PROBLEM DEFINITION PACKAGE

This Problem Definition package describes a draft of the problems to be addressed by the CALFED Bay-Delta Program. The intent of this package is to list the Bay-Delta system problems and encompass the concerns of stakeholders and the public that can be addressed within the scope of the program. The program defines a problem as a condition, occurrence, or potential consequence that a stakeholder feels should be examined, addressed, or mitigated. For example, "Lack of riverine edge habitat limits spawning success and survival of juveniles of many fish species that use such habitats for spawning and rearing."

Included in the package are lists of problem statements in outline format, and tree diagrams depicting the successive levels of detail for each listed problem. The problem statements were developed from the results of the first public workshop (August 3, 1995), consultations with state and federal agencies, review of previous planning studies, and public input from numerous program presentations.

The draft problem statements on the following pages have been prepared for the four problem areas: water quality, ecosystem quality, water supply, and vulnerability of the Bay-Delta system functions.

As discussed at the first workshop, different people observe the same problem in different ways. Some people focus on the *cause* of the problem, while other focus on the *action* needed to fix the problem. Other people approach a problem from the goal or *objective* perspective. Many of the comments we have received were focused on causes, actions, or objectives. Therefore, the problem statements are followed by a summary of *Other Issues Raised* at the workshop. Although these are not included in the problem statements, they will be considered during subsequent steps in the process.

The problem definition is an important foundation for the long-term solution-finding process. The problem statements described here form the basis of several future program activities:

- Program mission and objectives will be developed to correspond with the identified problems
- Potential actions will be identified in part to respond to the identified problems
- The geographic scope of the potential solutions is determined in part by the scope of the identified problems
- The level of detail for developing and evaluating potential alternatives is guided in part by the identified problems

In the next steps of the solution-finding process, the program will be working with the public and agencies to define objectives. The program will also be developing a complete listing of the causes of each identified problem and potential actions to address the problem or meet the objective.

Draft

WATER QUALITY PROBLEMS

Water quality problem statements are developed around five beneficial use categories and are presented in the attached outline and tree graphic. These categories represent the primary beneficial uses requiring adequate water quality from the Delta: drinking water, agriculture, industry, recreation, and ecosystems. **Drinking water** quality problem statements are tied to health effects, aesthetics, treatment costs and difficulty, and federal and state drinking water regulation. **Agricultural water quality** problem statements relate to economic productivity, crop choice and operational difficulties. **Industrial water quality** problem statements relate to treatment and production costs and operational difficulties. **Recreational water quality** problem statements relate to health risk and aesthetics. **Ecosystem water quality** problems are addressed under Ecosystem Quality.

Water Quality
Problem Statements

The water quality in the Bay-Delta is insufficient to meet the beneficial uses of the Delta water. At times, water quality standards have not been met and contaminants have been found in some fish and wildlife species triggering public health warnings.

The major problems can be categorized as follows:

A. Water quality is often inadequate or is perceived as inadequate for **Drinking Water needs.**

1. Certain water quality parameters present in Delta water have or may have **Adverse Human Health Effects**.

2. Certain water quality parameters present in Delta water have or may have **Adverse Aesthetic Effects**, in particular concerning taste, odor and appearance.

3. Levels of certain water quality contaminants may increase the **Cost of Treating** Delta water in order to meet the existing drinking water quality standards.

4. **Fluctuating Raw Water Quality** increases the difficulty of water treatment plant operations.

5. **Stricter Future Regulations** may be difficult to meet with the existing treatment techniques and raw water quality.

B. Delta water quality is often inadequate for **Agricultural** needs.

1. Certain water quality contaminants may reduce **Agricultural Economic Productivity** by reducing crop productivity, the choice of suitable crops, or by increasing costs.

2. Certain water quality contaminants such as sediments may result in **Operational Difficulties**.

3. **Salinity** in agricultural water increases salinity of drainage water to other surface and groundwater supplies.

C. Delta water quality is often inadequate for some **Industrial** needs.

1. Certain water quality contaminants may increase **Cost of Treatment and Production** for industrial users.

2. **Fluctuation of Raw Water Quality** increases the difficulty of plant operation for industrial users.

D. Delta water quality is often inadequate for water **Recreational** needs.

1. Certain water quality contaminants may pose an **Increased Health Risk** to recreationists.

   a. **Body Contact Recreational Activities** in the Delta may increase the risk of exposure to contaminants.

   b. **Consuming Fish** caught in the Delta may increase the risk of exposure to contaminants.

2. Certain water quality parameters may adversely impact **Aesthetic Conditions** in the Delta, in particular taste, odor and appearance.

3. Water quality regarding **Nuisance Vegetation** may impede recreational boating and other on-water recreation.

E. Water quality is often inadequate for **Environmental** needs for the Bay-Delta system. (see Ecosystem Quality)

ECOSYSTEM QUALITY PROBLEMS

The Bay-Delta system no longer supports habitats and habitat quality necessary to ensure those ecological functions necessary to sustain healthy populations and communities of plants and animals. For that reason the problem statements are expressed in terms of limitations in important habitats of desirable plant and animal species that use the Bay-Delta ecosystem for at least a portion of their life-cycles. Some species reside in San Francisco Bay as adults and use Delta habitats for spawning and juvenile rearing (e.g., longfin smelt). Other species (e.g., salmonids) spawn upstream of the Delta and reside as adults in the Pacific Ocean but must travel through the Delta and Bay during juvenile outmigration and adult inmigration. Limitations in Delta habitat affect these and other species in various ways.

The CALFED Bay-Delta Program seeks to use an ecosystem approach to fixing habitat problems in the Bay-Delta ecosystem. An ecosystem approach entails addressing the underlying causes of ecosystem degradation through protecting, enhancing, and restoring important habitats.

Important species of fish, animals, plants, and other life-forms are identified in the problem statements as examples of the organisms adversely affected by the named habitat problems. The health and sustainability of individual species and species communities residing in the Delta or Bay will be used as health indicators to judge the success of the CALFED Bay-Delta Program in resolving habitat problems. The evidence shows that better habitat generally leads to more abundance of species. For example, recovery of populations of resident species (e.g. Delta smelt) and anadromous species (e.g. Chinook salmon) that use the Delta would indicate that improvements to Delta habitats had been successful.

Draft

Ecosystem Quality
Problem Statements

The Bay-Delta Ecosystem does not support high quality habitats for diverse and valuable plant and animal species. Many plant and animal species that use the Bay-Delta have experienced moderate to severe declines. The major problems for the aquatic and wetland habitats are outlined below:

A. **Important Aquatic Habitats** are inadequate to support production and survival of native and other desirable estuarine and anadromous fish in the estuary. Examples of fishes that have experienced declines related to changes in Delta habitat include delta smelt, longfin smelt, Sacramento splittail, Chinook salmon, striped bass, and American shad. The problems for specific aquatic habitats include:

1. **Lack of Shallow Riverine Habitat** limits spawning success and early survival of many estuarine and anadromous fish in the estuary. Examples of affected species include Sacramento splittail, Chinook salmon, striped bass, delta smelt, American shad.

   a) **Lack of Riverine Edge Habitats** limits spawning success and survival of juveniles of many fish species that use such habitats for spawning and rearing (e.g., Sacramento splittail, delta smelt, Largemouth Bass, and Chinook salmon).

   b) **Lack of Shallow Shoal Habitat** within the main channels of the Delta and upper Bay limits shallow foraging habitat for juveniles of many estuarine fish (e.g., Sacramento splittail, striped bass, delta smelt, longfin smelt, starry flounder, and white sturgeon).

