APPENDIX P

APPENDIX P - REFINEMENT PROCESS TO PRODUCE PRELIMINARY PHASE II ALTERNATIVES

The CALFED Bay-Delta Program is in the process of developing and refining alternative solutions to problems of the Bay-Delta system. Previously, the Program narrowed the range of solutions to ten refined alternatives which were recently the focus of attention in a formal Scoping process. At the same time, staff of the Bay-Delta Program worked with CALFED agencies to evaluate the ten alternatives against solution principles. Both of these processes suggested a modification in the structure of alternatives. The ten alternatives varied in the level of effort applied to actions related to ecosystem quality, water quality, system vulnerability, and water use efficiency. We have now concluded that it may be more appropriate to include each of these as a common program that is essentially the same across a range of alternatives. This range of alternatives would thus be defined by variations in the remaining components that form parts of the alternatives, related to Delta conveyance and water storage.

The scoping comments, evaluations, and reasoning that led to this change in the structure of alternatives are summarized below.

STRUCTURE OF TEN ALTERNATIVES

All of the draft alternatives developed by the Program, including the initial set of 20 and the refined set of ten, were structured to include a varying level of effort applied to certain components of the alternatives. Levels of effort characterized as *modest*, *moderate*, or *extensive* were applied to many of the components. This approach was used originally in order to provide a range of solution alternatives, and to offer a rough level of equity meeting different objectives within each alternative.

The information package for Workshop 6 categorized actions into 20 components within the four resource areas of water supply, water quality, ecosystem quality, and system vulnerability. This structure can be simplified by forming larger components. Using this approach, the ten alternatives can be described as including components related to ecosystem quality, water quality, system vulnerability, water use efficiency, Delta conveyance, and water storage. Each alternative also includes the same set of core actions. The first four components vary principally in the level of effort applied. The two components that include distinctly different approaches among the alternatives are Delta conveyance and water storage.

ISSUES FROM SCOPING

During April and May the Program conducted nine scoping meetings around the state, a workshop in Sacramento, and a meeting of the Bay-Delta Advisory Council. The comments received during scoping cover a wide range of technical, policy, and financial concerns (as described in *Scoping Comment Summary* section). Some of the comments prompted consideration of modifying the structure and presentation of the alternatives. These comments led to the conclusion that several components in the alternatives might be more appropriately treated as programs that must be included in all the alternatives. Some of these comments and our conclusions are:

The best possible source water quality is of paramount importance to urban water suppliers.

Agencies that deliver drinking water are very concerned about the cost of meeting future drinking water quality standards, as well as the technical challenges associated with treating source water of degraded quality. This suggests strong pollutant source control measures in every alternative.

Delta levees will be needed to protect agriculture, infrastructure, and habitat no matter how water is conveyed in the Delta.

Delta levees protect many values including farms, habitat, infrastructure, and Delta water quality. Even if a new conveyance facility is built that protects water quality for some export users, adequate levee integrity will still be required to protect water quality and many other values in the Delta. This argues for a similar level of Delta levee protection in each alternative.

Ecosystem actions at the modest and perhaps the moderate level appear inadequate; the Program needs a single coherent vision of ecosystem restoration.

The restoration of ecosystem functions and the recovery of Bay-Delta species will likely require diverse actions that will be extensive in scope. There is really no alternative to a single comprehensive plan for restoring ecosystem health. Adaptive management will be vital in guiding efforts to improve ecosystem quality. It is this adaptive management that will provide the needed flexibility in the ecosystem restoration program.

Water use efficiency must be strongly pursued in all the alternatives.

This suggests that water use efficiency measures should be implemented at an increased

level among all the alternatives, where previously some alternatives included efficiency at modest or moderate levels.

Alternative A, Extensive Demand Management, is the one draft alternative that relied principally on water use efficiency to balance supply and demand. While there was great concern expressed that Alternative A may have gone too far and used some improper approaches, it was generally agreed that a high level of water use efficiency is essential.

Water use efficiency is not the only component of the alternatives that will help meet water supply objectives; conveyance and storage components will also play an important role. In any alternative, these three components will need to be developed to complement each other. Thus, alternatives may take a common *approach* to water use efficiency but the level of effort may vary among the alternatives. The water use efficiency component must also be flexible in order to accommodate differences in local conditions and local needs.

In response to comments such as these, some components of the alternatives can be viewed in a different way. Water use efficiency, water quality, system vulnerability, and ecosystem quality could be viewed as *programs* that are present in all the alternatives, and are composed of a series of actions that are implemented incrementally over time.

The remaining components, Delta conveyance and water storage, include the approaches that could vary by alternative. Distinctly different alternatives that cover the range represented by the ten draft alternatives could be formed by combining the four common programs with the two variable components. This general concept was confirmed by application of Solution Principles for alternative refinement and evaluation.

ALTERNATIVE REFINEMENT AND EVALUATION AGAINST SOLUTION PRINCIPLES

The next activity for the Program included additional refinement of alternatives, leading to selection of a set of Phase II alternatives that is large enough to offer a reasonable range of solutions while small enough to allow for detailed analysis. Application of the Solution Principles to the ten draft alternatives provided for alternative refinement and consolidation.

The refinement and consolidation of the ten alternatives proceeded according to these steps:

(1.) Review how each alternative satisfies the Mission Statement and Objectives.

(2.) Review input from CALFED, BDAC, scoping meetings, workshops, stakeholders, and the public on each alternative.

(3.) Evaluate and document how well each alternative satisfies each Solution

Principle.

(4.) Determine potential ways to modify each alternative to improve any "low" Solution Principle ratings.

(5.) Verify that the alternative, if revised, would still meet the Objectives and the other Solution Principles.

(6.) Review the alternatives and potential modifications to identify improved alternatives.

(7.) Merge similar improved alternatives into a single alternative.

Staff from CALFED agencies and the Program team evaluated alternatives against Solution Principles. As the detailed Solution Principles were applied to the ten alternatives, and modifications were devised to improve "low" Solution Principle ratings, a pattern emerged. The results confirmed that the set of Phase II alternatives could be defined by combining the four common programs with the two variable components.

The results of the evaluation against Solution Principles are summarized below. Each alternative was evaluated against each solution principle, but the summary focuses on the solution principle evaluations that led to modifications in the alternatives.

- **Alternative A, Extensive Demand Management.** The extensive land retirement proposed in this alternative would not adequately reduce conflicts in the system or be equitable. The secondary costs of land retirement would reduce affordability. These shortcomings would make the alternative less implementable. A water use efficiency program that is flexible and complementary to other water supply components in the alternative would meet solution principles better. Modest levels of pollutant source control and habitat restoration may be insufficient to reduce conflicts in the system, achieve equity or durability. The approach of Alternative A, reliance on existing Delta conveyance and extensive demand management, is reflected in the new Alternative 1, and in the strong water use efficiency component that is a part of all preliminary Phase II alternatives.

- **Alternative B, New Storage to Improve Delta Outflow.** The storage proposed in this alternative may not be used to full benefit if conveyance constraints continue to exist in the Delta. Reduced cost-effectiveness of storage makes the alternative less affordable. An appropriate approach to analysis would include consideration of a range of storage options with each option for Delta conveyance. The approach of Alternative B, reliance on existing Delta conveyance and new water storage, is reflected in the new Alternative 1, which includes the variable water storage component.

- **Alternative C, Dual Delta Conveyance.** This alternative meets solution

principles well. Evaluation of a broad range of conveyance capacities would ensure that a dual system had optimal flexibility to manage the Bay-Delta system to meet objectives for ecosystem quality, water quality, and water supply reliability. This will help to reduce conflicts, avoid redirected impacts, and make the alternative more equitable and durable. Alternative C is reflected in the new Alternative 3.

- **Alternative D, Through Delta Conveyance.** This alternative, like several others, includes moderate levels of habitat restoration, pollutant source control, and levee stabilization. In every alternative that includes these moderate efforts, an increased level of effort may help to reduce conflicts and increase durability, equity, and implementability. A higher level of effort may reduce affordability, but this cannot be determined with certainty until financing plans are developed later in the process. The approach of Alternative D, conveyance through modified Delta channels, is reflected in the new Alternative 2, including its common programs for ecosystem restoration, water quality, and system integrity.

- **Alternative E, Delta Channel Habitat and Conveyance.** The conveyance improvements proposed in this alternative would reduce conveyance constraints in the Delta, but this alternative includes no new storage to contribute to water supply reliability or flexibility. The resulting reduced cost-effectiveness of conveyance makes the alternative less affordable. An appropriate approach to analysis would include consideration of a range of storage options with each option for Delta conveyance. Alternative E, conveyance through extensively modified Delta channels, is reflected in the new Alternative 2, including its common programs for ecosystem restoration, water quality, and system integrity.

- **Alternative F, Extensive Habitat Restoration with Storage.** This alternative relies on restoration of ecosystem functions to improve both ecosystem quality and water supply reliability. The alternative does a good job of meeting ecosystem quality objectives but there is uncertainty over the extent to which it would meet objectives for water supply reliability. Inclusion of additional storage or conveyance elements would reduce conflicts, increase equity, durability, and implementability, and avoid redirection of impacts. This alternative is reflected in the new Alternative 1, and its approach to ecosystem restoration is reflected in the common program for ecosystem restoration that is included in all the preliminary Phase II alternatives.

- **Alternative G, East Side Foothills Conveyance.** The extensive conveyance facilities proposed in this alternative would reduce conveyance constraints in the Delta, but the affordability or cost-effectiveness may be low because the alternative includes little new storage to contribute to water supply reliability or flexibility. In addition, many of the benefits of the east side foothills conveyance can be achieved with optional features of a less extensive isolated conveyance facility such as spur lines that provide opportunities to offset releases from San

Joaquin tributary reservoirs for environmental purposes. These elements are reflected in the new Alternative 3, along with a variable storage component that may improve reliability and flexibility.

- **Alternative H, Chain of Lakes Conveyance.** The unique feature of this alternative is a combined isolated conveyance and storage facility through the Delta. This approach could satisfy the solution principles, but it may be possible to meet the program objectives to the same or a greater extent with a different approach that is more affordable, does more to reduce conflicts, and better avoids redirected impacts. The in-Delta storage of this alternative will be evaluated as part of the storage variable component, and the conveyance will be evaluated as one option for the conveyance in new Alternative 3.

- **Alternative I, West Side Conveyance and River Restoration.** The new conveyance and storage facilities in this alternative are so extensive that it may have low affordability and implementability. The magnitude of the alternative may work against its ability to reduce conflict or avoid significant redirected impacts. Many of the benefits of the alternative could be achieved by including selected elements in an alternative of reduced magnitude. Some of the reduced magnitude elements will be evaluated as options in new Alternative 3 including the variable storage component and optional conveyance facilities.

- **Alternative J, East Side Conveyance.** This alternative fully isolates a conveyance facility from Delta channels, diverging entirely from the concept of a common Delta pool and perhaps reducing flexibility. (The common pool concept suggests the Delta provides a common source of fresh water supply for all Delta water and that users of the common pool will share in the benefits and problems of maintenance and protection of the fresh water supply in the Delta). Diverging entirely from the common Delta pool concept may result in lower implementability, durability, and equity. Strong assurances would be needed to ensure that the facility reduced conflict and did not redirect impacts. An alternative that includes partial, rather than full, isolation may achieve comparable benefits while better satisfying solution principles. Alternative J is reflected in the new Alternative 3, a dual facility that will be analyzed at a wide range of conveyance capacities.

IMPLICATIONS FOR PROGRAM DIRECTION AND ALTERNATIVE STRUCTURE

As a result of comments received in scoping, and the evaluation of alternatives against Solution Principles, each of the preliminary Phase II alternatives includes two parts. The first part of each alternative consists of variable components related to water storage and Delta conveyance. This part of the alternative also addresses increased opportunities for water transfers that result from storage and conveyance. The second part of each alternative contains certain uniform

components or common programs related to **water use efficiency, water quality, system vulnerability, and ecosystem quality**. The core actions identified earlier in the program are also part of these uniform components. Components in this second part of each alternative are really programs that consist of actions or projects which are initiated in the first stage of implementation of the alternative, with continued implementation over time. As a result, the preliminary Phase II alternatives may be portrayed most clearly not as a discrete list of alternatives but rather as a matrix of the variable components combined with a set of relatively uniform common programs.

