigation practices - modest level
42.05--Export agricultural drainage to other watersheds - modest level
42.07--Improve pest-control practices - moderate level
42.08--Manage irrigation tailwater to reduce pesticides - maximum reasonable level
42.09--Manage drainage timing to reduce instream impacts - moderate level

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42.10--Treat drainage to remove pollutants - moderate level
42.11--Dilute pollutants in Delta inflow from SJR using stored water - modest level

43--Management of Urban and Wastewater Discharge
43.2--Treat discharges to remove problem constituents - modest level
43.4--Increase key nutrient inputs to estuary - modest level

44--Dredged Material Management
44.1--Limit dredging to avoid fish migration periods - moderate level
44.2--Use techniques to localize sediment movement - moderate level
44.3--Dispose dredged materials at nonaquatic sites - moderate level
44.4--Remove contaminated sediments in critical habitat sites - modest level
44.5--Ensure material used for levee maintenance is noncontaminated - maximum reasonable level

45--Management of Mine Drainage
45.1--Manage discharges from abandoned mines - maximum reasonable level
45.2--Remediate abandoned mining sites discharging pollutants - maximum reasonable level

46--Levee Maintenance and Stabilization
46.1--Maintain and stabilize existing levees - moderate level

50--Integrated Habitat Management Programs
50.1--Establish integrated habitat management programs - full implementation

Preliminary Alternative EQ-341

Group — ECOSYSTEM QUALITY

Title — **Maximize Native Fish Production**

Increase production of native anadromous and Bay-Delta resident fish through maximum reasonable levels of habitat improvements, reduced diversions, isolated diversion facilities, improved water quality, improved water management, improved agricultural practices, and supportive hatchery activities.

Key Actions

Habitat Restoration---Restore riverine, riparian, wetland, and adjacent terrestrial habitat, and expand floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries to restore fish spawning, rearing, feeding, and migrating habitats and improve fish survival.
Habitat Management---Establish comprehensive and integrated habitat management programs to maximize benefits to fish populations, and improve floodway drainage to reduce fish stranding.
Control Introduced/Nuisance/Predator Species---Reduce the numbers of nuisance and predator species from key habitats and export facilities, and modify habitat to limit introduced/nuisance species.
Hatcheries---Expand hatchery production of salmon and steelhead in Sacramento and San Joaquin river basin to develop new self-sustaining wild runs; construct hatchery facilities for delta smelt, sturgeon, and perhaps Sacramento perch to restore stocks to self-suffient levels.
Project Operations---Change reservoir operations and Delta inflow and export patterns to benefit fish habitat and production.
Reduce Diversions and Diversion Effects--Modify diversion timing, increase diversion capacity to allow less diversion during key periods, acquire water supplies for fish to improve flows, improve existing screens and install new screens, consolidate diversions, enforce screening requirements, and convert industrial water use to cooling towers. Isolate Delta, Sacramento River, and San Joaquin River diversions by constructing conveyance facilities.

Supporting Actions

Fisheries Management---Tag/mark all hatchery fish to assess role of hatchery produced fish and to focus harvest on hatchery fish.
Hatcheries---Improve hatchery operations to maximize production, improve genetics, and limit effects on wild salmon and steelhead populations to the maximum extent possible.
Fish Passage Improvements---Improve passage of anadromous fish at all feasible small dams and other barriers in the Sacramento and San Joaquin rivers and their tributaries.
Flow Pulses---Provide flows for fish passage and attraction to the maximum extent reasonably possible.
Levee Maintenance and Stabilization--Protect levees from catastrophic failure to preserve Delta habitat conditions and minimize loss of fish and invertebrates to flooded islands.
Water Quality--Improve watershed management, and reduce pollutant inputs from agricultural and mine drainage, dredging, and urban and wastewater discharges.
Water Supply--Improve water supply for fish by acquiring water supply for fish, developing alternate supplies for drought situations, constructing new off-stream storage upstream of the Delta, providing institutional mechanisms for long-term water management, and providing in-Delta storage on Delta islands converted to storage within cross Delta conveyance system.

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Core Actions

Bay-Delta Habitat Restoration—Core actions to improve and protect existing aquatic, riparian, and wetland habitats in the Bay-Delta compliment key actions to restore habitat in the Bay-Delta.

Upstream Habitat Restoration— Core actions to improve and protect existing aquatic, riparian, and wetland habitats upstream of the Delta compliment key actions to restore upstream habitats.

Reduction in Diversion Effects— Core actions to reduce diversion effects compliment key actions to diversion effects.

Management of Anadromous Fish—Core-level implementation of actions such as improving hatchery operations, reducing hatchery effects on wild populations, and improving fish harvest regulations and their enforcement would supplement key actions to improve conditions for anadromous fish.

Reductions in Diversion/Export Reliance—This alternative would rely on core-level implementation of actions such as educating users about reclamation, conservation, water pricing and desalination feasibility, as well as encouraging land fallowing and retirement to reduce water demand.