2. **Lack of Shaded Riverine Aquatic Habitat** limits growth and survival of estuarine resident and anadromous fish in the estuary (e.g., Sacramento splittail, Chinook salmon, and tule perch).

   a) **Lack of Riparian Woodland** limits cover and terrestrial food production for Delta fish.

   b) **Lack of Large, Woody Debris** along Delta levees limits feeding and refuge habitat for juvenile and adult fish in the Delta.

3. **Lack of Tidal Slough Habitat** limits the fish-production capacity of the Delta (e.g., delta smelt, Chinook salmon, striped bass, Sacramento splittail, and Tule Perch and copepods).

   a) **Lack of and Degradation of Dead-End Sloughs** reduces areas available for spawning and rearing of some native resident fish species.

   b) **Lack of Open-Ended Sloughs** may have reduced areas available for spawning and rearing of some fish species.

   c) **Abundant Water Hyacinth** may limit productivity of tidal slough habitats.

   d) **Energetic Exchange** during tidal cycling is limited by lack of tidal slough habitat.

4. **Upstream Relocation of Estuary Entrapment/Null Zone Habitat** by low Delta outflow limits production of fish and their prey in the estuary (e.g., delta smelt, longfin smelt, and striped bass).

   a) **Saltwater Intrusion into Suisun Bay** reduces the bay's value as a low-salinity nursery area.

b) **Low Salinity (less than 10 ppt) Habitat** is confined to deeper channels in the Western Delta where it is of limited value as compared to Suisun Bay.

c) **Brackish Water (1 to 25 ppt) Habitat** occurs less frequently in San Pablo Bay with reductions in Delta outflow during the winter and spring which may limit production of bay species such as bay shrimp, starry flounder, Pacific herring, and dungeness crab.

5. **Reduced and Altered Transport Flows** hinder successful movement of juvenile fish from spawning habitats to nursery habitats in the Delta and Bay (e.g., delta smelt, longfin smelt, striped bass, Chinook salmon, and Sacramento splittail).

a) **Reduced Transport of Young Fish from the Delta to Suisun Bay** nursery areas because of low Delta outflow reduces growth, survival, and abundance of important estuarine fish. (e.g., striped bass and delta smelt)

b) **Reduced Transport of Young Fish through the Delta** to the ocean limits survival and abundance of estuarine and anadromous fish. (e.g., Chinook salmon, steelhead, and American shad).

c) **Increased Transport of Young Fish from North to South across the Delta** and direct entrainment of fish because of high export-to-inflow ratios reduces survival and abundance of estuarine and anadromous fish (e.g., Chinook salmon, delta smelt, striped bass, steelhead, and American shad).

d) **Local Structures** block and alter transport flows and increase predation rates (e.g., Chinook salmon).

6. **Altered Migratory Cues** disrupt upstream and downstream movement of anadromous and estuarine fish (e.g., Chinook salmon, steelhead, and white sturgeon).

a) **Upstream Migration of Adult Salmonids through the Delta is Disrupted** by lack of olfactory cues caused by export of spawning-river water in the Delta.

b) **Outmigration of Juvenile Fish through the Delta is Hindered** by net downstream flow cues toward South Delta export pumps (e.g., delta smelt, striped bass, American shad, and Sacramento splittail).

c) **Upstream Migration of Adult Estuarine Fish into Delta and River Spawning Areas is Hindered** by altered net flow of water across the Delta.

7. **Reduced Food Chain Productivity** in aquatic habitats limits forage availability for fish species (e.g., delta smelt, longfin smelt, Sacramento splittail, Chinook salmon, striped bass, starry flounder, bay shrimp, and neomysis)

a) **Entrainment of Food Chain Productivity** limits habitat suitability for desirable fish species.

b) **High Concentrations of Toxicants** in the water column and in sediments may reduce production and survival of aquatic plants and invertebrates.

c) **Introduced Species** consume energy and occupy habitat space for important organisms.

d) **Reduced Residence Time of Water** in Delta channels limits plankton blooms.

e) **Reduction in Nutrient Inputs** from wetland and riparian habitats may limit aquatic productivity.

f) **High Salinity Levels** in Delta aquatic habitats limit seasonal productivity patterns of estuarine food-chain organisms.

g) **Reduction and Seasonal Shift of Freshwater Inflow to Estuary** directly limits primary and secondary productivity of the estuary during critical periods.

h) **Lack of Shallow Water Habitats in the Estuary** directly limits primary and secondary productivity .

8. **Excessive Concentrations of Toxic Constituents and their Bioaccumulation** directly limits survival and growth of desirable fish species (e.g., delta smelt, longfin smelt, Sacramento splittail, Chinook salmon, striped bass, and starry flounder).

a) **Excessive Pesticide Residues** directly affect some fish and wildlife species.

b) **Excessive Hydrocarbons, Heavy Metals, and other Pollutants** directly harm some fish and wildlife species.

B. **Important Wetland Habitats** are inadequate to support production and survival of wildlife species in the Delta. The problems for the specific wetland habitats include:

1. **Lack of Brackish Tidal Marsh Habitats** of high quality limits supportable populations of wildlife species that inhabit them (e.g., Suisun Slough thistle, Suisun Song Sparrow, and Snowy Egret).

a) **Altered Vegetation Composition** in brackish marshes caused by changes in salinity levels limits habitat suitability for some species.

b) **Reduced Areal Extent and Patchiness** of brackish marsh limits wildlife populations and genetic exchange.

c) **Inappropriate Salinity Levels** reduces forage production and habitat suitability for some species.

d) **Disconnection of Supporting Habitats** such as aquatic habitats and riparian woodlands and adjacent uplands limits productivity in brackish marshes.

2. **Lack of Freshwater Habitats** of high quality limits supportable populations of native wildlife species (e.g., giant garter snake, tri-colored blackbird, and Mason's lilaeopsis).

a) **Inappropriate Salinity Levels** do not support desirable vegetation composition and thereby limit habitat suitability for some species.

b) **Reduced Areal Extent** of high quality habitats does not support sustainable populations sizes of some wildlife species.

c) **Inappropriate Juxtaposition** of freshwater marsh habitats does not provide corridors for population movement and genetic exchange.

d) **Vulnerability of Levee Failure on Delta Islands** threatens sustainability of existing freshwater marshes.

3. **Limited Riparian Woodland Habitats** of high quality in the Delta reduces diversity and sizes of supportable native wildlife populations (e.g., Swainson's hawk, riparian brush rabbit, western yellow-billed cuckoo, neotropical migrant songbirds, and northern California black walnut).

   a) **Lack of Riparian Habitat Structure** near foraging areas limits nesting opportunities for some native bird species.

   b) **Fragmentation** of riparian habitat patches does not provide corridors for population movement and genetic exchange.

   c) **Limited Areal Extent** of riparian habitats prevents use by some native bird species.

   d) **Disconnection of Supporting Habitats** such as aquatic habitats and brackish marshes limits productivity in riparian woodlands.