The array of alternatives evaluated during Phase II may be portrayed using the matrix format shown below:

POTENTIAL PHASE II ALTERNATIVES MATRIX			
	Alternative 1	Alternative 2	Alternative 3
Conveyance Component:	Existing	Through Delta Modification	Dual System
Storage Component (Evaluated for Each Alternative):			
Common Programs (Including Core Actions):	Water Use Efficiency Program		
	Ecosystem Restoration Program		
	System Integrity Program		
	Water Quality Program		

PRELIMINARY PHASE II ALTERNATIVES

Although the common programs would be very similar in each alternative, there would be some differences in the details of the common programs in order to complement the variable components of the particular alternative. For instance, the ecosystem restoration component of each alternative might include restoration of shallow water habitat in the Delta. If an alternative continued to rely on exports from the existing south Delta pumping plants, then shallow water habitat might not be located in the south Delta where fish would be vulnerable to entrainment, but would be located elsewhere. Among the common programs, the water use efficiency common program will need to be particularly flexible because it will be closely tied to the variable conveyance and storage components and the opportunities for water transfers. Still, the goal of the water use efficiency common program would remain the same across all the alternatives.

Many actions, including ranges of implementation level, were described in the ten alternatives. These actions provide the basic framework of the components, but should not be considered final

or definitive. Refinement of all the components, including the common programs, will continue well into Phase II of the Program. This refinement will include determination of both the level of effort and the specific combination of actions included in each component, as well as preliminary site evaluation.

An approach that uses common programs combined with variable components offers several advantages. The common programs offer consistent solutions to problems in several resource areas where this seems appropriate. At the same time, these common programs will greatly reduce the complexity involved in modeling the alternatives and comparing the Phase II alternatives. Common programs that are implemented incrementally over time offer the flexibility to apply adaptive management and the opportunity to make actions more affordable by financing costs over a period of time. The alternatives, common programs and variable storage component are described below.

Preliminary Phase II Alternatives

Introduction

As described in the previous section, *Refinement Process to Produce Preliminary Phase II Alternatives*, the scoping process and the alternative refinement and evaluation against solution principles led to a simplified structure for the alternatives. Each alternative includes the same set of core actions and four common programs related to water use efficiency, water quality, system integrity, and ecosystem quality. Delta conveyance and water storage provide the primary differences between alternatives.

Each alternative will be comprised of a different configuration of Delta conveyance, supported by the core actions and common programs. Storage, in a variety of sizes and combinations, will be studied to determine the combination of conveyance and storage which meets the Program objectives at the highest and most cost effective level for each alternative.

The initial results of scoping, agency review, and solution principle evaluation has resulted in three primary Delta conveyance configurations (alternatives):

(1.) Existing System Conveyance where little or no modifications are made to the flow capacity of the existing Delta channels
(2.) Through Delta Conveyance where a variety of modifications to Delta channels could be made to increase the conveyance efficiency
(3.) Dual Delta Conveyance where a combination of improved through Delta conveyance and conveyance isolated from Delta channels is used

The evaluations for the Dual Delta Conveyance (Alternative 3) will include extensive study of the isolated conveyance portion to find an optimal range of combined through Delta and isolated conveyance for this alternative. For the purpose of this workshop packet, a dual conveyance subcomponent which has sufficient isolated conveyance capacity so as to be a functional equivalent of a fully isolated facility is included. This subcomponent would be subject to further analysis during the CEQA/NEPA review and more informed evaluation against the solution principles to determine whether that concept can satisfy those criteria.

The Program team has prepared draft alternatives for the Existing System Conveyance, Through Delta Conveyance, and the Dual Delta Conveyance (with a broad range of isolated conveyance sizes) for your review. We are particularly interested in your thoughts on whether the use of these three presents a broad enough range of alternatives to insure compliance with the CEQA/NEPA requirement to examine a wide spectrum of alternatives.

Some Guiding Assumptions

During the last year the CALFED Bay-Delta Program has worked to identify problems, define objectives, and develop comprehensive alternatives to solve problems of the Bay-Delta system. The program mission, objectives, and solution principles have guided the development of these alternatives, and will continue to guide us in the further refinement of alternatives during Phase II of the program.

As we have studied the hydrology and biology of the system, and as we have talked with stakeholders including individuals and organized groups, we have developed some fundamental assumptions about the Bay-Delta and the effects that our actions may have on the system. These assumptions are embodied in the preliminary Phase II alternatives. The assumptions will be studied and tested during Phase II to further our understanding of them, but the success of any comprehensive solution to problems of the Bay-Delta rests largely on the basic validity of these assumptions.

First, we assume that the importance of a unit of water in the system is not fixed, but varies according to the flow rate, the time of year, and the water year type. Thus, it is possible to increase diversion and storage of water during some high flow periods (while preserving peak flows that serve important functions in the system) in order to provide water supply for beneficial uses including ecosystem restoration. Some of this stored water can be used to augment outflow during dry years when there is keen competition for water. At these times water operations have their greatest impact on the ecosystem, and additional water is most needed by Bay-Delta species. In short, water can be diverted during high flow periods with relatively little impact on the system, and can be released at other times to produce great benefit to the system.

Second, we assume that a comprehensive program of ecosystem restoration will result in the improvement of ecosystem functions and the recovery of Bay-Delta species that are currently threatened, endangered, or of special concern. In addition to restoration of physical habitat, our efforts will include improved management of flows that will not only reduce the impacts of diversions on the environment during critical periods but will enhance flows during the periods of time which produce the greatest benefits to ecosystem health. We assume that this approach which combines physical habitat improvements with enhanced flows will result in fewer constraints on the operation of water supply systems.

These assumptions lead us to conclude that we can improve conditions for water users and the environment simultaneously, reducing conflict and achieving a lasting solution to problems of the Bay-Delta system.

Alternative 1

Conveyance Variable:	**Existing System Conveyance**
Storage Variable:	**North-, South- and/or in-Delta storage** **Conjunctive use/Groundwater Banking** (may include a range between no storage or any combination of these)
Common Programs: (includes core actions)	**Water Use Efficiency Measures** **Water Quality Improvements** **System Integrity** **Ecosystem Restoration**

Conveyance Variable

Continued use of existing Delta conveyance system

This alternative is formed around using the existing Delta channels for conveyance. The channels could continue to be maintained in their current configuration with Delta exports subject to the current permitted south Delta pumping limits. Increasing the permitted capacity of the pumps, for specific windows of time when fishery impacts are lowest, will be investigated in increments up to the full physical capacity of the pumps. The higher permitted capacity may require selective south Delta channel improvements to eliminate high channel velocities under certain flow conditions. This alternative could somewhat reduce fish entrainment losses by decreasing diversions from the Bay-Delta watershed during environmentally sensitive periods when fish are more vulnerable.

Storage Variable

Study combinations of storage and conveyance

Studies during the next phase of the Program will determine what storage, if any, could be beneficial to the alternative when teamed with the conveyance and common programs. Combinations of storage elements in a variety of sizes for each increment of permitted pumping capacity will be studied to determine the combination of conveyance and storage which meets the program objectives at the highest and most cost effective level. See the detailed Storage Component description following the alternatives.

Given the continued conveyance constraints through the Delta with this alternative, new south of Delta surface storage may not be cost effective due to difficulties in filling and making full use of it. However, new south of Delta surface storage (size to be determined; possibly in the range of 0 - 1.0 MAF) may be useful depending on the degree of water saving that can be achieved with the water use efficiency program. New conjunctive use/groundwater banking (size to be determined; possibly in the range of 0- 600 TAF) may prove to be more cost effective. North of Delta storage (size to be determined; possibly in the range of 0 - 1.5 MAF) could be used to manage Delta inflow. In-Delta storage (size to be determined; possibly in the range of 0 - 600 TAF) could provide flexibility for diversions and to enhance environmental flows. More analysis of the benefits, impacts, and technical merits of in-Delta storage will be required during Phase II of the Program.

New storage could enhance existing conveyance

The size, location, and operating criteria for any new surface or groundwater storage will be refined, considering the other components, during studies in the next phase of the Program.

Refine storage size, location, and operations

Operations

The operation of the Delta diversions would remain similar to historical operations. Increasing the permitted capacity of the south Delta pumps would improve operational flexibility by increasing the ability to pump during windows of time which cause the least environmental disruption. Evaluations will be performed by fishery experts to determine the relative importance to the fishery of the various windows of time available for pumping during the year. Pumping operations will be crafted to fit pumping within the windows of least impact to fisheries (e.g., late fall and early winter). Pumping curtailments will be designated for the windows of highest importance to the fishery (e.g., March through June).

Some shift in diversion timing may be possible

Real-time monitoring (although experimental at this time) could be expanded to guide pumping operations, allowing pumping to be curtailed when vulnerable fish are present. This could result in a moderate shift in Delta withdrawals from the March through June period to the fall through mid-winter. Construction of water storage facilities downstream and upstream of the Delta and expanded conjunctive use programs in the San Joaquin Valley and other service areas could greatly increase water management flexibility to convey Delta water to export areas during less environmentally damaging periods, thus avoiding entrainment of vulnerable fish while maintaining the total volume of Delta water use.

Relationship with Other Components

See the descriptions of the four common components (programs) following the alternatives.

Ecosystem Restoration - The implementation of the common program for ecosystem restoration will provide a high level of habitat improvement in the Bay-Delta system. The positioning of new habitat restoration activities would need to consider the continued use of the existing Delta channels and south Delta pumps. New habitat would be located away from the pumps and main conveyance channels to reduce loss of fish.

Avoid new habitat near pumps

Water Quality Improvements - With continued through Delta flow, the current level of water quality for in-Delta uses would be maintained. However, export water quality may be only minimally improved, or even degraded in the absence of remedial measures. Complementary water quality improvements may therefore be desirable. The common water quality program will be crafted to provide the highest achievement of water quality objectives consistent with cost factors considering all beneficial uses. Achieving this high level may require implementing the source control elements of the program near the highest level of the range.

May need additional water quality improvements

System Integrity - While the common program for system integrity will provide a high level of protection for all Delta islands, key islands would need special protection to reduce the vulnerability of water quality for the Delta and Delta exporters. The overall improvements to system integrity will improve flood control in the Delta with special focus on North Delta flood protection needs.

Improve key islands first

Water Use Efficiency - While implementation of the common approach to water use efficiency will substantially reduce the dependence on the Delta for exports, the inherent water diversion limitations with the existing system conveyance will require that water use efficiency measures be pursued at a higher level in this alternative, particularly during drought years (drought fallowing agreements). These conveyance limitations reduce the opportunity to bank water for use during dry periods and the opportunity for water transfers available with other conveyance alternatives.

Need for higher levels of water use efficiency

Potential Benefits, Concerns, and Other Considerations that Need to be Addressed in Phase II

Potential benefits of continued use of the Existing System Conveyance with modified export schedule include:

Little disturbance of existing conditions

- Preserves the common Delta pool
- The continued use of the existing conveyance system creates little need for additional institutional assurances
- Less disturbance of habitat in and adjacent to existing channels
- Avoids impacts to in-Delta terrestrial habitats and existing land uses
- May improve operational flexibility for exports

Potential concerns of continued use of the Existing System Conveyance with modified export schedule include:

Little improvements in benefits

- Fish entrainment at the pumps continues
- Export and in-Delta water quality would not improve over existing conditions
- Fish still drawn into areas where they are subject to delay to migration patterns and predation
- South Delta water quality would not improve over existing conditions
- Dredging to support increased pumping can affect aquatic environments
- Real-time monitoring for fisheries management is currently experimental and requires continued evaluation of effectiveness and therefore may not be useful
- Hydrologic and biologic studies are required to identify criteria (quantity and timing windows) for water diversion into storage
- Does not address total salt load in the San Joaquin Valley, resulting in continued high salinity of agricultural return flows to the San Joaquin River

Other considerations include:

- Coordinated CVP/SWP operations could include a "joint point of diversion and use" to allow water pumped by either project to be used by both project users.
- San Joaquin environmental water can be used for pulse

flows for fish transport or diluting poor quality flows.

- Investigate the feasibility of wheeling and exchanging water to augment San Joaquin River flows.
- Determine institutional needs to implement long-term drought planning programs.
- Determine institutional requirements for amending California Water Codes to facilitate water transfer procedures.
- Evaluate the use of a Delta central planning institution to manage inflows, transfers, export operations, and outflows.

Potential Sequencing

Core actions

Stage 1. Implementation would begin with the core actions. The core actions include the portions of the common programs (water use efficiency, water quality improvements, system integrity, and ecosystem restoration) that qualify for early implementation.