Water Supply Enhancement—Core-level implementation of actions such as incentives for conjunctive use would supplement supplemental actions to enhance water supply.

Increasing Water Supply Predictability—This alternative would rely on the core-level implementation of actions such as improving the ability to implement water transfers, long-term drought planning, institutions for water management, and coordination of land use and water supply planning.

Management of Water Quality—This alternative would increase the core level of implementation of actions to manage Delta water quality such as implementing source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, industrial, and mine discharges and runoff.

Improvement to System Reliability/Vulnerability—This alternative would increase the core level of implementation of actions to improve system reliability such as managing the highest priority levees, modifying agricultural practices to reduce subsidence, and establishing an emergency levee management plan.

Preliminary Assessment

Ecosystem Quality—This alternative would substantially improve ecosystem quality through habitat restoration, direct fish population enhancements via hatcheries, and increased water for fish and wildlife. Quality would remain limited by water exports and the existing level of loss of habitat and small fish from Detla export facilities. Maximum reasonable levels of actions to improve and protect existing aquatic, riparian, and wetland habitats within and upstream of the Delta would enhance anadromous and Bay-Delta native fish populations.

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Water Supply Reliability—This alternative would reduce water supply reliability because of added demands on water for fish and fish habitat. This reduction would be partially offset by improvements in levee stability in the Delta and long-term drought contingency planning. Core actions involving water transfers, long-term planning and management, and integrated land-use and water supply planning would help to limit the reduction in reliability of the water supply.

Water Quality—Key actions provide for major improvement in water quality in the Bay-Delta and rivers through implementing source controls and regulations for pollutants in agricultural drainage, urban and wastewater discharge, dredged material, and mine drainage, and through restoration of wetland habitats. These actions along with core actions that would make modest efforts to manage would be sufficient to alleviate many existing water quality problems.

System Reliability—This preliminary alternative achieves considerable improvements in system reliability through the implementation of key and core actions. Moderate levels of maintaining and stabilizing high priority levees, modifying agricultural practices to reduce subsidence, implementing levee maintenance standards, and providing funding for levee maintenance and stabilization would provide for moderate improvements in reliability.

ALTERNATIVE 341 ACTIONS

SPECIFIC ACTION PACKAGE

1--Restoration of Delta Shallow Water Habitat
1.1--Convert existing leveed lands to tidal action - maximum reasonable level
1.2--Protect existing shallow water habitat from erosion - maximum reasonable level
1.3--Restore tidal action to existing diked wetlands - maximum reasonable level
1.4--Reconstruct levees to include shallow water habitat - maximum reasonable level
1.5--Fill deep water to produce shallow water habitat - maximum reasonable level

2--Restoration of Delta Riverine Habitat
2.1--Reconstruct river banks and shallow areas - maximum reasonable level
2.2--Restore/preserve channel islands - maximum reasonable level
2.3--Restore natural channel configuration - maximum reasonable level
2.4--Modify maintenance designs to include riverine elements - maximum reasonable level

3--Restoration of Delta Riparian Habitat
3.1--Improve and protect degraded riparian habitats - maximum reasonable level
3.2--Establish new areas of riparian habitat - maximum reasonable level
3.3--Reestablish historic riparian areas - maximum reasonable level
3.4--Modify levee maintenance practices - maximum reasonable level
3.5--Protect existing riparian habitat - maximum reasonable level

4--Restoration of Delta Wetland Habitat
4.1--Enhance existing wetlands - moderate level
4.2--Expand wetland acquisition programs - moderate level
4.3--Convert agricultural lands to wetlands - modest level
4.4--Protect existing wetland habitat - moderate level

5--Restoration of Delta Terrestrial Habitat
5.1--Protect existing upland habitat - modest level
5.2--Establish upland habitat - modest level
5.3--Preserve the habitat values of agricultural land uses - modest level
5.4--Clean-up sites containing toxic substances - maximum reasonable level

6--Establishment of Floodways and Meander Belts
6.1--Relocate levees to widen floodways - maximum reasonable level
6.2--Allow river channels to meander - maximum reasonable level
6.4--Restore floodways as habitat corridors - maximum reasonable level

7--Control of Introduced/Nuisance Species
7.1--Remove or reduce nuisance species in key habitats - maximum reasonable level
7.4--Inspect for invasion of nuisance species - maximum reasonable level
7.5--Modify habitat to favor native species - maximum reasonable level

9--Restoration of Upstream Anadromous Fish Habitat
9.1--Manage flows and temperatures in upstream habitats - maximum reasonable level
9.2--Restore and replenish spawning gravels - maximum reasonable level
9.3--Restore channel configuration - maximum reasonable level
9.4--Restore shoreline habitat conditions - maximum reasonable level
9.6--Improve floodway drainage to reduce fish stranding - maximum reasonable level