4. **Reduced Breeding Waterfowl Habitats** limits production of desired populations of dabbling ducks (e.g., mallard, cinnamon teal, and wood duck).

   a) **Lack of Brood Habitat** of high quality near nesting habitat limits dabbling duck production.

   b) **Lack of Nesting Habitat** of high quality near brood habitat limits dabbling duck production.

5. **Reduction in Wintering Waterfowl Habitats** for foraging and resting limits desired populations of wintering waterfowl (e.g., Aleutian Canada goose, mallard, tundra swan, white-fronted goose).

   a) **Decreasing Waste Grain** on agricultural lands limits availability of waterfowl forage.

   b) **Lack of Resting Areas** near foraging areas limits wintering waterfowl populations that can be supported in the Delta.

   c) **Reduction in Historical Foraging Habitats** (e.g., freshwater marsh and brackish water marsh) limits availability of high quality foraging areas for wintering waterfowl.

   d) **Vulnerability of Levee Failure on Delta Islands** threatens sustainability of some wintering waterfowl habitats.

6. **Lack of Wintering Habitat for Greater Sandhill Cranes** limits wintering crane populations (e.g., lesser sandhill crane, greater sandhill crane).

   a) **Lack of Foraging Habitats** of high quality for cranes in proximity to roosting habitats limits supportable wintering populations.

   b) **Lack of Roosting Habitats** of high quality for cranes in proximity to foraging habitats limits supportable wintering populations.

7. **Lack of Connectivity among Wetland Habitats** does not provide corridors for population movement and genetic exchange.

8. **Restricted Flood Plains and Associated Riparian Habitat** of sufficient size and high quality in the Delta reduce the diversity and sizes of fish and wildlife populations.

   a) **Lack of Suitable Flood Plains** reduces the availability of temporarily flooded spawning habitat for fish such as the Sacramento splittail.

   b) **Narrow Restricted Channels** increase the risk of levee failure and subsequent catastrophic losses of wildife habitat protected by these levees.

C. **Populations of some species of plants and animals** dependent on the Delta have declined to the point that these species are endangered, threatened, or of special concern.

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WATER SUPPLY PROBLEMS

The problems of water supply associated with the Bay-Delta system can be divided into two basic categories: conflict among beneficial uses and economic impacts. If there were no conflict among competing beneficial uses, only hydrology would constrain exports or out-of-stream uses. The identified problems can be measured in two ways: adequacy of supply and predictability of supply. In turn, shortfalls or uncertainty are manifest in economic impacts.

The adequacy of a supply is the degree to which supply and demand are matched. Mismatches between supply and demand generally cause problems, both for water users and the environment. The predictability of a supply is the degree to which we can accurately predict supply or supply patterns in the future. Unpredictable supplies cause problems because they increase the likelihood that we will either overinvest in water supply (e.g., build unnecessary storage), underinvest in production (e.g., plant too few acres) or suffer unacceptable shortages.

In turn, problems with adequacy and predictability can be viewed from either planning or operational perspectives. An operational perspective looks at current water conditions and tries to project water supply patterns in the short-term (days, weeks, months, possibly years). A planning perspective does not look at current conditions, but attempts to define the water supply patterns that can be expected in the future over the long-term.

Finally, different end users use water differently. What is a problem for one user may not be a problem for another user. Thus, the various users of water must be considered separately. For example, urban and agricultural water users want supplies which are relatively consistent, year after year. By contrast, the environment requires variations in flows from year to year. Too many high flow or low flow years are undesirable.

Water Supply
Problem Statements

Bay-Delta water supplies are insufficient to meet current and projected beneficial uses dependent on the Bay-Delta system. As instream and out-of-stream water demands have grown, water shortages for all the uses have become larger and more frequent and water supplies have grown less predictable. This water reliability problem is projected to become more acute over time.

The major problems can be categorized as follows:

A. **Bay-Delta system water supply quantities and timing** do not meet short- and long-term beneficial use needs.

1. The Bay -Delta system supplies do not meet the short- and long-term **in-Delta** beneficial use needs.

   a. **In-Delta short-term water supplies** do not meet needs in water short periods for the following two users:

      a.1. Water supply quantities and timing do not meet short-term (existing and future) **agricultural water needs.**

      a.2. Water supply quantities and timing do not meet short-term **environmental water needs** (see Ecosystem Quality section).

   b. The Bay-Delta system water supplies are inadequate to meet **projected long-term in-Delta** needs for the following three users:

      b.1. Water supply quantities and timing do not meet long-term (existing and future) **agricultural water needs**.

      b.2. Water supply quantities and timing do not meet long-term (existing and future) **urban water needs**.

      b.3. Water supply quantities and timing do not meet long-term **environmental water needs** (see Ecosystem Quality section).

2. Bay-Delta **system export water supply** quantities and timing do not meet short- and long-term needs and the opportunities for transferring water across the delta are limited.

   a. **Short-term export water supplies** do not meet needs in water short periods for the following three users:

      a.1. Water supply quantities and timing for export do not meet short-term (existing and future) **agricultural water needs.**

      a.2. Water supply quantities and timing for export do not meet short-term (existing and future) **urban water needs**.

      a.3 Water supply quantities and timing for export do not meet short-term **environmental water needs** (see Ecosystem Quality section).

   b. The Bay-Delta system water supplies are inadequate to meet projected **long-term export water needs** for the following three users:

b.1. Water supply quantities and timing for export do not meet long-term (existing and future) **agricultural water needs**.

b.2. Water supply quantities and timing for export do not meet long-term (existing and future) **urban water needs**.

b.3. Water supply quantities and timing for export do not meet long-term **environmental water needs** (see Ecosystem Quality section).

3. Available water does not meet short-and long-term expected needs for **Delta outflow**; (see Ecosystem Quality and Water Quality sections).

B. **Bay-Delta system water supplies are uncertain** with respect to short- and long-term needs as shown below:

1. The water supply in and from the Bay-Delta system is unreliable due to the **vulnerability of the levees** that protect it (see Vulnerability of Delta Functions Section).

2. The amount of water available from the Bay-Delta system from season to season and from year to year **cannot be predicted** with desired certainty.

a. The amount of water available from the Bay-Delta system over the **short-term** cannot be predicted with sufficient certainty for the following three water users:

a.1. **Agricultural water** users cannot plan and manage for efficient water use due to the unpredictability of the water supply available in the coming season.

a.2. **Urban water** users cannot plan and manage for efficient water use due to the unpredictability of the water supply available in the coming season.

a.3. **Environmental water** users cannot plan and manage for efficient water use due to the unpredictability of the water supply available in the coming season; (see Ecosystem Quality section)

b. The amount of water available from the Bay-Delta system over the **long-term** cannot be predicted with sufficient certainty for the following three water users:

b.1. Long-term regional planning for **agricultural water** supply cannot be conducted with sufficient certainty due to the unpredictability of available Bay-Delta system water supply.

b.2. Long-term regional planning for **urban water** supply cannot be conducted with sufficient certainty due to the unpredictability of available Bay-Delta system water supply.

b.3. Long-term regional planning for **environmental water** supply cannot be conducted with sufficient certainty due to the unpredictability of available Bay-Delta system water supply; (see Ecosystem Quality section)

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VULNERABILITY OF BAY-DELTA SYSTEM FUNCTIONS PROBLEMS

Many of the "problems" commonly listed for the vulnerability of Bay-Delta system functions are actually causes of problems. For example, poor levee construction, poor maintenance, the lowering of the islands due to subsidence, levee instability, and lack of resistance to earthquake and floods are causes of the problems tied to levee failure. Four major problems for the vulnerability of Bay-Delta system functions due to potential failure of Delta levees were identified. Inundation could result in loss of land use and associated economies, damage ecosystem habitats, endanger water supply reliability, and damage infrastructure in the Delta.