Most beneficial portions of common programs

Stage 2. Actions implemented during Stage 2 of this alternative would include modest levels of the four common programs (water use efficiency, water quality improvements, system integrity, and ecosystem restoration). Since these are programs that will be funded over many years, they will be prioritized so actions yielding the highest benefit are implemented early. Dredging to maintain channels would be included in Stage 2.

Higher levels of common programs

Stage 3. The third stage would include moderate levels of the four common programs based on prioritization of benefits. This stage would also include selective channel improvements (if included) with corresponding increases in permitted pumping capacity. Storage (if included) would be constructed.

Highest levels of common programs

Stage 4. The fourth stage will include the most aggressive levels of the four common programs based on prioritization of benefits.

Alternative 2

Conveyance Variable:	**Through Delta Conveyance**
Storage Variable:	**North-, South- and/or in-Delta storage** **Conjunctive use/Groundwater Banking** (may include a range between no storage or any combination of these)
Common Programs: (includes core actions)	**Water Use Efficiency Measures** **Water Quality Improvements** **System Integrity** **Ecosystem Restoration**

Conveyance Variable

This alternative is formed around physical modification of Delta channels to support continued conveyance through the Delta from north to south. A new screened or unscreened diversion from the Sacramento River along with channel modifications will increase flow capacity and decrease flow velocity. The diversion will be studied for the general reach between Georgiana Slough and Hood. Channels could be widened and/or deepened to improve flow conditions (size to be determined).

Improved conveyance across Delta from north to south

The channel improvements could be designed to provide corridors of habitat along selected channels. Studies will be made to determine the placement of habitat corridors and whether they should be included along channels intended for conveyance. Setback levees could provide restored shaded riverine aquatic habitat, shallow water habitat, as well as increased water conveyance and flood protection.

Incorporate habitat

The magnitude of the improvements will be studied during Phase II but may vary from selective channel improvements that reduce hydraulic constraints, to extensive reconfiguration with wide habitat and flow corridors. The size and configuration of the channel improvements will be determined by biological and hydrologic studies, considering the other components of the program. The width of setbacks needed to provide optimum benefits for ecosystem quality and water supply still needs to be determined. If standard setbacks are inadequate, the conversion of islands into tidally influenced habitat will be studied to determine its technical

Optional conveyance configurations could include extensive land conversion to habitat uses

feasibility and cost effectiveness.

Setback levees might reduce the impact of the south Delta diversions on fish populations by reducing channel velocities toward those diversions and providing attractive habitat for fish. The potential for continued entrainment will be studied in the next phase of the Program. A full range of through Delta conveyance options will be studied, including both screened and unscreened diversions from the Sacramento River near Hood, near Locke, through Andrus Island, and from the San Joaquin River near its confluence with Old and Middle Rivers. The studies will include evaluation of potential reductions in carriage water (additional flows released during export periods to ensure maintenance of water quality standards and assist with maintaining natural outflow patterns in Delta channels) during dry and critical years.

Refine with studies

Storage Variable

Studies during the next phase of the Program will determine what storage, if any, could be beneficial to the alternative when teamed with the conveyance and common programs. Combinations of storage elements in a variety of sizes for each increment of through Delta conveyance improvement will be studied to determine the combination of conveyance and storage which meets the program objectives at the highest and most cost effective level. See the detailed Storage Component description following the alternatives.

Study combinations of storage and conveyance

New south of Delta surface storage (size to be determined; possibly in the range of 0 - 1.5 MAF) may be useful in modifying timing of Delta diversions. New conjunctive use/groundwater banking (size to be determined; possibly in the range of 0- 500 TAF) could work well to enhance the effectiveness of the water use efficiency program. North of Delta storage (size to be determined; possibly in the range of 0 - 1.5 MAF) could be used to manage Delta inflow. In-Delta storage (size to be determined; possibly in the range of 0 - 600 TAF) could provide flexibility for diversions and enhance environmental flows. More analysis of the benefits and impacts of in-Delta storage is needed.

New storage could enhance through Delta conveyance

The size, location, and operating criteria for any new surface or groundwater storage will be refined, considering the other components, during studies in the next phase of the Program.

Refine storage size, location, and operations

Operations

The permitted capacity of existing export pumps could be expanded to their full physical capacity, but only during windows when fish are less vulnerable. Evaluations will be performed by fishery experts to determine the relative importance to the fishery of the various windows of time available for pumping during the year. Pumping operations will be crafted to fit pumping within the windows of least impact to fisheries (e.g., late fall and early winter). Pumping curtailments will be designated for the windows of highest importance to the fishery (e.g., March through June). Real-time monitoring (although experimental at this time) could be expanded to guide pumping operations, allowing pumping to be curtailed when vulnerable fish are present. This could result in a moderate shift in Delta withdrawals from the March through June period to the fall through mid-winter. Construction of water storage facilities downstream and upstream of the Delta and expanded conjunctive use programs in the San Joaquin Valley and other service areas could greatly increase water management flexibility to convey Delta water to export areas during less environmentally damaging periods (e.g., late fall and early winter), thus avoiding entrainment of vulnerable fish while maintaining the total volume of Delta water use.

Moderately shift Delta withdrawals to the fall through mid-winter

Diverting water from the Sacramento River and conveying it through the Delta would require development of new standards to ensure continued protection of the Bay-Delta ecosystem. The existing standards related to export ratios and salinity, and requirements for carriage water, will need to be re-evaluated with the development of these new facilities to ensure a necessary level of protections for the ecosystem.

Withdrawals from the Delta would continue to rely on existing facilities (with potential modifications of existing screening facilities and/or new screens on the Sacramento River). As described above, Delta withdrawals could be shifted away from the March through June period to the extent possible by using existing storage and new storage (if any) downstream of the Delta. The shift in Delta withdrawal timing would reduce impacts associated with Delta exports. Improved channel capacities in the north and south Delta would improve efficient water movement across the Delta.

Continue exports from south Delta

Average and Wetter Year Operation

- North of Delta storage could be filled during the receding limb of peak flood hydrographs and released as needed to meet downstream needs. South of Delta storage could be filled with withdrawals from the Delta during the receding limb of peak flood hydrographs. Water stored in this

manner could offset pumping during the spring and summer period to reduce Delta withdrawals and impacts to Delta fisheries.

- Using timing shifts allowed by meeting consumptive demand from south of Delta storage, Delta withdrawals could be moderately reduced in the March through June period. During average and wetter water years the reduced withdrawals may result in increased Delta outflow by a similar amount during the March through June period.

Dry and Critical Year Operation

- Conjunctive use programs, groundwater banking, and drought year land conversion agreements developed in the San Joaquin Valley could be used to offset Delta withdrawals for export and increase Delta outflow in the March through June period.

Relationship with Other Components

See the descriptions of the four common components (programs) following the alternatives.

Ecosystem restoration coordinated with other improvements

Ecosystem Restoration - The implementation of the common program for ecosystem restoration will provide a high level of habitat improvement in the Bay-Delta system. Setback levees, island flooding, and large conveyance corridors can be physically configured to implement desired ecosystem restoration strategies. For example, a setback levee could be constructed with a vegetated water side slope and a gradually sloping water side bench to create shallow riverine, riparian and upland habitats.

Water quality improvements

Water Quality Improvements - With continued through Delta flow, the current level of water quality for in-Delta uses would be maintained or improved. However, export water quality may be only minimally improved, or even degraded in the absence of remedial measures. Complementary water quality improvements may therefore be desirable. The common water quality program will be crafted to provide the highest achievement of water quality objectives consistent with cost factors considering all beneficial uses. Achieving this high level may require implementing the source control elements of the program near the highest level of the range.

System integrity coordinated with other

System Integrity - While the common program for system integrity will provide a high level of protection for all Delta islands, key islands would need special protection to reduce the vulnerability of water quality and

conveyance for the Delta and Delta exporters. The overall improvements to system integrity will improve flood control in the Delta with special focus on North Delta flood protection needs.

improvements

Water Use Efficiency - Water use efficiency programs will be developed to complement the storage and conveyance components of the alternative. Implementation of the common water use efficiency program will substantially reduce the dependence on the Delta for exports. The through Delta improvements should improve the opportunities to transfer conserved water to environmental and supply uses.

Water use efficiency improved

Potential Benefits, Concerns, and Other Considerations that Need to be Addressed in Phase II

Potential benefits of Through Delta Conveyance include:

- Improved operational flexibility such as ability to shift timing of diversions to protect fisheries, increase supply opportunities, transfers, and wet year diversions
- Preserves the common Delta pool
- May reduce entrainment effects of existing export facilities on fish
- Improves fishery habitat
- May improve export water quality, especially at certain times of the year
- May improve in-Delta water quality
- May reduce carriage water losses in critical years thereby benefitting water supply
- Creates a more efficient method of transferring water to export pumps.

Preserves common Delta pool while reducing conflicts

Potential concerns of Through Delta Conveyance include:

- Habitat corridors combined with conveyance channels may adversely impact fish entrainment
- Real-time monitoring for fisheries management is currently experimental and requires continued evaluation of effectiveness and therefore may not be useful
- Hydrologic and biologic studies are required to identify criteria (quantity and timing windows) for water diversion into storage
- Depending on the type of improvements chosen, a

through Delta facility may have temporary construction impacts on aquatic environments due to dredging

Many studies required

- Setback levees may have long-term impacts on terrestrial habitats and on agricultural land uses
- Screened diversion on the Sacramento could expose a higher number of migrating salmon to screening impacts
- Diversion on the Sacramento River downstream of the City of Sacramento would be within native fish critical habitat
- Screened diversions on the Sacramento River may be subject to periodic shutdowns when critical fish populations are determined to be present in the area of the screens
- There are significant technical challenges to overcome in designing an efficient screening system for diversions over 3,000 cfs
- Total Delta outflow may be reduced, though outflow during important periods is increased
- Implementing a through Delta facility, which utilizes very wide channels and low velocities may require large conversions of agriculture land to aquatic environments
- May only partially address total salt load in the San Joaquin Valley, resulting in continued high salinity of agricultural return flows to the San Joaquin River

Other considerations include:

- Coordinated CVP/SWP operations could include a "joint point of diversion and use" to allow water pumped by either project to be used by both project users.
- Increased pumping capacity at CVP/SWP south Delta facilities will be guided by real-time monitoring programs.
- San Joaquin environmental water can be used for pulse flows for fish transport or diluting poor quality flows.
- Investigate the feasibility of wheeling and exchanging water to augment Jan Joaquin River flows.
- Determine institutional needs to implement long-term drought planning programs.
- Determine institutional requirements for amending California Water Codes to facilitate water transfer procedures.
- Evaluate the use of a Delta central planning institution to manage inflows, transfers, export operations, and outflows.

- An alternative formulation consisting of a screened diversion near Andrus Island and crossing the island to Georgiana Slough, then across Tyler Island to the Mokelumne River will be investigated. This information would include pumped releases at Georgiana Slough that would establish a hydraulic barrier to fish migration.

Potential Sequencing

Core actions

Stage 1. Implementation would begin with the core actions. The core actions include the portions of the common programs (water use efficiency, water quality improvements, system integrity, and ecosystem restoration) that qualify for early implementation.

Most beneficial portions of common programs

Stage 2. The second stage of implementing this alternative will begin channel improvements and provide modest levels of the four common programs (water use efficiency, water quality improvements, system integrity, and ecosystem restoration). Since these are programs that will be funded over many years, they will be prioritized so actions yielding the highest benefit are implemented early.

Higher levels of common programs

Stage 3. The third stage will include additional channel improvements and moderate levels of the four common programs based on prioritization of benefits. This stage would also include the diversion screen (if included) and channel improvements with corresponding increases in permitted pumping capacity. Storage (if included) would be constructed.

Highest levels of common programs

Stage 4. This stage will complete the channel improvements and include the most aggressive levels of the four common programs based on cost-effectiveness.

Alternative 3

Conveyance Variable:	**Dual Delta Conveyance**
Storage Variable:	**North-, South- and/or in-Delta storage** **Conjunctive use/Groundwater Banking** (may include a range between no storage or any combination of these)
Common Programs: (includes core actions)	**Water Use Efficiency Measures** **Water Quality Improvements** **System Integrity** **Ecosystem Restoration**

Conveyance Variable

This Dual Delta Conveyance alternative is formed around a combination of improved though Delta conveyance and new isolated conveyance. It could include a new screened diversion facility on the Sacramento River between Hood and Freeport. This diversion facility could supply a new small isolated conveyance facility to transport water around the east side of the Delta to the existing south Delta pumping plants. The new screened diversion facility may also supply water for continued through-Delta conveyance.