Draft

Vulnerability of Bay-Delta Sytems Functions

Problem Statements

The Bay-Delta system is subject to an unacceptably high risk of catastrophic inundation of Delta islands due to potential levee failure from earthquakes, floods, and physical condition. Inundation would result in loss of agricultural production, wildlife habitat and infrastructure, and could result in increased salinity intrusion into the Delta, adversely affecting habitat and water supply operations. Periodic levee failures indicate that the risk of inundation is unacceptably high. Other disruptive events could include losses from toxic spills. The major problems are:

A. **Existing Agricultural Land Use and Economic Activities in the Delta are at Risk from Catastrophic Inundation of Delta Islands.** Inundation of one or more islands in the Delta would disrupt farming operations and other land uses either permanently or for a significant period of time until repairs could be made.

B. **Water Supply Facilities and Operations in the Delta are at Risk from Catastrophic Inundation of Delta Islands.** Inundation of one or more key islands in the western and central Delta would accelerate salinity intrusion into the Delta. This salinity intrusion could result in a need to stop export pumping, perhaps for extended periods, until flushing flows from upstream reservoirs lower salinity in the Delta water supply to acceptable levels. Stored water supplies in upstream reservoirs could be seriously depleted. Other disruptive events that could require stopping export pumping and release of increased flushing flows include risk from toxic spills.

C. **Existing Infrastructure in the Delta is at Risk from Catastrophic Inundation of Delta Islands.** Inundation of roads, electric power lines, telephone lines, gas mains, and other infrastructure could cause lengthy breaks in service. In addition, several State highways and many Delta roads run along levees that are vulnerable to collapse due to overtopping, seismic events, or structural failure. Major water pipelines also pass through the Delt and are at risk of failure. Even if they survive the initial effects of inundation, long-term inundation would make continued maintenance and repair much more difficult.

D. **The Existing Delta Ecosystem is at Risk from Catastrophic Inundation of Delta Islands.** Significant habitat for terrestrial species would be severely damaged by inundation of one or more Delta islands. If the inundation continued for extended period, survival of flora and fauna dependent on the habitat would be critically reduced. In addition, as described in B above, salinity intrusion into the Delta would likely increase causing significant impacts to aquatic freshwater habitat.

Other Issues Raised

During development of the problem definition, the Bay-Delta Program has received numerous suggestions and comments on causes of the problems in the Delta, potential actions to resolve problems, and possible objectives for the program. These suggestions were received at the first public workshop, BDAC meetings, CALFED meetings, agency meetings, internal staff discussions, and numerous public presentations by the program staff.

The following listing is not a complete listing of causes, actions, or objectives. The lists will be developed and refined in the next steps of the solution-finding process over the next several months.

WATER QUALITY

CAUSES

Pollutant Causes

- Agriculture and water hyacinth control cause herbicide problem
- Outboard motor effluent causes hydrocarbon discharge
- Car/street runoff/air are hydrocarbon source
- Lawns/gardens/golf courses etc. (non-agriculture) are source of pesticides
- Agricultural drainage increases contaminants in Delta
- Natural runoff and wastewater contribute pollutants
- Toxic spills could contribute pollutants
- Contaminant accumulation in sediment (with dredging and other resuspension of contaminants)
- Contaminant accumulation in biological resources

Water Quality Causes Related to Water Supply

- Reduced water quantity contributes to water quality problems
- Diversion of water from Delta affects water quality (reduces dilution, increases salinity)
- Upstream water operational changes affect water quality
- Hydropower affects water temperature
- Too dependent on water from area of origin to meet water quality needs
- Water cost to meet water quality needs for the environment
- Level of diversion too high (reduces dilution of water quality problems)
- Overdrafting groundwater increases salinity intrusion into groundwater basins

Natural Constituents Causes

- Total organic carbon in Delta contributes to treatment byproducts
- Salinity intrusion in Delta raises salinity in water supplies
- Salts from agricultural drainage raises salinity in water supplies
- Sediments and silt south of Delta (plugs sprinklers)
- Wind driven sediments increase turbidity in South Delta
- Sediments bury fish eggs and silt up channels (habitat connections)
- Sediments affect navigation
- Algal blooms reduce dissolved oxygen

Other Causes

- Water quality regulations constrain actions
- Politics constrain actions
- Undesirable plant species obstruct recreation

ACTIONS

_ Watershed management improves water quality
_ Reduce entitlement for water from Delta

OBJECTIVES

_ Need to define what we are looking for as a preferred condition

Ecosystem Quality

CAUSES

Causes of Species Problems

- Ballast water releases and other sources introduce exotic species
- Changes in habitat and other perturbations involving flows, food, and pollutants reduce species populations
- Structures cause enhanced predation
- Poaching reduces populations
- Unscreened diversions reduce fish populations
- Structures block migration
- Enhanced and unnatural predation reduces populations
- Limitation of critical habitat reduces populations
- Displacement of native species (desired) by exotic and/or undesired species affects ecosystem dynamics and habitat and reduces diversity
- Reduced flows and unnatural flows interfere with migration

Water-based Causes of Habitat Problems

- Changes in water flow and timing affect habitats
- Dredging alters aquatic habitat
- Boat wakes alter shallow water habitat
- Removal of woody debris and snags reduces protective cover
- Boat wakes disturb riparian habitat
- Channelization increases water flow
- Reversal and alteration of natural flows affects size and distribution of habitat
- Decreased residence time of water in the Delta reduce nutrient availability
- Changing salinity levels shift tidal wetland habitats

Land-based Causes of Habitat Problems

- Changes in upstream areas affects quality of Delta uses
- Changes in land use and land management in the Delta and upstream affects habitat quality
- Sediments and silts in the headwaters cause problems in Delta
- Changes in land use result in loss of habitat and reduced water quality
- Land uses that support habitat are threatened
- Design of Delta channels affects riparian habitat
- Loss of riparian habitat increases water temperature
- Riprap levees have caused the loss of riparian habitat and shade, raising water temperature

- Loss of escape cover reduces habitat quality
- Terrestrial habitats in Delta are dependent on levees
- Levees are habitat
- Subsidence makes it harder to restore habitat - land too low
- Agriculture-based wetlands contribute to other Delta problems (salts, herbicides) (asked as a question)
- Intrusion of exotic species into wetlands (grasses) reduces habitat quality
- Water diversions divert biological productivity
- Human management requires tradeoffs between habitats

Other Causes

- Regulatory system makes it difficult to recreate habitats

ACTIONS

- Dams are a surrogate for nature (sediment trap and temperature control)
- Harvest regulation must consider illegal harvest
- Improve harvest management

OBJECTIVES

- Diversity of self-sustaining habitats in Delta
- Re-establish desirable natural communities
- Need to understand how system did work

OTHER ISSUES IDENTIFIED

- Funding for restoration is inadequate
- No funding source

Water Supply

CAUSES

Causes of Predictability Problems

- Lack of understanding of system yield decreases reliability of predictions and forecasts
- Endangered Species Act fish take limits create uncertainty in modeling of water availability and predictability
- Premise that adequate Delta outflow is 1200 to 1500 cubic feet per second results in unrealistic forecasts of water availability
- Lack of certainty about accretions and depletions in dry years reduces predictability
- Conservative estimate of available flow due to early forecast each year reduces water availability
- Lack of knowledge of water use patterns increases uncertainty
- Predicting need for water is difficult because there is incomplete understanding of how much water is diverted
- Inadequate understanding of how much, when, and where water is taken causes unpredictability

Causes of Flexibility Problems

- Inadequate and arcane legal system to deal with water rights constrains flexibility to meet water needs
- Competition for water occurs when users are at their peak demand, causing increased urgency and conflict
- The regulatory process for water transfer constrains transfers
- California water supply is <u>not</u> reliable due to regulatory climate
- The timing of water availability constrains transfers
- Uncertainty in area of origin statutes. Public trust doctrine.
- Dependence on water from Delta reduces flexibility

Causes of Water Supply Problems

- Wrong location for a diversion reduces export availability
- Lack of upstream and downstream storage reduces supply availability
- Design of system doesn't allow for separation of water for different uses
- Lack of ground water management contributes to water reliability problem
- Lack of conjunctive use contributes to water reliability problem
- Insufficient facilities to allow for ground water storage
- Inadequate use of water management techniques reduces available water

- Insufficient use of operational and management tools reduces water availability
- Insufficient or fluctuating water levels reduce ability to divert water
- Increasing demand results in inadequate supply
- Cropping patterns increase water needs
- Salinity and other water quality problems increase water usage for dilution

Other Causes

- Trying to meet water quality requirements of the Delta on backs of few basins rather than all results in unfair use of water
- Cost of other sources of water (desalination) force continued look at surface and ground water
- Pricing of water does not maximize beneficial use
- The exotic zebra mussel will impair flow through fish screens

ACTIONS

- More storage
- Water transfers (voluntary)
- Conjunctive use
- Groundwater recharge
- Change water prices
- Change crop patterns

OBJECTIVES

- Greater fairness and equity in use of water to meet water quality requirements
- Flexibility of solutions
- Measure acceptable reliability
- Reduce conflict among users

OTHER ISSUES IDENTIFIED

- Measure water consumer satisfaction (to identify when you're done)

System Vulnerability

CAUSES

- Flood management affects Delta functions
- High cost of failure caused by current water supply system and land use
- Levee failure would affect water quality
- Land uses affect levee stability
  Boat traffic (waves) erodes unarmored levee surfaces
- Uncoordinated releases upstream raise water levels against levees
- Extreme fluctuation and range of water levels reduces levee stability
- Subsidence in Delta reduces levee stability
- Rising sea level reduces levee stability
- Strengthening some levees transfers problem
- Local solutions may exacerbate Delta problems
- Dredging reduces stability of levees
- Institutional fragmentation contributes to ineffective levee maintenance
- A toxic spill would affect water quality

ACTIONS

- Flood islands
- Disaster preparedness contingencies
- Form SWAT team to respond to emergencies
- Relocate assets at risk
- Setback levees - Nature Policy Plan example
- Plan for accretion of Delta soils
- Use clean sediment for levees and other actions
- Comprehensive management approach

OTHER ISSUES IDENTIFIED

- Unreliability of federal and state funding for flood protection
- Regulatory constraints relating to levees
- Funding for levee construction/repairs
- Lack of understanding of levee structure
- Subsidence problem is getting smaller (islands reaching a stable compaction)
- Can't fix part of levee problem
- System is brittle - some points are more brittle or vulnerable
- There is a conflict between maintenance of levees and levee habitat
- There is a conflict between maintenance of habitat and maintenance of recreation

Comments on Process and Approach

- Delta is not broken; it is unravelled
- Think about how problems aggravate others
- If you focus only on those four problems may not have full scope
  - Need people as the cause and link existing and potential uses to solutions
  - All users need to be involved
- The geographic limit of the problem set is too narrow; different from solution geographic limit
- Delta broken because some Delta functions depend on water from outside watershed
- Another way to "map" the problem - start with a phenomenon and look at causes
- The definition of a "problem" is not clear. "The Delta broken because of TOC" is not the problem--is TOC a "problem" because of or to the drinking water treatment process?
- The Delta is not meeting beneficial uses
- Another way to frame the problem: people have different sets of objectives; something which prevents them from attaining their objectives is a problem
- We don't understand very well how these problems work; we need adaptive management
- Beneficial uses of hydropower negatively affected by potential water quality changes
- Impacts of solutions on water supply outside Delta (upstream)
- Area of origin issues
- Think about the quality of water and sediments

OBJECTIVES PACKAGE

During the first public workshop (August, 3, 1995) participants said that some initial written materials on Bay-Delta system problems would have facilitated the discussions and brainstorming on the problem definition. Therefore, this draft Objectives Package was prepared to provide initial ideas for potential objectives to address the problem statements. All of the objective statements are preliminary and subject to modification as more input is received.

Objectives describe what a stakeholder really cares about, reflecting underlying values. The wording in the following objective statements is linked closely with the wording in the preceding problem statements. Where the problem describes a condition, occurrence, or potential consequence, the objectives describe a condition or occurrence to be achieved or to strive for, or an aspect of performance with a threshold that must be exceeded in order to fulfill the objective.

A draft of the CALFED Bay-Delta Program mission statement is attached on the following page in graphical format. The graphic shows the relationship of the mission to the draft objectives for each problem area.

Your review of this material before the meeting and your contributions during the meeting will help progress towards refined objectives statements.

B-000483

CALFED BAY-DELTA PROGRAM

MISSION STATEMENT

The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan to restore ecological health and to improve water management and beneficial uses in the Bay-Delta System

WATER QUALITY

Provide adequate water quality for all beneficial uses

ECOSYSTEM QUALITY

Improve and increase aquatic and terrestrial habitats and ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species

WATER SUPPLY

Improve the ability of the Bay-Delta system to meet current and projected water supply beneficial uses

VULNERABILITY OF BAY-DELTA SYSTEM FUNCTIONS

Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic inundation of Delta islands

See Objectives Trees for Each

Draft Revised: 8/30/95

Water Quality
Objective Statements

Provide adequate water quality for all beneficial water users.

The major objectives can be categorized as follows:

A. Provide adequate water quality in Delta Water exported for **Drinking Water** needs.

1. **Reduce** the level of water quality parameters of **Concern to Human Health** in raw water supply or treat to reduce concern.

2. **Reduce** the water quality parameters that cause **Aesthetic Effects**, in particular concerning taste, odor and appearance in raw water supply or treat to reduce effects.

3. **Minimize the Cost of Treating** Delta water and continue to meet the existing drinking water quality standards.

4. **Minimize the Fluctuation of Raw Water Quality** to improve water treatment plant operation.

5. **Improve Raw Water Quality** and/or treatment to comply with stricter future regulations.