New conveyance improves reliability, flow conditions, water quality

The new dual diversion facility on the Sacramento River could be equipped with state-of-the-art fish screens to minimize entrainment of fish. During Phase II, real-time monitoring (consistent with its experimental status at this time) will be evaluated to determine its capacity to shift diversions among multiple intakes and avoid entrainment effects during critical periods. A new canal, isolated from Delta channels, to convey water (with emphasis on the range of 5,000-12,000 cfs) from the new diversion point to the existing Banks and Tracy Pumping Plants will be evaluated along with a combination of storage elements. The sizing analysis to be conducted in Phase II will consider a wide range of capacities and will determine an optimal range of capacities for this alternative. For some of the smaller isolated conveyance capacities, a buried pipeline concept will be evaluated. In addition, a fully isolated conveyance with sufficient capacity to meet the full physical capacity of the State and Federal Projects will be evaluated.

Dual diversion and isolated conveyance protect water quality and fish

Potential to enhance Delta tributary flows

The isolated facility could be sized to supply most Delta export needs during sensitive spring periods and potentially to provide drinking water supplies to some users in Sacramento County, San Joaquin County, and the Bay Area through spur lines. The isolated conveyance facility includes siphons under all important stream courses to prevent disruption of water quality and aquatic habitat values in the streams. Direct connections to water districts served by spur lines could provide opportunities to offset releases from San Joaquin River tributary reservoirs for environmental purposes.

Some through-Delta conveyance continues

The through Delta conveyance capacity could range from use of the existing unaltered channels to channel enlargements by dredging and setback levees. However, since the through Delta conveyance will operate in conjunction with the isolated conveyance, the through Delta channel modifications are not likely to be as extensive as in Alternative 2. For example, selective improvements to north and south Delta channels may be adequate when combined with higher capacities of isolated conveyance. Improvements to north Delta channels could be designed to provide multiple benefits for flood conveyance, habitat restoration, water supply, and south Delta water quality. A variety of actions and operational scenarios will be studied and implemented to address potential adverse effects of salinity in San Joaquin River inflow, to maintain water levels and circulation in south Delta channels, and to reduce recycled salt load to the San Joaquin Valley.

Optional diversion points

A range of diversion points from Hood through Freeport are possible on the Sacramento River below the confluence with the American River. One variation that can be investigated is a screened diversion point upstream of Bryte that utilizes either the Yolo Bypass or the Sacramento Ship Channel to convey water south to Liberty Island and then crosses Ryer and Grand Islands, siphons under the Sacramento River, and rejoins the previously discussed eastern canal alignment. A further variation could include an extension to tie this facility to the Tehema Colusa Canal.

Optional conveyance configurations

Other configurations could include alternate conveyance routings such as the isolated conveyance constructed as a series of flooded islands connected by siphons. The configuration and relative sizes of the isolated and through Delta conveyances will be refined, considering the other components, during the studies in the next phase of the Program. A full range of isolated conveyance capacities and through Delta conveyance options, will be considered.

Storage Variable

Study combinations of storage and conveyance

Studies during the next phase of the Program will determine what storage, if any, could be beneficial to the alternative when teamed with the conveyance and common programs. Combinations of storage elements in a variety of sizes for each through Delta/isolated conveyance will be studied to determine the combination of conveyance and storage which meets the program objectives at the highest and most cost effective level. See the detailed Storage Component description following the alternatives.

New storage could enhance Dual Delta conveyance

New south of Delta surface storage (size to be determined; possibly in the range of 0 - 1.5 MAF) may be useful in changing timing of Delta diversions. New conjunctive use/groundwater banking (size to be determined; possibly in the range of 0- 500 TAF) could work well to enhance the effectiveness of the water use efficiency program. North of Delta storage (size to be determined; possibly in the range of 0 - 3.0 MAF) could be used to manage Delta inflow and to manage instream flows and diversions in the Sacramento River. The storage could be filled using the excess capacity in the Tehama Colusa Canal and the Glenn Colusa Canal. The reservoir(s) could be used to serve the irrigation districts served by these canals to curtail diversions out of the river during more environmentally sensitive periods. The Tehama Colusa Canal could also be extended to serve the North Bay aqueduct and eliminate that Delta diversion. Future extensions of the canal possibly include a direct connection to the isolated facility. In-Delta storage (size to be determined; possibly in the range of 0 - 600 TAF) could provide flexibility for diversions and to enhance environmental flows. More analysis of the benefits and impacts of in-Delta storage is needed.

Refine storage size, location, and operations

The size, location, and operating criteria for any new surface or groundwater storage will be refined, considering the other components, during studies in the next phase of the Program.

Operations

Moderately shift Delta withdrawals to the fall through mid-winter

The dual conveyance will normally operate with some through Delta portion to maintain water circulation in the central and south Delta during critical periods for stage and water quality. Remaining Delta diversions could be carried, depending on conveyance size, by the isolated conveyance.

The permitted capacity of existing export pumps could be expanded to their full physical capacity, but only during windows when fish are less vulnerable. Evaluations will be performed by fishery experts to determine

the relative importance to the fishery of the various windows of time available for pumping during the year. Pumping operations will be crafted to fit pumping within the windows of least impact to fisheries. Pumping curtailments will be designated for the windows of highest importance to the fishery (e.g., March through June). Real-time monitoring could be expanded to guide pumping operations, allowing pumping to be curtailed when vulnerable fish are present. This could result in a moderate shift in Delta withdrawals from the March through June period. Construction of water storage facilities downstream and upstream of the Delta and expanded conjunctive use programs in the San Joaquin Valley and other service areas will greatly increase water management flexibility to convey Delta water during less environmentally damaging periods, thus avoiding entrainment of vulnerable fish while maintaining the total volume of Delta water use.

The configuration of dual Delta conveyance may offer a significant increase in flexibility to divert water while protecting fish from entrainment. With two distinct diversion points, one on the Sacramento River and another in the south Delta, operations can be designed to emphasize use of different diversions at different times according to the presence of vulnerable species near the diversion points.

Re-evaluate standards for protection of Bay-Delta ecosystem

Diverting water from the Sacramento River into the Delta and isolated facility would require development of new standards to ensure continued protection of the Bay-Delta ecosystem. The existing standards related to export ratios and salinity, and requiremenets for carriage water, will need to be re-evaluated with the development of these new facilities to protect the ecosystem from impacts of exporting water to the south of the Delta.

Average and Wetter Year Operation

- The flow through the isolated conveyance will be the increment above that needed to maintain Delta channel stage and water quality. Delta export withdrawals greater than the capacity of the isolated conveyance facility could be conveyed through the improved Delta channels.
- Water transfers could be conveyed through the isolated facility during periods of available capacity and through the Delta. Transfers made in average and wetter years would be stored in either surface or groundwater facilities or made available to end users to meet consumptive demands.

Dry and Critical Year Operation

- A greater portion of the Delta export could be conveyed through the isolated facility to reduce, to the maximum extent possible, impacts to Delta fisheries while balancing needs for Delta channel stage and water quality.
- Conjunctive use programs and groundwater banking developed in the San Joaquin Valley could be used to reduced exports in the spring and summer.
- Opportunities will increase for transferring water through the isolated facility which would be used to satisfy unmet consumptive use demands.

Relationship with Other Components

See the descriptions of the four common components (programs) following the alternatives.

Water quality improvements

Water Quality Improvements -Water Quality for exports could be improved depending on the size of the isolated facility. If the isolated facility was sized similar to the full south Delta pumping capacity, the water quality of exports would be similar to the Sacramento River at the diversion. The export water quality would be a blend of Sacramento River and south Delta water but the water quality of exports would improve over existing conditions. Isolated conveyance operations would reduce the flow of relatively high quality water from the Sacramento River into the central and south Delta. With continued through Delta flow, adequate water quality for in-Delta uses would be maintained. Water quality and stage could be reduced at critical times, adversely affecting Delta water users. Purchase of water on the San Joaquin River system, in-Delta storage, and measures to control stage and quality in the south Delta could offset these effects. A program will be developed to provide the highest water quality considering all beneficial uses.

Ecosystem restoration coordinated with other improvements

Ecosystem Restoration -A major benefit would be achieved by relocating the export diversion from the current south Delta location and adding a state-of-the-art screening facility(s) to reduce diversion effects on fish. The dual conveyance offers increased flexibility to improve fishery benefits, especially if both diversions are screened. For the through Delta modifications setback levees, island flooding, and large conveyance corridors can be physically configured to implement desired ecosystem restoration strategies. For example, existing islands can be reshaped or a setback levee could be constructed with a vegetated water side slope and a gradually sloping water side bench to create shallow riverine, riparian and upland habitats.

System Integrity -The probability of a complete prolonged shutdown of the water projects and local diversions will be greatly reduced with dual conveyance. While the common program for system integrity will provide a high level of protection for all Delta islands, key and/or remaining islands would need special protection to reduce the vulnerability of water quality and conveyance for the Delta and Delta export. The overall improvements to system integrity will improve flood control in the Delta.

System integrity coordinated with other improvements

Water Use Efficiency - Implementation of the common water use efficiency program will substantially reduce the dependence on the Delta for exports. An isolated facility and Delta channel improvements would increase the flexibility to use the conserved water for environmental and supply purposes. There would be greater opportunity to bank water for use during dry periods and greater opportunities to utilize water transfers.

Water use efficiency improved

Potential Benefits, Concerns, and Other Considerations that Need to be Addressed in Phase II

Potential benefits of the Dual Delta Conveyance include:

- Improved operational flexibility such as ability to increase supply opportunities, transfers, and wet year diversions
- Preserves some continued diversion from the common Delta pool
- More flexibility to increase supply while avoiding fishery impacts
- Can improve export water quality, especially at certain critical times of the year
- Can supply water to Bay Area and east of Delta water users, providing opportunities for restoring flows in Delta tributaries
- Reducing the amount of export pumping in the south Delta in combination with moving the diversion point for the balance of exports will reduce entrainment of fish during more vulnerable periods.
- May reduce carriage water losses in critical years thereby benefitting water supply
- May significantly reduce total salt load in the San Joaquin Valley, improving the quality of agricultural return flows to the San Joaquin River

Improved system flexibility

Potential concerns of the Dual Delta Conveyance include:

- Real-time monitoring for fisheries management is currently experimental and requires continued evaluation of effectiveness
- Hydrologic and biologic studies are required to identify criteria (quantity and timing windows) for water diversion into storage
- Could affect central and south Delta water quality
- Channel widening may require agricultural land conversion
- Construction of isolated conveyance facility affects wetland and terrestrial habitats and land uses
- Screened diversion on the Sacramento could expose a higher number of migrating salmon to screening impacts
- Diversion on the Sacramento River downstream of the City of Sacramento would be within native fish critical habitat
- Screened diversions on the Sacramento River may be subject to periodic shutdowns when critical fish populations are determined to be present in the area of the screens
- There are significant technical challenges to overcome in designing an efficient screening system for diversions over 3,000 cf.
- Total Delta outflow may be reduced

Need to evaluate potential adverse effects

Other considerations include:

- Coordinated CVP/SWP operations could include a "joint point of diversion and use" to allow water pumped by either project to be used by both project users.
- San Joaquin environmental water can be used for pulse flows for fish transport or diluting poor quality flows.
- Investigate the feasibility of wheeling and exchanging water to augment Jan Joaquin River flows.
- Determine institutional needs to implement long-term drought planning programs.
- Determine institutional requirements for amending California Water Codes to facilitate water transfer procedures.
- Evaluate the use of a Delta central planning institution to manage inflows, transfers, export operations, and outflows.

- Diversion would be constructed at a location upstream of the Delta such as Hood or Freeport and sited to minimize intrusion into native fish habitat.
- Use best available screening technology on multiple

Need to evaluate many other considerations

intakes and real-time monitoring to minimize fisheries impacts.

- Siphons will carry isolated conveyance facilities beneath existing Delta channels to minimize environmental, water quality, and flood conveyance impacts.
- The feasibility of using a buried aqueduct and multiple intakes needs to be investigated.
- A variation of this alternative will be investigated that would divert water upstream of Bryte and use the Yolo Bypass or the Sacramento Ship Channel for conveyance to the planned isolated facility near Hood or Freeport.
- Potential to exchange water to increase San Joaquin River flows needs to be investigated.
- East-side channel flood control improvements could be investigated, particularly on the lower reaches of the Mokelumne River.

Potential Sequencing

Core actions

Stage 1. Implementation would begin with the core actions. The core actions include the portions of the common programs (water use efficiency, water quality improvements, system integrity, and ecosystem restoration) that qualify for early implementation.

Most beneficial portions of common programs

Stage 2. Actions implemented during Stage 2 of this alternative will include modest levels of the four common programs (water use efficiency, water quality improvements, system integrity, and ecosystem restoration). Since these are programs that will be funded over many years, they will be prioritized so actions yielding the highest benefit are implemented early.

Higher levels of common programs

Stage 3. Stage 3 will consist of constructing the dual diversion facilities on the Sacramento River in the north Delta, the isolated conveyance facility for a portion of Delta exports, and north Delta channel improvements. Moderate levels of the four common programs will be implemented based on prioritization of benefits.

Highest levels of common programs

Stage 4. In Stage 4 downstream water storage (if included) will be constructed to increase capabilities to coordinate Delta water use and shifted upstream reservoir storage operations. Storage upstream of the Delta (if included) will be constructed to maximize flexibility in managing flows through the Delta. The most aggressive levels of the four common programs will be implemented based on prioritization of benefits.

Components of Alternatives

INTRODUCTION

The three Preliminary Phase II Alternatives are formed around different configurations of Delta conveyance. As described earlier, each alternative includes the same set of core actions and four common programs related to **water use efficiency, water quality, system integrity, and ecosystem quality**. Descriptions of each of these four common programs are provided on the following pages for your review. Core actions, included in the common programs, have been included in earlier workshop packets and are not discussed separateley here.

Each alternative could include some combination of storage to support the core actions, common programs, and the Delta conveyance. A description of the variable **storage** component follows descriptions of the common programs.

Water Use Efficiency Measures

Description

The Bay-Delta system provides the water supply for a wide range of instream, riparian, and other beneficial uses. As water use and competition among uses with respect to timing of water availability have increased during the past several decades, conflicts have increased among uses of Delta water which in turn have magnified the impact from natural fluctuations in the hydrologic cycle. Making more efficient use of water is an important way to reduce the mismatch between the available water supply and timing and the combined beneficial needs for that water.

Water use efficiency measures include various programs that seek to reduce the demand for water and increase the reuse of water in the system. These measures include agricultural and urban conservation, water recycling or reclamation, and temporary and long-term land conversion to other uses.

Upstream of the Delta, water use efficiency methods can make water available for other uses and help shift the timing of diversions for reduced impact on fisheries. South of the Delta (in the export area), water use efficiency methods can 1) make water available for other uses, 2) reduce the shortages that typically occur for many water users (environmental and other beneficial users) during extended droughts, 3) reduce diversions at times to provide some increase in Delta outflow, 4) increase the time before new facilities are needed, and 5) potentially allow for smaller sizing of new water facilities.

A number of comments received during scoping have led us to conclude that water use efficiency measures might be treated as a program with an uniform approach for all alternatives. Scoping comments related to water use efficiency include the following:

- Increased water efficiency may lead to hardening of demand (i.e., reducing opportunities for additional water use reductions during shortages), and increase the need for reliability
- Each alternative should have a stronger theme for water use efficiency
- Alternatives should recognize the difference between long-term conservation and shortage measures
- Water use efficiency needs to be preserved as a local implementation item
- There may not be any water use efficiency opportunities for additional reduction in many basins that are already at or near full efficiency
- Water pricing needs to be addressed more explicitly

The water use efficiency program will have a uniform approach for all alternatives that allows local water agencies to make appropriate water management decisions based on local conditions as well as changes in system conveyance and storage. The geographic or physical characteristics of a given alternative will affect how well the program performs. For instance, new storage can modify the operations and extend the effectiveness of water use efficiency.

Even with this uniform approach, the level of implementation could be somewhat different between alternatives. For instance, a higher level of conservation and reclamation may be appropriate with the existing system conveyance compared with the dual Delta Conveyance because of reduced opportunity to deliver Delta water south to the export areas.

The program will consist of actions or projects which are initiated in the first stage of the alternative with continued implementation over time. The program will include the core actions that apply to water use efficiency in the first stage. As implementation progresses, monitoring of effectiveness of the early stages will help refine later stages of implementation. The specific level of implementation will be defined during future phases of the Program by a combination of analyses and policy decisions.

NOTE: A BDAC Water Use Efficiency Work Group is assisting CALFED Program staff in identifying policy issues with respect to water use efficiency implementation. The Work Group will also help to identify techniques which encourage implementation of water use efficiency programs and integrated resource planning at the local level.

Implementation Methods

The following actions and implementation methods are in addition to the core actions. Measures to improve water use efficiency or reduce demand include the following:

Urban Water Conservation Measures such as Best Management Practices (BMPs). Greater urban water use efficiency may be achieved through implementation of BMPs by more municipal/industrial water suppliers and users, or by expanding the BMPs to include additional practices and higher implementation rates, resulting in less water use particularly in areas where the excess water is not returned for beneficial use. The level of implementation of urban water conservation in any alternative will depend on storage and conveyance components of the alternative as well as conditions in particular service areas. For example, increased implementation of municipal and industrial water conservation may be evaluated at a range of 200,000 to 400,000 AF/yr over current implementation commitments.

Agricultural Water Conservation Measures such as Efficient Water Management Practices (EWMPs). Greater agricultural water use efficiency may be achieved through adoption and implementation of EWMPs by agricultural water suppliers and users, and by expanding the EWMPs to include additional practices, resulting in less water use particularly in areas where the excess water is not available for beneficial use (e.g., salt sinks). The level of implementation of agricultural water conservation in any alternative will depend on storage and conveyance components of the alternative as well as conditions in particular service areas. For example, increased implementation of agricultural water conservation may be evaluated at a range of 200,000 to 400,000 AF/yr over current implementation commitments.

Temporary and Long-Term Land Conversion Agricultural water demand could be reduced

through temporary land conversion to other uses or fallowing during drought periods to reduce dry year demand, and through long-term land conversion to make water available for other uses. This program would maximize the potential for temporary land fallowing (such as rotational fallowing) during droughts. An example program may be a Conservation Acreage Reserve Program (land trust) that would offer incentives for voluntary contracts to implement specific, active management practices (minimum irrigation cropping and upland habitat management) for a specific number of years. Most of the water would be used by the local districts that conduct the land management, with increased opportunities for transfers by willing districts. The level of implementation of temporary and long-term land conversion in any alternative will depend on storage, conveyance, and water quality components of the alternative as well as conditions in particular service areas. For example, increased implementation of temporary and long-term land conversion may be evaluated at a range of 1 to 2 MAF/yr through the use of incentives and other programs.

Fallowing and land retirement may have far greater impacts than other ways of reducing use, and these impacts will be carefully considered in the development of a water use efficiency common program.

Water Recycling or Reclamation More efficient use of developed supplies may be achieved through water recycling. Urban wastewater recycling options include recharging groundwater, use for agricultural irrigation, recycling and treating for potable or non-potable urban use, use of grey water, and storage for use in meeting Delta flow standards. Agricultural recycling options include using drainage for irrigation purposes, while maintaining appropriate salt leaching requirements. Reclamation and reuse programs will focus on facilities that currently discharge treated wastewater into salt sinks or other degraded bodies of water. The use of recycled water will increase the overall availability of water and may reduce the amount of Delta exports at times. The level of implementation of water recycling in any alternative will depend on storage and conveyance components of the alternative as well as conditions in particular service areas. For example, increased implementation of water recycling may be evaluated at a range of 0.8 to 1.0 MAF/yr over current implementation commitments.

The water use efficiency component of the CALFED alternatives will need to complement other components intended to meet water supply reliability objectives, including the conveyance and storage components. Although the specifics may vary according to the other components, the approach to implementation may be uniform across all the alternatives. Implementation of the water use efficiency program may be achieved in several ways. Ideally, local and regional water users will carry out integrated resources planning (IRP). This planning will examine all water supply and water use options available to the users. The process will take into consideration existing supplies, new opportunities created by CALFED storage and conveyance components, the cost of existing and new supplies, and the opportunities for water conservation and water recycling.

The best mix of these approaches will be selected to meet local conditions and needs. Other mechanisms may be used to ensure or to increase implementation of water use efficiency

measures. Preferred mechanisms include incentives and disincentives (including economic incentives). Regulatory methods may also be used.

Relationship to Other Components

New Surface Storage, Conjunctive Use/Groundwater Banking - The effectiveness of water use efficiency methods can be enhanced by storage of the saved water for later use. For example, the groundwater banking and conjunctive use programs in Delta export areas such as the San Joaquin Valley and the Tulare lake Basin and in the Sacramento Valley could be expanded.

Through Delta or Dual Conveyance - Improved conveyance to the South Delta export pumps will help move water when it is needed. The opportunity for transfers will be increased, which will provide market incentives for implementation of water use efficiency actions.

Water Quality Improvements - Conversion of certain drainage-affected agricultural lands to other uses may reduce the pollutant load entering the Delta.

Potential Benefits, Concerns, and Other Considerations that Need to be Addressed in Phase II

Potential benefits of the water use efficiency program include:

- Reduces demand for Delta exports and related entrainment effects on fisheries
- Can help in timing of diversions for reduced entrainment effects on fisheries
- Could make water available for transfers
- May delay need (and size) for new water facilities
- May improve overall Delta and tributary water quality
- Could reduce the total salt load to the San Joaquin Valley

Potential concerns of the water use efficiency program include:

- Average year conservation may produce few critical year benefits unless conserved water can be stored
- Land fallowing will need to be structured so as to avoid or mitigate potentially large reductions in agricultural production and severe economic impacts on "third parties" including suppliers, workers and local government
- Conservation may adversely affect downstream water reuse
- Conservation can "harden" water demand, reducing opportunities for additional water use reductions during shortages, and increasing the need for reliability

Other considerations include:

- Emphasis for land retirement will be placed on land which contributes to regional

drainage problems. In-Delta land retirement can reduce diversion effects, assist with actions to control subsidence, and improve water quality.

- Maximize the potential for temporary fallowing (such as rotational fallowing). Land fallowing upstream of the Delta may reduce Delta inflows and may also be available for use in water transfers.
- Reclamation and reuse programs would focus on facilities that currently discharge treated wastewater to salt sinks or other degraded bodies of water which are not reusable.

Water Quality Improvements

Description

The Delta is a source of drinking water for millions of Californians and is critical to the state's agricultural sector. Appropriate water quality and sufficient nutrients are required to maintain the high quality habitat needed in the Bay-Delta system to support a diversity of fish and wildlife populations. Export water users require low salinity levels, and urban suppliers need low nutrient levels to maintain reasonable water treatment costs. A conflict over water quality in the system results from the fact that land uses often do not contribute to good water quality, and ecosystem water quality needs are usually, but not always, compatible with urban and agricultural water quality needs.

Pollutants enter the Delta through a variety of sources, including sewage treatment plant discharges, industrial facility discharges, and runoff from forests, farms and farm fields, mines, residential landscaping, urban streets, and natural sources, such as tidally-induced salinity intrusion into the system. Contaminants enter the system from upstream sources and from sources within the Delta. Natural seawater intrusion, exacerbated by diversion patterns, adds chlorides and bromides to exported supplies, and agricultural drainage adds chlorides and organic carbon. These constituents combine to produce potentially hazardous water treatment byproducts when subjected to municipal water treatment processes. Other constituents contributed by wastewater treatment plant discharges to system tributaries further complicate the pursuit of good raw drinking water quality for urban needs. The practice of drawing higher natural salinities and agricultural drainage to diversion points produces a self perpetuating cycle of increasing volumes of salt in exported water supplies.

The common program for water quality improvement will focus on pollutant source control. Reducing the total pollutant load entering the Delta will provide benefits for all water users. These include improved drinking water quality, reduced salt load for agricultural diversions, and improved water quality for the ecosystem, including reduced toxicity. Additional benefits can also be obtained by timing release of remaining pollutant discharges.

A number of comments received during scoping have led us to conclude that water quality improvements might be treated as a program that is generally uniform among the alternatives. Some of these comments are:

- The alternatives must address the issue of how each will obtain the best source of water for urban needs
- Alternatives should not suggest that the dilution of pollutant elements will satisfy the goal of improving water quality
- Each alternative should address salt and chemical recirculation
- Reduction of pollutants at the source should be a main focus of the Program
- The Program needs to address the San Joaquin drainage issue
- Alternatives must not degrade Delta water quality
- Degradation of water quality as water is transported through the Delta affects the

ability of urban agencies to recycle water
- Disinfection by-products resulting from bromides in Delta water is a concern for urban drinking water quality
- All alternatives must have improved and augmented water quality actions

While the water quality improvement component will be implemented at one comprehensive level for all alternatives, some minor adjustments may be needed depending on geographic or physical characteristics of a given alternative. For instance, the use of Dual Delta Conveyance may require more focus on in-Delta water quality than an alternative with only through-Delta conveyance. Water quality for urban use could also vary depending on the conveyance included with a given alternative. In each alternative, the program will be developed to provide the highest water quality considering all beneficial uses.