B. Provide adequate water quality for **Agricultural** use.

1. Improve water quality to **Maintain or Improve Agricultural Economic productivity** by reducing water quality contaminants that reduce crop productivity, cropping choices, or increase cost.

2. Improve water quality or recommend change in irrigation technology to **Minimize Operational Difficulties**.

3. **Reduce Salinity Levels** to minimizethe risk of polluting other surface and groundwater supplies from agricultural drainage.

C. Provide adequate water quality for **Industrial** use.

1. **Reduce Industrial Treatment and/or Production Costs**.

2. **Minimize the Fluctuation of Raw Water Quality** to improve industrial plant operations.

D. Provide adequate water quality for water **Recreational** use.

1. **Reduce Health Risk** to recreationists.

   a. **Reduce Health Risk Associated with Body Contact** recreational activities.

   b. **Reduce Health Risk Associated with Consuming Fish** caught in the Delta.

2. **Improve Aesthetic Conditions** in the Delta, in particular taste, odor and appearance.

3. **Reduce Occurrence of Nuisance Vegetation** that may impede recreational boating.

E. Provide adequate water quality for Environmental needs. (see Ecosystem Quality)

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Ecosystem Quality Objective Statements

Improve and increase aquatic and terrestrial habitats and ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species.

A. **Improve and Increase Aquatic Habitats** so that they can support the sustainable production and survival of native and other desirable estuarine and anadromous fish in the estuary.

1. **Increase Amount of High Quality Shallow Riverine Habitat** to allow sustainable fish spawning and early rearing.

   a) **Increase Amount of Quality Riverine Edge Habitat** to allow spawning and rearing by a sustainable population of native fish species.

   b) **Increase Amount of Quality Shallow Shoal Habitat** within the main channels of the Delta and upper Bay to allow shallow foraging by a sustainable population of juvenile estuarine fish.

2. **Increase Amount of High Quality Shaded Riverine Habitat** to allow the growth and survival of sustainable populations of estuarine resident and anadromous fish in the estuary.

   a) **Increase Amount of Quality Riparian Woodland Habitat** to allow production of terrestrial food sufficient to support sustainable populations of resident and anadromous fish.

   b) **Increase Amount of Large, Woody Debris** along Delta levees to allow juvenile and adult feeding and refuge for sustainable populations of fish.

3. **Increase Amount of Quality Tidal Slough Habitat** containing emergent and submerged vegetation to support the fish-production capacity of the Delta.

   a) **Increase Amount of Dead-End Slough Habitat** to allow spawning and rearing of sustainable populations of some resident species.

   b) **Increase Amount of Open-Ended Slough Habitat** to allow spawning and rearing of sustainable populations of some resident species.

   c) **Reduce Water Hyacinth** populations in tidal slough habitats to improve habitat quality for sustainable populations of Delta fish.

   d) **Increase Amount of High Quality Tidal Slough Habitat** to allow increased energetic exchange between aquatic and terrestrial ecosystems.

4. **Increase Amount of High Quality Estuary Entrapment/Null Zone Habitat** to support sustainable fish populations in the Delta.

   a) **Reduce Saltwater Intrusion** into Suisun Bay to increase the nursery area for sustainable populations of plants and animals.

b) **Expand** the geographic extent of **Low Salinity Habitat** in Suisun Bay.

c) **Increase** the occurrence of **Brackish Water Habitat** in San Pablo Bay during the winter and spring to support sustainable populations of Bay species.

5. **Provide Sufficient Transport Flows** at the proper times to move juvenile fish from spawning habitats to nursery habitats in the Delta and Bay.

a) **Increase the Transport of Young Fish from the Delta to Suisun Bay** nursery areas to support sustainable populations of important estuarine species.

b) **Increase the Transport of Young Fish Through the Delta** to the ocean to support sustainable populations of estuarine and anadromous fish species.

c) **Reduce the Transport of Young Fish from North to South across the Delta** and the entrainment of fish in the Delta to increase the survival and abundance of estuarine and anadromous species.

d) **Reduce the Blockage of and Alterations to Transport Flows** by local structures.

6. **Reestablish Appropriate upstream and downstream movement** of anadromous and estuarine fish.

a) **Enhance Upstream Migration of Adult Salmonids** through the Delta.

b) **Increase Successful Outmigration of Juvenile Fish through the Delta.**

c) **Enhance Upstream Migration of Adult Estuarine Fish into the Delta and River Spawning Areas.**

7. **Improve the Productivity of the Aquatic Habitat Food Chain** to support sustainable populations of desirable fish (and other) species.

a) **Reduce Entrainment** of biological productivity throughout the aquatic food chain.

b) **Reduce Concentrations of Toxicants** in the water column and in sediments.

c) **Reduce the Effects of Introduced Species** on ecosystem productivity and in competing with desirable species for habitat.

d) **Increase the Residence Time of Water in Delta Channels** to increase plankton productivity and reduce undesirable algal-mat growth in the Delta.

e) **Increase the Input of Nutrients** from wetland and riparian habitats to aquatic habitats.

f) **Reduce Salinity Levels** in Delta aquatic habitats.

g) **Increase Flows of Freshwater** into the Estuary.

h) **Increase Amount and Quality Shallow Water Habitats** in the Estuary.

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8. **Reduce Concentrations of Toxic Constituents and Their Bioaccumulation** to eliminate their adverse effects on populations of fish and wildlife species.

   a) **Reduce the Concentrations of Pesticide Residues** in Delta water and sediments.

   b) **Reduce the Concentrations of Hydrocarbons, Heavy Metals, and other Pollutants** in Delta water and sediments.

B. **Improve and Increase Important Wetland Habitats** so that they can support the sustainable production and survival of wildlife species.

1. **Increase the Amount of High Quality Brackish Tidal Marsh Habitat** to better support sustainable populations of native wildlife species in the Delta.

   a) Modify salinity levels in Brackish Tidal Marshes to **Improve their Vegetation Composition.**

   b) **Increase the Areal Extent of Brackish Tidal Marsh Habitats.**

   c) **Restore Appropriate Salinity Levels** in brackish tidal marshes to enhance forage productivity and habitat suitability for some native species.

   d) **Improve the Connectivity** Between Brackish Tidal Marsh Habitats **and Their Supporting Habitats** such as aquatic habitats and riparian woodlands and adjacent uplands.

2. **Increase the Amount of High Quality Freshwater Marsh Habitat** to better support sustainable populations of native wildlife species in the Delta.

   a) **Restore Appropriate Salinity Levels** in freshwater marsh habitat in the Delta to enhance forage productivity and habitat suitability for some native species.

   b) **Increase the Areal Extent** of freshwater marsh habitats.

   c) **Improve the Juxtaposition** of freshwater marsh habitats to provide corridors for population movement and genetic exchange for dependent species.

   d) **Reduce the Vulnerability** of existing freshwater marshes to levee failure.

3. **Increase the Amount of High Quality Riparian Woodland Habitat** in the Delta to better support sustainable populations of native wildlife populations.

   a) **Increase Amounts of Riparian Habitat Structure** for nesting near foraging areas for some native bird species.

   b) **Reduce the Fragmentation** of riparian woodland habitat patches to provide corridors for population movement and genetic exchange for dependent species.

   c) **Increase the Areal Extent** of riparian woodland habitats.

   d) **Improve the Connectivity** Between Riparian Woodlands and Their Supporting Habitats such as aquatic habitats and brackish marsh habitats.