The program will consist of actions or projects implemented in stages over time. The program will include the core actions that apply to water quality improvements in the first stage. As implementation progresses, information on effectiveness of the early stages will help refine later stages of implementation. The specific level of funding for implementation will be defined during future phases of the Program by a combination of analyses and policy decisions. The analyses will consider the costs of achieving various pollutant load reductions to the Delta and the costs of treating for drinking water.

NOTE: A water quality technical group is assisting CALFED Program staff in identifying technical issues with respect to water quality implementation.

Implementation Methods

The following implementation methods are in addition to the core actions. Pollutant source control consists of actions to reduce discharges of water quality constituents of concern to aquatic habitats and water users in the Bay-Delta system and its tributaries. Implementation includes encouraging voluntary compliance for Best Management Practices and other measures that control sources of salinity, selenium, pesticide residues, and heavy metals as well as increased levels of implementation for water quality improvement. Examples of activities to improve water quality may include but are not limited to:

- Coordinate the development of efficient water quality management practices
- Coordinate the development of management programs and enforcement programs for source control of agricultural drainage to reduce leachate concentrations and volumes, restrict spray programs adjacent to waterways, reduce runoff volumes, and reduce concentrations of pollutants in runoff
- Construct wetlands to treat 10,000 to 15,000 AF of upstream wastewater effluent and Delta agricultural drainage
- Manage drainage timing (i.e., restrict drainage discharges by 60 to 70 percent during periods of low Delta inflow) to reduce instream impacts to water quality
- Improve management of urban stormwater runoff including increased Best

Management Practices and by retaining and timing discharges (i.e., retain an additional 20 to 30 percent of runoff volume contained permanently)

- Provide economic incentives for land conversion to reduce costly water quality related drainage problems in the San Joaquin Valley
- Coordinate development of watershed protection programs (for water quality, ecosystem enhancement, and water yield)
- Provide incentives for filtration system upgrades and phased conversion of municipal treatment facilities from processes resulting in high disinfection byproduct precursors (DBP) discharges to processes that do not produce DBPs
- Mine drainage remediation measures developed in site specific studies at the Walker Mine, Malakoff diggins, etc. and provide an urban crediting system
- Actions to reduce effects of salinity in the San Joaquin River to maintain water levels and circulation in the south Delta and to reduce recycled salt load to the San Joaquin Valley
- Provide water for dilution of pollutant discharges remaining after above source control methods
- Treat 20 to 30 percent of agricultural drainage to remove pollutants, to either be reused or used as part of a localized drainage management practice

Relationship to Other Components

New Surface Storage, Conjunctive Use/Groundwater Banking - Storage can help timing for release of pollutants remaining after source control efforts.

Through Delta or Dual Conveyance - Improved conveyance to south Delta export pumps will improve water quality for those diversions but may decrease quality for in-Delta diversions.

Water Use Efficiency - Water use efficiency measures can improve water quality entering the Delta by reducing some agricultural drain water containing pollutants.

Potential Benefits, Concerns and Other Considerations that Need to be Addressed in Phase II

Potential benefits of the water quality program include:

- Improves Delta water quality by reducing the volume of urban and agricultural runoff/drainage and concentration of pollutants entering the Delta
- Improves water quality for the ecosystem by reducing toxics as a limiting factor
- Improves drinking water quality and public health benefits
- Reduces concentration of compounds contributing to trihalomethane formation potential and degradation of drinking water supplies

Potential concerns of the water quality improvement program include:

- Retention of agricultural drainage and changing the timing of releases to the river and Delta does not change the total mass of salts recycled through the San Joaquin Valley irrigation system
- Treatment systems for agricultural drainage may be prohibitively expensive
- Wetland treatment systems may expose wildlife to toxic effects
- Source control actions for agricultural drainage may be prohibitively expensive for some agricultural interests
- Management of urban stormwater runoff may be prohibitively expensive and difficult to implement
- Need to study watershed management to determine potential for improving water quality
- Need to determine impacts or benefits to south Delta stage, circulation, and water quality

Other considerations include:

- Identify priority sources and provide regulatory and economically effective institutional incentives for implementation.
- Remediation actions should include consideration of surface regrading, revegetation, and hydraulic works for infiltration control, and mine drainage handling (e.g. discharge reuse, evaporation ponding, regulated discharge, rerouting) and treatment (e.g. mine sealing, limestone neutralization, etc.)
- Evaluate potential to give urban areas flexibility to fund high priority mine remediation in-lieu of increasing expenditures on wastewater treatment plant improvements.
- Retire lands that directly contribute to degraded water quality conditions in the Delta and its tributaries.
- Prioritize agricultural drainage sites for drainage management, such as west-side of San Joaquin Valley, Panoche Creek area, etc.
- Potential benefits of south Delta stage, circulation, and water quality actions to be verified.
- Evaluate the feasibility of developing additional water supplies on the San Joaquin River for water quality dilution.
- Wetland treatment should be initiated as a "pilot program" to establish its feasibility and expanded appropriately.
- Prioritize sources and pollutants of concern and direct enforcement activities accordingly.

Levee System Integrity

Description

The Bay-Delta system faces an unacceptably high risk of inundation of Delta islands due to potential levee failure, which can result in loss of land use, infrastructure and associated economies, damage to aquatic and terrestrial habitats, reduced water supply reliability, and reduced water quality in the Delta. Agricultural productivity and significant habitat for terrestrial species would be severely damaged by inundation of one or more Delta islands. In addition, increased salinity intrusion would likely cause significant impacts to aquatic freshwater habitat and water supply operations.

Improvements to Delta levees and channels are included in this common component to reduce the risk of failure due to floods, earthquake, and general deterioration of the facilities. These improvements to system integrity will be accomplished through development and implementation of the Delta Long-Term Levee Protection Plan. The plan will include a maintenance/stabilization element and a Special Projects element that collectively will address levee maintenance, stabilization improvements, subsidence reduction, an emergency levee management plan, beneficial reuse of dredged material, and establishment of habitat corridors as mitigation for impacts from maintenance and stabilization.

The Delta Long-Term Levee Protection Plan will provide a uniform approach for improving system reliability. Uniform funding and guidance for levee maintenance and/or improvements to a set standard would be provided on a cost-shared basis for Delta islands. Funding for flood control and habitat improvements would be on a prioritization system to ensure long-term protection of Delta system functions providing the highest public benefit.

A number of comments received during scoping have led us to conclude that system integrity might be treated as a program that is generally uniform among the alternatives. Some of these comments are:

- Most parties support an enhanced levee stabilization program
- A greater level of levee stabilization needs to be implemented (PL99) in all alternatives
- Flood control measures in the North Delta need to be included in all alternatives
- A consistent level of funding for levee maintenance needs to be provided
- A single regional authority to coordinate Delta system integrity actions needs to be implemented
- An emergency response program for all levee programs needs to be created
- Subsidence reversal as an integrated component of the program needs to be incorporated

While the system integrity component will be implemented at one comprehensive level with a high target achievement level, some minor adjustments may be needed depending on geographic or physical characteristics of a given alternative. For instance, a through-Delta alternative may

use islands and channels for conveyance and thereby dictate how levees and channels in certain areas need to be improved.

The program will consist of actions or projects implemented in stages over time, perhaps 20 to 30 years, to ensure long-term protection and affordability. The program will include the core actions that apply to system integrity in the first stage. As implementation progresses, information on effectiveness of the early stages will help refine later stages of implementation. The specific level of funding for implementation will be defined during future phases of the Program by a combination of analyses and policy decisions. The analyses will include a risked-based benefit/cost analysis including consideration of converting land vulnerable to levee failure to areas of improved habitat.

NOTE: A system integrity technical group is assisting CALFED Program staff in identifying technical issues with respect to system integrity implementation.

Implementation Methods

The following implementation methods are in addition to the core actions. The Delta Long-Term Levee Protection Plan will consist of several elements. These elements will address levee maintenance and improvements to achieve a long-term goal of reducing the vulnerability of Delta functions throughout the Delta and identify stable funding sources. A strategic plan for Delta islands will be developed. The plan will prioritize work on highest priority sites anywhere within the Delta. High-priority sites would be identified through a ranking scheme that is expected to include criteria such as the protection of public infrastructure facilities (e.g., highways, pipelines, railroads), private infrastructure (e.g., homes, marinas), navigation (e.g., project/direct agreement levee systems), water quality at Delta export locations (e.g., west Delta islands), flood protection, cultural resources, recreation, and fish and wildlife. The elements include:

Levee Maintenance Plan - Establish a stable source of funding for levee maintenance and establish a uniform long-term Delta standard, including maintenance guidelines, which can incorporate habitat friendly levee maintenance procedures. Improve flood conveyance capacity of Delta channels through channel maintenance actions (e.g., maintenance dredging) or in conjunction with levee upgrades and improvements. These actions would reduce the vulnerability of Delta functions to inundation , improve flood capacity in high priority channels, and provide greater opportunities for habitat restoration.

Stabilization of the Highest Priority Western Delta Island Levees - Significant improvement in reliability of Delta water quality and the water conveyance system can be accomplished while incorporating aquatic habitat restoration and enhancement features. This can produce benefits in stabilizing fishery populations, complementing the increased certainty for water supply produced by the protections to Delta water conveyance tied to the levee stabilization.

High Priority Buffer Zones - Provide incentives for setting aside high priority buffer zones

adjacent to levees of Delta islands with deep peat soils to control subsidence, maintain levee stability, and provide areas for habitat restoration. This land conversion may reduce demands on Delta water and reduce discharges of organics and other constituents into Delta channels. Additional more aggressive long-term subsidence reversal programs could be included for some islands, in coordination with the ecosystem restoration program.

Restoration of Highest Priority Habitat - This action can be integrated with efforts to establish buffer zones for subsidence control or implementation of mitigation banking opportunities for levee maintenance/improvement actions. Restoration efforts would be monitored for results and appropriate adjustments made in future restoration efforts.

Emergency Levee Management Plan - Identify a stable source of funding for an emergency levee management plan to address Delta levee failures through enhanced coordination of existing agencies and ensuring adequate availability of materials and equipment.

Relationship to Other Components

Through Delta or Dual Conveyance - Levee and channel improvements for conveying water to the South Delta export pumps should made in conjunction with flood control and aquatic habitat improvements.

Potential Benefits, Concerns and Other Considerations that Need to be Addressed in Phase II

Potential benefits of the Delta Long-Term Levee Protection Plan include:

- Subsidence reduction helps long-term Delta system integrity
- Ensures suitable funding, equipment and materials availability, and coordination to rapidly respond to levee failures
- Provides funding for continued maintenance of levees to protect Delta functions
- Increased reliability for water supply needs from the Delta
- Increased reliability for in-Delta land use and habitat
- Increased reliability for in-Delta aquatic and wildlife habitat

Potential concerns of the Delta Long-Term Levee Protection Plan include:

- Providing increased levee stability and higher levels of flood protection in a staged fashion can expose adjacent islands to higher levels of flood risk until their priority is reached in the staged program
- Attempting to reach a uniform high level of flood protection may be prohibitively expensive
- Creating aquatic habitat as part of levee stabilization work may impact terrestrial habitats and vice versa

- Creating subsidence buffer zones may remove agricultural lands from production and impact terrestrial habitats
- Improving flood protection in the North Delta may impact both aquatic and terrestrial habitats
- Without an adequate subsidence control plan, levee stabilization may not be successful over the long term in the peat soil areas of the Delta

Other considerations include:

- Determine extent and cost effectiveness of levee improvements and buffer zone programs.
- Buffer zones may be managed to provide wildlife habitat.
- Integrate protection and stabilization of levees with Delta habitat restoration and water transport activities.
- Channel improvements may include widening for improved conveyance, stabilizing berms, and related actions and should be integrated with levee improvements.
- Improvements to channels include dredging for sediment removal in channels with restricted flood capacity.
- Evaluate combination of floodway capacity and reservoir flood reservation.

Ecosystem Restoration

Description

CALFED is working to achieve a healthy Bay-Delta ecosystem that provides for the needs of plants, animals, and people using the system. This healthy ecosystem will include a range of sustainable habitat types, providing environmental, recreational, and aesthetic benefits. It will support an abundance of resident and andromous fish, including viable recreational and commercial fisheries. A healthy ecosystem will also support sustainable production and survival of plant and wildlife species, including resident species as well as migrants such as the waterfowl that use the Pacific Flyway each winter. These qualities are benefits or ecosystem services that a healthy Bay-Delta ecosystem will provide.

These sustainable fish, wildlife, and plant populations depend on an ecosystem that provides all the natural processes and features, called ecosystem functions, that they need. The Bay-Delta system will never be returned to the conditions that existed prior to human disturbance, but Bay-Delta ecosystem functions will be restored. A healthy functioning ecosystem will include all the habitats necessary for survival of species that use the system, including freshwater and brackish tidal marsh, shallow water, riparian woodlands, and shaded riverine areas. These habitats will be large enough in area to support sustainable populations of Bay-Delta species, and will be interconnected to allow movement and prevent isolation of plant or animal populations. To the extent possible, natural processes of the system will be restored. These include for example, proper water flow to ensure appropriate salinity levels, meander zones that create necessary habitat and generate sediments that are important to the system, and nutrients that support the food web of the system.

A number of comments received during scoping have led us to conclude that habitat restoration might be treated as a program that is generally uniform among the alternatives. Some of these comments are:

- The Program needs to expand watershed management techniques and actions as part of overall effort
- The Program needs to clarify and elaborate restoration definition, goals, objectives, etc. (need a more fully developed plan)
- Will the Program address overall increases in Delta outflow? Will this be explicit in the restoration activities?
- The Program needs to discuss outflow enhancements and instream flow requirements
- The Program needs to develop a broad vision and a high level ecosystem restoration plan and make that common to all alternatives
- The Program needs to develop guarantees that the ecosystem actions will be effective
- More habitat needs to be added to reduce conflict and increase durability
- A more intense fish screening program needs to be added to reduce conflict and increase durability

While the ecosystem restoration program will be implemented at one comprehensive level, some minor adjustments may be needed depending on geographic or physical characteristics of a given alternative. For instance, habitat restoration activities could be located differently, depending on use of through-Delta or isolated conveyance (e.g., if the south Delta export pumping continues from existing channels, then fisheries habitat would probably not be restored near the pumps).

The program will consist of actions or projects implemented in stages over time. The program will include the core actions that apply to ecosystem restoration in the first stage. As implementation progresses, information on effectiveness of the early stages will help refine later stages of implementation. The specific level implementation will be defined during future phases of the Program by a combination of analyses and policy decisions.

NOTE: A BDAC Ecosystem Restoration Work Group is assisting CALFED Program staff in identifying key policy issues with respect to restoration of ecosystem health.

Implementation Methods

The following implementation methods are in addition to the core actions.

The Program's strategy for habitat restoration is to reverse the decline in ecosystem health by reducing or eliminating factors which degrade habitat, impair ecological functions, or reduce the population size or health of species. These factors may cause direct mortality of plants and animals in the system, but more often they result in indirect mortality by degrading habitat conditions or functions. For this reason, the Program objectives emphasize the improvement of habitats and ecological functions.

When there is a single factor limiting an ecological function or the population size or health of a species, remedial actions to restore functions or populations are clear. Often, however, there are many factors or stressors that reduce ecological functions or cause mortality of species at different stages in the life cycle. In the Bay-Delta system, some of these include inadequate physical habitat that fails to provide areas for reproduction, foraging, or escaping from predators; inadequate water quality including temperature and toxic contaminants; fragmented habitat that impedes migration; inadequate or altered water flow regimes; direct and indirect mortality caused by water diversions from the system; presence of undesirable introduced species that compete with or prey upon other species; and recreational and commercial harvest. In cases where there are multiple factors affecting species, the strategy of the Program is to take a broad ecosystem approach, thus making incremental improvements in all the significant identified factors that affect important species and their habitats. This effort must start by addressing factors most likely to be limiting, particularly for species of special concern. Subsequent efforts will work to protect or restore broader ecosystem functions. Actions may be guided by pre-disturbance conditions, but must recognize competing uses of the system, and irreversible changes that have occurred.

Several criteria will help to focus efforts aimed at maintaining and restoring ecosystem functions and achieving ecosystem quality objectives:

- **Address Limiting Factors** - Restoration of ecosystem functions must begin with the greatest needs or deficiencies in the system.

- **Use Natural Processes** - Selection of actions will favor those that take advantage of natural processes to achieve desired results. This will reduce the amount of effort to carry out and maintain our actions, and increase the likelihood of long-term sustainability of the Bay-Delta system.

- **Increase Resilience** - Actions will be selected so that some of the system's natural resilience to disturbance is restored. Restoration of particular habitat types will be undertaken at appropriate sites distributed throughout the system, and genetic diversity will be protected so that species maintain the ability to respond to gradual changes in conditions. Genetic diversity is most at risk in species or races that are endangered, threatened, or of special concern.

- **Achieve Multiple Benefits** - Efforts will be made to increase benefits by selecting or designing actions that improve habitat conditions or ecological functions for multiple species. Actions will also be favored if they improve other resources areas including water quality, system integrity, and water supply reliability as well as improving ecosystem quality.

- **Measure Results** - Program results will be measured on two different levels. First, actions will be structured so that the effectiveness of each one is measurable. At a broader scale, the Program will include monitoring to assess the overall success of the many actions working together. This will allow adaptive management of the restoration: adjustment of our actions to make them more effective, and changes in emphasis as the condition of the ecosystem improves.

- **Make up for Unavoidable Loses** - Finally, where competing uses of Bay-Delta resources make it impossible to avoid specific impacts on species, habitats, or ecological functions, efforts will be made to compensate by reducing other causes of mortality or improving habitats and functions elsewhere in the system.

A variety of actions are contemplated as building blocks for the Program:

Protect and Enhance Existing Bay-Delta Habitat - Protecting and enhancing existing valuable habitat before it is lost to further degradation is critical. The habitats include shallow areas adjacent to levees, channel islands, riparian habitats, wetlands, and upland habitats.

Restore Habitat - Substantial restoration of habitats in the Bay-Delta system is required to improve ecosystem functions. Many of these can be incorporated into habitat corridors. In keeping with Program solution principles of reducing conflict and avoiding significant

redirected impacts, habitat restoration will emphasize acquisitions and easements from willing landowners. Habitat restoration activities include:

- Improving Bay-Delta shallow water (tidal) habitat, including converting existing leveed lands to tidal action and incorporating shallow water habitat in the reconstruction of levees. For example, these actions could include, but are not limited to, converting 8,000 to 12,000 acres of existing leveed lands to tidal action and including shallow water habitat in reconstruction of 50 to 100 miles of levees. Candidate areas for Delta shallow water habitat restoration include Prospect Island, Liberty Island, Little Holland Tract, Hastings Tract, Yolo Bypass, Twitchell Island along Threemile Slough and Sevenmile Slough, Georgiana Slough, the north and South Forks of the Mokelumne River, and the southeast Delta.

- Restoring riparian habitat by revegetation and expansion at in-Delta tidal areas, within-island sites, and in the river system, including the Sacramento River corridor and its tributaries, the San Joaquin River corridor and its three major tributaries. For example, these actions may include:
  - Improving riparian conditions on 1,400 to 1,600 acres of degraded riparian lands above the 200 to 400 acres improved through the Core Actions
  - Establishing new areas of riparian habitat through acquisition of 4,000 to 5,000 acres of riparian land
  - Improving riparian habitat through modified levee maintenance practices on an additional 10 to 15 percent of existing levees above the 15 to 25 percent of levees improved through Core Actions
  - Restoring of Delta non-tidal wetland habitat by protecting and enhancing 200 to 400 acres of existing wetland habitats above the 100 to 300 acres protected through Core Actions
  - Converting 5,000 to 7,000 acres of suitable lands to wetland habitat

- Converting diked bay lands to tidal wetlands habitat in the Suisun Bay. For example this could include 4,000 to 6,000 acres in Suisun Bay or creating tidal wetlands with dredge spoils between Collinsville and Carquinez Strait

- Improving riverine habitat on the Sacramento River and along Delta channels by reconstructing river banks and protecting channel islands. For example, riverine habitat on the Sacramento River between Verona and Collinsville and along Delta channels could be restored by:
  - Setting back levees to restore natural riverine cross sections to 100 to 125 miles of waterways
  - Reconstructing river banks and shallow water habitat on 100 to 150 miles of leveed banks along the Sacramento River
  - Protecting and enhancing 1,500 to 2,000 acres of riverine habitats

on channel islands above the 500 to 1,000 acres protected through Core Actions

- Improving riverine habitat by restoring riverine channel features in the Sacramento River upstream of the Delta, including tributaries by:
  - Restoring and enhancing riparian vegetation on 25 to 75 miles of river upstream of the Delta between Verona and Colusa
  - Relocating levees at appropriate locations between Verona and Colusa to restore riverine habitat
  - Establishing 20 to 40 river miles of meander belts above Colusa
  - Restoring 6,000 to 7,000 acres of riparian habitat above Colusa above the 2,000 to 4,000 acres restored through Core Actions

- Restoring riverine channel features in the San Joaquin River. Examples include:
  - Restoring channel configurations to 30 to 50 miles of degraded river to deepen channels and improve water temperatures
  - Isolating in-channel gravel quarry areas from main flows

- Modifying floodway corridor habitat. Examples include:
  - Modifying floodways to convert 7,000 to 12,000 acres of agricultural production land into wetland habitat
  - Reducing fish stranding by regrading floodways

- Restoring floodway functions and expanding meander zones

- Expanding wetlands

Develop and/or Acquire Environmental Water - Water can be acquired from willing sellers or developed through new facilities or transfers to improve instream flows, increase Delta outflow, and for other environmental needs.

Habitat Management - A variety of actions can be used to improve management of Bay-Delta system habitats, including changes in levee maintenance procedures, changes in agricultural practices, improved coordination between agencies and programs, and improved permitting for habitat restoration.

Control of Introduced Species - Improved control of introduced species helps prevent introductions and helps protect and enhance the natural ecosystem values of the Delta by reducing competition.

Fish Screens and Facilities - Improvements in fish screening throughout the Bay-Delta system can have a significant reduction in loss of fish. Incorporate rehabilitated fish facilities at Tracy and Banks pumping plants in all alternatives.

Fish Protection and Management - Improving protection and management of fish in the Bay-

Delta system are important to sustaining healthy populations. These involve management of spawning gravels, modification of barriers that restrict fish passage and migration, use of real-time monitoring and adaptive management, management of hatchery fish, and improving data management for regulation of fish harvest.

Relationship to Other Components

New Surface Storage, Conjunctive Use/Groundwater Banking - Storage can improve instream flows, Delta outflows, and modification of timing of diversions.

Through Delta or Dual Conveyance - Improved conveyance to the south Delta export pumps can improve timing of diversions to reduce impacts on fish.

Water Quality Improvements - Water quality improvements through source controls and timing of remaining pollutant releases improves water quality and reduces toxicity for the ecosystem.

System Integrity - Improvements of levees and channels for improved system integrity can also incorporate new habitat features.

Water Use Efficiency - Reduced diversions associated with water use efficiency measures helps reduce diversion effects on fisheries.