4. **Increase the Amount of Breeding Waterfowl Habitat** to better support sustainable populations of dabbling ducks.

   a) **Increase the Amount of High Quality Brood Habitat** near nesting habitat for dabbling ducks.

   b) **Increase the Amount of High Quality Nesting Habitat** near brood habitat for dabbling ducks.

5. **Increase the Amount of Wintering Waterfowl Habitat** for foraging and resting to better support sustainable populations of wintering waterfowl.

   a) **Increase** supplies of suitable forage such as **Waste Grain** on agricultural lands.

   b) **Increase** the amount of **Resting Areas** near foraging areas for wintering waterfowl.

   c) **Increase** the amount of high quality **Foraging Areas** (e.g. freshwater marsh and brackish water marsh) for wintering waterfowl.

   d) **Reduce the Vulnerability** of some existing Wintering Waterfowl Habitats to levee failures.

6. **Increase the Amount of Wintering Habitat for Greater Sandhill Cranes** to better support sustainable populations.

   a) **Increase** the amount of **Foraging Habitat** in proximity to roosting habitat.

   b) **Increase** the amount of **Roosting Habitat** in proximity to foraging habitat.

7. **Improve the Connectivity Among Wetland Habitats** to provide corridors for population movement and genetic exchange.

8. **Increase Flood Plains and Associated Riparian Habitat** to improve diversity and sizes of fish and wildlife populations.

   a) **Increase** suitable flood plains to improve the availability of **Temporary Flooded Spawning Habitat** for fish.

   b) Improve narrow restricted channels to **Reduce the Risk of Catastrophic Losses** of wildlife habitat from levee failure.

C. **Increase population health and population size** of Delta species to levels that assure sustained survival.

Water Supply
Objective Statements

Improve the ability of the Bay-Delta system to meet current and projected water supply beneficial uses.

A. Improve the adequacy of Bay-Delta system water **supply quantities and timing** to help meet reasonable **short- and long-term beneficial use** needs.

1. Maintain adequate Bay -Delta system supplies to meet the short- and long-term **in-Delta** beneficial use needs.

   a) Maintain or provide adequate **in-Delta short-term water supplies** in water short periods for the following two users:

      a.1) Maintain water supply quantities and timing that meet short-term expected (existing and future) **agricultural water needs**.

      a.2) Provide water supply quantities and timing that meet short-term expected **environmental water needs** (see Ecosystem Quality section).

   b) Maintain or improve the adequacy of Bay-Delta system water supplies to meet **long-term** needs of in-Delta beneficial use for the following three users:

      b.1) Maintain adequate water supply quantities and timing that meet long-term (existing and future) **agricultural water needs**.

      b.2) Maintain adequate water supply quantities and timing that meet long-term expected (existing and future) **urban water demands**.

      b.3) Provide adequate supply quantities and timing that meet long-term expected **environmental water demands** (see Ecosystem Quality section).

2. Improve Bay-Delta **system export water supply** quantities and timing to help meet reasonable short- and long-term needs.

   a) Improve **adequate short-term export water supplies** during water short periods for the following three users:

      a.1) Water supply quantities and timing for export to help meet short-term (existing and future) **agricultural water needs**.

      a.2) Water supply quantities and timing for export to help meet short-term (existing and future) **urban water needs**.

      a.3) Water supply quantities and timing for export to help meet short-term **environmental water needs** (see Ecosystem Quality section).

   b). Provide Bay-Delta water supplies that are adequate to help meet **long-term export water projections** of beneficial use need for the following three users:

      b.1) Water supply quantities and timing for export to help meet long-term (existing and future) **agricultural water needs**.

b.2) Water supply quantities and timing for export to help meet long-term (existing and future) **urban water needs**.

b.3) Water supply quantities and timing for export to help meet long-term **environmental water needs** (see Ecosystem Quality section).

3. Improve the adequacy of Bay-Delta water to meet short-and long-term expected needs for **Delta outflow**; (see Ecosystem Quality section).

B. Reduce the uncertainty of **Bay-Delta system water supplies** to help meet short- and long-term needs as shown below:

1. Improve the reliability of the Bay-Delta system by reducing the **vulnerability of the levees** that protect it (see Vulnerability of Delta Functions Section).

2. **Improve the Predictability** of the amount of water available from the Bay-Delta system from season to season and from year to year.

a) Improve the predictability of the amount of water available from the Bay-Delta system over the **short-term** for the following three water users:

a.1) Improve predictability for **agricultural water** supplies for planing and management for efficient water use in the coming season.

a.2) Improve predictability for **urban water** supplies for planing and management for efficient water use in the coming season.

a.3) Improve predictability for **environmental water** supplies for planning and management for efficient water use in the coming season; (see Ecosystem Quality section)

b) Improve the predictability for the amount of water available from the Bay-Delta system over the **long-term** for the following three water users:

b.1) Improve long-term predictability for **agricultural water** supplies.

b.2) Improve long-term predictability for **urban water** supplies.

b.3) Improve long-term predictability for **environmental water** supplies. (see Ecosystem Quality section)

Draft

Vulnerability of Bay-Delta Systems Functions

Objective Statements

Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic inundation of Delta islands.

A. **Reduce the risk to existing land use and associated economic activities** from catastrophic inundation of Delta islands.

B. **Reduce the risk to water supply facilities and operations** in the Delta from catastrophic inundation of Delta islands or other disruptive event such as a toxic spill.

C. **Reduce the risk to existing infrastructure** in the Delta from catastrophic inundation of Delta islands.

D. **Reduce the risk to existing Delta ecosystem** from catastrophic inundation of Delta islands.

Water Quality Problems

The water quality in the Bay-Delta is insufficient to meet the beneficial uses of the Delta water. At times, water quality standards have not been met and contaminents have been found in some fish and wildlife species triggering public health warnings.

- **A. Drinking Water Quality (inadequate)**
  - A.1. Adverse Human Health Effects
  - A.2. Adverse Aesthetic Conditions
  - A.3. Increased Cost of Treatment to Meet Drinking Water Standards
  - A.4. Treatment Plant Difficulties with Fluctuating Raw Water Quality
  - A.5. Uncertainty on Ability to Treat Future Drinking Water Standards
- **B. Agricultural Water Quality (indadequate)**
  - B.1. Reduced Agricultural Economic Productivity
  - B.2. Operational Difficulties from Sediments
  - B.3. Salinity Drainage Problems to Surface and Groundwater
- **C. Industrial Water Quality (inadequate)**
  - C.1. High Cost of Treatment and Production
  - C.2. Operational and Treatment Difficulties with Fluctuating Raw Water Quality
- **D. Recreational Water Quality (indadequate)**
  - D.1. Human Health Risk
    - D.1.a. Body Contact Activities (quality risk)
    - D.1. b. Fish Consumption (quality risk)
  - D.2. Aesthetic Conditions (inadequate)
  - D.3. Nuisance Vegetation for Recreational Boating
- **E. Environmental Water Quality (see Ecosystem Quality tree)**

Ecosystem Quality Problems

The Bay-Delta Ecosystem does not support high quality habitats for diverse and valuable plant and animal species. Many plant and animal species that use the Bay-Delta have experienced moderate to severe declines.

A. Aquatic Habitats
(inadequate)
Examples of affected species include delta smelt, longfin smelt, splittail, Chinook salmon, striped bass, and American shad.

- A.1. Shallow Riverine (lacking)
  - A.1.a. Riverine Edge (lacking)
  - A.1.b. Shallow Shoal (lacking)
- A.2. Shaded Riverine Aquatic (lacking)
  - A.2.a. Riparian Woodland (lacking)
  - A.2.b. Woody Debris (lacking)
- A.3. Tidal Slough (lacking)
  - A.3.a. Dead-End Sloughs (lacking)
  - A.3.b. Open-Ended Sloughs (lacking)
  - A.3.c. Water hyacinth occupies habitats
  - A.3.d. Energetic Exchange (limited)
- A.4. Null-Zone (upstream relocation)
  - A.4.a. Saltwater Intrusion into Suisun Bay
  - A.4.b. Low Salinity (confined to deeper channels)
  - A.4.c. Brackish Water (less frequently in San Pablo Bay)
- A.5. Transport flows (reduced; altered)
  - A.5.a. Young Fish to Suisun Bay (reduced transport)
  - A.5.b. Young Fish through Delta (reduced transport)
  - A.5.c. Young Fish across Delta (increased transport)
  - A.5.d. Structural Blockages (altered flows)
- A.6. Migratory Cues (altered)
  - A.6.a. Upstream Migration of Adult Salmonids (disrupted)
  - A.6.b. Outmigration of Juvenile Fish (hindered)
  - A.6.c. Upstream Migration of Estuarine Fish (hindered)
- A.7. Food Chain Productivity (reduced)
  - A.7.a. Food Chain Productivity (entrained)
  - A.7.b. Toxicants (excessive)
  - A.7.c. Introduced Species (occupy habitat)
  - A.7.d. Residence Time (reduced)
  - A.7.e. Nutrient Inputs (reduced)
  - A.7.f. Salinity Levels (inappropriate)
  - A.7.g. Freshwater Inflow (reduced)
  - A.7.h. Shallow water habitat (lacking)
- A.8. Toxicity and Bioaccumulation (excessive)
  - A.8.a. Pesticide Residue (excessive)
  - A.8.b. Hydrocarbons and Heavy Metals (excessive)

B. Wetland Habitats
(inadequate)
Examples of affected species include wintering and breeding waterfowl, sandhill cranes, and neotropical migrants.

- B.1. Brackish Tidal Marsh (lacking)
  - B.1.a. Vegetation Composition (inappropriate)
  - B.1.b. Areal Extent (reduced)
  - B.1.c. Salinity Levels (inappropriate)
  - B.1.d. Supporting Habitats (disconnected)
- B.2. Freshwater Marsh (lacking)
  - B.2.a. Salinity Levels (inappropriate)
  - B.2.b. Areal Extent (reduced)
  - B.2.c. Juxtaposition (not connected)
  - B.2.d. Levee Failure (vulnerable)
- B.3. Riparian Woodland (insufficient)
  - B.3.a. Habitat Structure (inappropriate)
  - B.3.b. Fragmentation (increased)
  - B.3.c. Areal Extent (limited)
  - B.3.d. Supporting Habitats (disconnected)
- B.4. Breeding Waterfowl Habitats (reduced)
  - B.4.a. Nesting Habitat near Brood Habitat (lacking)
  - B.4.b. Brood Habitat near Nesting Habitat (lacking)
- B.5. Wintering Waterfowl Habitats (insufficient)
  - B.5.a. Waste Grain (decreasing)
  - B.5.b. Resting Areas (insufficient)
  - B.5.c. Historical foraging areas (reduced)
  - B.5.d. Levee Failure (vulnerable)
- B.6. Wintering Habitat for Cranes (insufficient)
  - B.6.a. Foraging Habitats (insufficient)
  - B.6.b. Roosting Habitats (insufficient)
- B.7. Habitat Connectivity (lacking)
- B.8. Flood Plains (too restrictive)
  - B.8.a. Temporary Flooded Habitat (inadequate)
  - B.8.b. Habitat Protected by Levees (vulnerable)

C. T&E Species Recovery
(needed)

Draft Revised: 8/30/95

Water Supply Problems

Bay-Delta water supplies are insufficient to meet current and projected beneficial uses dependent upon the Bay-Delta water system. As instream and out-of-stream water demands have grown, water shortages for all the uses have become larger and more frequent and water supplies have grown less predictable. This water reliability problem is projected to become more acute over time.

- **A. Supply Quantities and Timing** (do not meet needs)
  - A.1. In-Delta Supply Needs (often not met)
    - A.1.a. Short-Term Supply (often not met)
      - A.1.a.1. Agriculture Needs (often not met)
      - A.1.a.2. Environmental Needs (see Ecosystem Quality tree)
    - A.1.b. Long-Term Supply (may not be met based on projections)
      - A.1.b.1. Agriculture Needs (not met)
      - A.1.b.2 Urban Needs (not met)
      - A.1.b.3. Environmental Needs (see Ecosystem Quality tree)
  - A.2. Export Supply Demands ("Project" and transfers not met)
    - A.2.a. Short-Term Supply (often not met)
      - A.2.a.1. Agriculture Needs (often not met)
      - A.2.a.2. Urban Needs (often not met)
      - A.2.a.3. Environmental Needs (see Ecosystem Quality tree)
    - A.2.b. Long-Term Supply (may not be met based on projections)
      - A.2.b.1. Agriculture Needs (not met)
      - A.2.b.2. Urban Needs (not met)
      - A.2.b.3. Environmental Needs (see Ecosystem Quality tree)
  - A.3. Delta Outflow Needs (see Ecosystem Quality tree)
- **B. Supplies are Uncertain**
  - B.1 Supplies are Vulnerable (see Vulnerability of Delta Functions tree)
  - B.2. Supply from Delta is Often Unpredictable
    - B.2.a. Short-Term Supply (often unpredictable)
      - B.2.a.1. Agricultural Water (often unpredictable)
      - B.2.a.2. Urban Water (often unpredictable)
      - B.2.a.3. Environ. Water (see Ecosystem tree)
    - B.2.b. Long-Term Supply (projections show higher unpredictability)
      - B.2.b.1. Agricultural Water (unpredictable)
      - B.2.b.2. Urban Water (unpredictable)
      - B.2.b.3. Environ. Water (see Ecosystem tree)

Draft Revised: 8/30/95

Vulnerability of Bay-Delta System Functions Problems

There is a continuing need to implement a comprehensive plan to manage the risk of sudden catastrophic levee failure and inundation of Delta islands to protect the Bay-Delta system. Inundation would result in loss of agricultural production, wildlife habitat, and infrastructure. Increased salinity intrusion as a result of island inundation would adversely affect aquatic habitat, water quality, and water supply.

- **A. Land Use and Economic Activities at Risk from Catastrophic Inundation**
- **B. Water Supply and Operations at Risk from Catastrophic Inundation**
- **C. Infrastructure at Risk from Catastrophic Inundation**
- **D. Ecosystem at risk from Catastrophic Inundation**

Draft Revised: 8/30/95