Potential Benefits, Concerns, and Other Considerations that Need to be Addressed in Phase II

Potential benefits of the habitat restoration program include:

- Reversing the decline in ecosystem health by reducing or eliminating factors which degrade habitat, impair ecological functions, or reduce the population size or health of species
- Produces a healthy Bay-Delta ecosystem that provides for the needs of plants, animals, and people using the system
- Supports sustainable production and survival of plant and wildlife species, including resident species as well as migrants such as the waterfowl that use the Pacific Flyway each winter
- Reduces the conflict between fisheries and diversions

Potential concerns of the habitat restoration program include:

- Setback levees along the Sacramento and San Joaquin Rivers may remove agricultural land from production
- Care needs to be taken so as not to increase flood risk to downstream areas
- Restoration of riparian habitats adjacent to levees may increase the difficulty of

maintaining safe and stable levees and may increase risk of levee catastrophic failure

- Reestablishment of river meander zones may increase sediment loads in the short-term and impact downstream navigation channels; sediment loads may also increase maintenance costs for flood bypass systems
- The enhancement of fishery populations may require reconsultation pursuant to the Endangered Species Act; (e.g., increased Delta smelt around the North Bay aqueduct)
- Floodway conversions to habitat may increase maintenance costs or impair floodway capacities; there may also be impacts to agricultural acreage
- Depending on how the program is implemented, actions to address salmon migration at the head of Old River may impact water stages and quality as well as flood stages in the south Delta channels
- There is uncertainty about implementation level and experience needed to achieve desired results
- Water supply reliability improvements resulting from ecosystem restoration could take considerable time to achieve

Other considerations include:

- Actions are intended to maintain recreational and commercial fisheries as well as enhance native salmon stocks.
- Habitat restoration must not impair capacity of flood ways.
- Select diversions for screening according to criteria including size of intake, location, peril to fish, and screening feasibility.
- San Joaquin environmental water can be used for pulse flows for fish transport or diluting poor quality flows

Storage

Description

The Bay-Delta system provides the water supply for a wide range of environmental, agricultural, and urban beneficial uses. As water use and competition among uses with respect to timing of water availability has increased, conflicts have increased among uses of Delta water. Adding more storage is a possible action in each alternative. Surface storage of water and conjunctive use/groundwater banking can be used to greatly increase the opportunities to improve the timing and availability of water for all water users. The benefits and impacts of surface and groundwater storage vary depending on the location, size, operational policies, and linkage to other components. Depending on the configuration of the alternative the benefits and impacts may be very different between storage located upstream of the Delta, in-Delta, and south of the Delta.

By regulating flows, surface or groundwater storage could optimize the capacity and operation of the existing system conveyance. South of Delta storage would allow increased permitted pumping capacity to be used during acceptable periods. During other times, water users would draw on the storage and export diversions could be reduced. Releases from north of Delta storage could be used for diversions and to manage the river flows. Storing water during periods that would not impact fisheries improves the ability to shift pumping to less sensitive periods. In-Delta storage would provide similar benefits. To protect Delta outflow, expanded in-lieu groundwater banking in the southern San Joaquin Valley and other areas dependent on Delta supplies could help reduce demands for surface water in dry years.

Many of the comments received during scoping and at Workshop 6 focused on the need for increased emphasis on storage for better water supply and flow management. Some of these comments are:

- The alternatives do not appear to increase overall supply of water. Current wording could be interpreted that exports could be cut in half and still meet CALFED Bay-Delta Program goals
- All the alternatives need to acknowledge the need to free up Delta constraints before storage can be effective
- Alternatives need to include expanded existing storage as a high priority (raise dams)
- Alternatives should provide more storage options
- Alternatives should prioritize conjunctive use first, then groundwater banking, then surface storage
- Alternatives should address the problem of groundwater overdraft in the southern San Joaquin Valley
- Conjunctive use is more acceptable in alternatives when practiced in a local area. Assurances of non degradation of local ground water supplies need to be provided if practiced on a State wide basis

Due to the importance and complexity of these issues, we have created a separate component for storage that requires additional analyses to refine sizes and operations. Unlike the common components discussed above, storage will be variable component that could differ with each alternative. Storage will be a variable component with surface and conjunctive use/groundwater banking elements.

Surface storage (in Sacramento River basin, San Joaquin River basin, export areas) can be either new or a modification of existing storage, each with different benefits and potential adverse impacts. Opportunities for increased conjunctive use in the Sacramento basin and groundwater banking in the San Joaquin basin need to be quantified to determine the benefits and potential adverse impacts.

To determine the optimum combination of surface and groundwater storage for any alternative, a full range of size, locations, and operational polices must be examined in Phase II. Shared use of storage for environmental, water supply, and water quality will be optimized to determine the greatest benefit from the storage and other components of the alternative. Combinations of storage elements in a variety of sizes for each conveyance method and capacity will be studied to determine the combination of conveyance and storage which meets the program objectives at the highest and most cost effective level.

Implementation Methods

The following implementation methods are in addition to the core actions. Surface storage can be constructed off-stream upstream of the Delta, off-stream in the Delta, or off-stream south of the Delta. Conjunctive use/groundwater banking operations and impacts vary with configuration and location. While on-stream surface storage is possible, it will be much more difficult to permit than off-stream surface storage. Therefore, the Program will focus on evaluation of off-stream surface storage and conjunctive use/groundwater banking for any storage needs within the alternatives.

Upstream Surface Storage - Runoff from precipitation north of the Delta usually occurs in large volumes over short periods of time in the winter and spring. New upstream off stream storage would capture a small portion of flows in excess of instream flow requirements and water supply needs. Water would only be diverted to the new storage following the peak flood flow, maintaining the beneficial geomorphologic effects of the highest flows. Water would be released when needed to supplement instream flows and for water supply. For example, water in north of Delta storage could be released directly to current north of Delta water users, reducing existing diversions from the Sacramento River. Water released for environmental purposes could include pulse flows to help transport fish through the Delta. Water could also be released to provide sustained flows for riverine and shallow water habitats and improve water quality in the Delta, particularly in dry years. Examples of upstream storage could include the off-stream Colusa-Sites Reservoir (0.5 to 3.0 MAF) or enlargement of existing Lake Berryessa Reservoir.

In-Delta Surface Storage - In-Delta storage could be developed by converting one or more Delta

islands into reservoirs. Existing levees would be reconstructed, and screened facilities for diverting water into the island would be provided. In-Delta storage would be filled during wet periods when probable harm to critical fishery resources would be lowest. Water would be released directly into the Delta for environmental, water supply, and water quality needs or connected directly to the export facilities to provide flexibility in diversion timing. New environmentally dedicated Delta storage reservoir could be located near export pumps on one or more islands such as Bacon, Mandeville, or Victoria. Water would be diverted into storage during November, December, and January and released in March to July as Needed. Real-time monitoring might guide operations to divert when species of concern are not present and release water to move fish away from diversions. A wide riparian and shallow water habitat corridor could be created around the perimeter of the Delta island storage to provide additional fish and wildlife benefits. If the stored water was to be used for municipal water supply, the need to remove or seal organic soils on reservoir islands to avoid release of carbon into stored water would require evaluation. Foundation and slope stability considerations may limit the daily drawdown of in-Delta storage, requiring higher amounts of storage. In Delta storage could range from 100 to 600 TAF and could be linked to Clifton Court Forebay, linked to an isolated facility, or could be separate from these. More analysis and review of the technical issues of in-Delta storage is needed in Phase II of the Program.

South of Delta Surface Storage - South of Delta storage would be filled by diversions which supply the Delta Mendota Canal or the California Aqueduct. Examples of existing south of Delta storage are San Luis Reservoir and Castaic Lake. Storage would be filled during wet periods of least potential harm to Delta fishery resources. With water in storage south of the Delta, export pumping could be curtailed at times of heightened environmental sensitivity.

Conjunctive Use - Conjunctive use is the management and operation of a groundwater basin in a manner similar to on stream reservoir operations to provide limited short-term flexibility in meeting water supply demands. Groundwater is removed and subsequently recharged over a period of years or within a particular year. Groundwater levels would tend not to drop drastically as a result of constant recharge from rivers and streams as well as direct recharge. In addition, groundwater levels would not tend to rise significantly above historic levels because of loss to river accretion. During drier periods, groundwater would be extracted for use in place of or to supplement surface water supplies within the region. In wetter periods, river and stream seepage as well as direct recharge would return the groundwater levels to previous equilibrium conditions.

Groundwater Banking - Groundwater Banking is the storage of water in existing depleted groundwater basins and the subsequent extraction and use of the stored water to meet water supply demands. Typically, large quantities of water can be stored in such basins. During wet periods, surface water would be delivered to these basins and stored for a period of months or years. During drier periods, the storage would be extracted and used in place of or to augment surface water supplies.

Operations

New storage could be sized to provide for multiple uses with each alternative. New surface storage upstream and downstream of the Delta could provide greater flexibility in timing inflows to the Delta and diversions from the Delta. Downstream storage, in conjunction with groundwater/conjunctive, use could be used to better manage the timing of Delta exports. Evaluations will be performed by fishery experts to determine the relative importance to the fishery of the various windows of time available for pumping during the year. Pumping operations will be crafted to fit pumping within the windows of least impact to fisheries (e.g., late fall and early winter). Pumping curtailments will be designated for the windows of highest importance to the fishery (e.g., March through June).

New upstream and downstream storage could be operated to fill during the receding limb of peak flood hydrographs, which would be unregulated by existing on-stream storage facilities. Down stream storage would be filled as much as possible utilizing the isolated facility if part of an alternative. Detailed analyses of hydrologic and biological conditions will be required to determine the impacts and criteria for filling storage in this manner.

Average and Wetter Year Operation

- Environmental storage could be conserved to the extent possible in average and wetter years. Water remaining in storage above established carry-over targets will be transferred to groundwater banking and conjunctive use areas to supplement long-term and drought period supplies.

- Water supply storage in the new facilities could be used on a seasonal basis to allow a shift in Delta withdrawals from the March through June period to less environmentally sensitive periods. Water remaining in storage above established carry-over storage targets will be transferred to groundwater banking and conjunctive use areas to supplement long-term and drought period supplies.

- Excess carry-over storage in Shasta and Oroville would be transferred to groundwater banking and/or conjunctive use areas. Vacating this water from on-stream project reservoirs could enable a greater portion of flood flows to be captured and stored.

Dry and Critical Year Operation

- There will be significantly reduced opportunity to fill either upstream or downstream storage, since flood events are generally much smaller and more infrequent during these years.

- The portion of storage allocated to environmental purposes upstream of the Delta could be used to increase Delta outflows during the late spring and summer period and as otherwise needed to improve ecosystem functions in the Delta. Environmental storage to the south of the Delta could be used to offset Delta withdrawals. Storage withdrawals for consumptive demands would be provided in exchange for upstream releases from water supply storage which would remain in the Delta as outflow.

Relationship to Other Components

Conveyance improvements and conveyance facilities could complement new storage. Conjunctive use and groundwater banking programs could be improved by the addition of surface storage.

Conveyance - Conveyance modifications would increase the ability to convey water from north of the Delta to south of the Delta at environmentally acceptable times. Upstream surface storage would accommodate shifts in export diversion timing by storing water until it can be diverted. Water would then be released to the conveyance facilities. Water could also be stored and released to manage Delta outflows. South of Delta storage would permit the increased conveyance capacity to be used during acceptable periods. During other times, water users would draw on the storage and export diversions would be reduced.

Conjunctive Use/Groundwater Banking - Groundwater recharge and extraction facilities could be optimized if new surface storage is used to regulate flows into and out of the groundwater basin.

Water Use Efficiency - Storage improves the flexibility for better management of water conserved through water use efficiency measures.

Water Quality Improvements - The timing of releases from storage can greatly improve water quality at critical times.

Ecosystem Restoration - All types of storage facilities increase the flexibility to help manage the downstream flow for environmental purposes.

Potential Benefits, Concerns, and Other Considerations that Need to be Addressed in Phase II

Potential benefits of surface storage and conjunctive use/groundwater banking include:

- Flexibility to coordinate supply opportunities
- Dry period supply opportunities
- Enhance environmental flows (shift water use patterns for habitat and fisheries)
- Management of downstream water temperatures
- Increase annual supply opportunities
- Enhance water transfer opportunities
- Flexibility to reduce entrainment (timing of diversions)
- Opportunities to improve timing of Delta outflow
- Increased flood control
- Increased recreational benefits
- Increased power generation

- Opportunity to improve water quality
- Opportunities to improve fish transport through the Delta

Potential concerns of surface storage and conjunctive use/groundwater banking include:

- Hydrologic and biologic studies are required to identify criteria (quantity and timing windows) for diversion of water to storage
- Reduced total Delta outflow, though outflow can be increased during critical periods for ecosystem health
- Increased total diversion rate in particular flood flow periods
- Potential increased Bay stratification impacts
- Site specific terrestrial and wildlife impacts
- Potential loss of culture resources
- Water quality impacts
- Adverse effects of land use change
- Decreased gravel recruitment
- Increased average and above year surface deliveries
- Terrestrial impacts in dry and critically dry years
- Potential impacts on adjacent groundwater users

Other considerations include:

- Conjunctive use and groundwater storage programs can include in-lieu operations which focus on providing adequate deliveries of surface water in wet years and lower deliveries in dry years. Groundwater stored south of the Delta would be used in-lieu of surface deliveries during dry years and seasonally to marginally offset Delta exports during fish sensitive periods.
- Groundwater storage may take the form of in-lieu recharge or direct recharge using injection wells or recharge basins.
- A portion of storage will be managed for in-Delta fisheries or other Bay-Delta environmental purposes.