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Bay-Delta Workshop
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RECOMMENDED BAY-DELTA FISH AND WILDLIFE STANDARDS

This testimony addresses key issue no. 1 in the notice for the July workshop to review standards for the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) Estuary:

- What fish and wildlife standards should the SWRCB evaluate as alternatives in its review of Bay-Delta standards?

At the May and June workshops for review of Bay-Delta standards, Jones & Stokes Associates testified regarding the importance of historical daily data for providing an accurate understanding and basis for efficient and effective management of Delta water and fishery resources. Jones & Stokes Associates testified that available daily data and analytical tools for interpreting those data offer several important advantages for evaluating historical Delta environmental conditions and developing future Delta water and fisheries management strategies, including formulation of Bay-Delta standards.

The use of daily data to support efficient and effective Delta management decisions may require a new approach to decision making on Delta water operations. We described such a new approach as the "Delta Master" concept at the June Bay-Delta workshop. Daily management actions for Delta water supply and fisheries resources might be coordinated by a designated Delta Master team, with oversight by the California State Water Resources Control Board (SWRCB). The team would be responsible for daily Delta water allocation and control of Delta facilities. Accurate and updated daily data would be essential for the Delta Master team's decisions on daily operations.

Jones & Stokes Associates is serving as the consultant to SWRCB and the U.S. Army Corps of Engineers (Corps) in preparing an environmental impact report/environmental impact statement (EIR/EIS) on a proposed in-Delta water supply facility. To support that EIR/EIS and under the direction of the SWRCB staff, Jones & Stokes Associates has developed integrated historical daily data files and associated analytical tools. Based on our experiences in conducting environmental assessments of Delta resources, we offer the following recommendations for Delta fish and wildlife standards.

DELTA WATER ALLOCATION DILEMMA AND ADAPTIVE MANAGEMENT

Figure 1 illustrates the basic Delta water allocation dilemma: How should highly variable Delta inflows be allocated among the variety of potential beneficial uses?

Each day, available Delta inflow is allocated among a variety of beneficial uses in the Delta. Riparian diversions and export pumping represent water supply "uses". Maintaining acceptable mineral concentrations and maintaining estuarine habitat represent two salinity control "uses". Maintaining fish transport flows and reducing fish entrainment represent two fish protection "uses".

The Delta ecosystem is characterized by great variability and uncertainty. It cannot be completely controlled and its behavior cannot be precisely predicted. Scientific research and resource monitoring over several decades have, however, provided an excellent foundation for establishing a framework for resource management in the Delta.

SWRCB should set short-term standards and make long-term management decisions in a framework of incremental, adaptive policymaking. Adaptive policymaking means that management evolves over time as we learn from resource responses to past management actions. The resource responses to near-term decisions and management actions are monitored and tested scientifically. Feedback loops convey information about resource responses back for additional incremental, adaptive policy decisions when resource objectives are not met.

Jones & Stokes Associates believes that sufficient scientific information and analytical tools are available now for SWRCB to establish a framework for adaptive Delta resource management. This framework should incorporate feedback loops between management decisions and scientific research and monitoring in the Delta and its watershed. The fundamental aspect of adaptive resource policymaking is that we neither wait for more scientific research before making decisions nor make decisions now that are expected to apply for all time.

A COMPREHENSIVE SYSTEM OF BAY-DELTA STANDARDS

Delta water resources can serve three basic categories of beneficial uses: water supply, salinity control, and fisheries protection. Delta standards have been developed to protect and manage each of these Delta water resource categories independently. Delta standards to protect one resource category will indirectly affect the other water resource categories. Therefore, Delta standards should be adopted in a comprehensive system that addresses all beneficial uses in an integrated manner.

A system of Delta standards should achieve three basic purposes:

- require daily information necessary to accurately describe and evaluate Delta conditions, resources, and responses to management actions;
- ensure minimum protection for Delta resources with allowances for extreme conditions; and
- encourage allocation of available Delta inflow to satisfy all beneficial uses of Delta water in an adaptive management framework.

These three purposes for Delta standards will be discussed in detail in the sections that follow. Adaptive management of Delta water allocation would consist of incremental modification of Delta operations, careful monitoring of aquatic ecosystem responses, and rapid evaluation of needs for further modifications of Delta operations.

Figure 2 shows a matrix of Delta water resource use categories and purposes for a system of Delta standards. The cells of the matrix indicate examples of information needs, minimum protection requirements, and adaptive management objectives appropriate to each resource category.

Daily Information Needs

SWRCB could set standards to address daily information needs for Delta resource management. Daily information is required to allow Delta aquatic resources to be accurately described, evaluated, and monitored at comparable levels of detail and reliability. Daily information should serve as the basis for guiding decisions on minimum protection standards and adaptive allocation. Alternative allocations of Delta inflow among multiple beneficial uses are difficult to effectively evaluate when interrelated effects on salinity control, fishery protection, and water supply are poorly described. Crucial needs for daily information would require that available information be reported and shared among those interested in Delta management issues.

Figure 3 lists recommended daily information requirements that might be adopted by SWRCB. Information about historical and real-time Delta conditions might be obtained through the California Data Exchange Center (CDEC). Historical data could be organized in a series of annual summary files for each major sampling or monitoring program. Recent Delta conditions could be reported in an electronic "bulletin board" format.

Water Supply Information

A considerable amount of information about Delta water supply resources is available and should be reported on a daily basis. Delta channel tidal flows and net flows can be estimated using ultrasonic velocity meter (UVM) measurements and hydrodynamic

model results. Tributary inflows (unimpaired and actual) and reservoir releases should be reported on a daily basis to allow Delta management decisions to be based on water sources and water rights. Delta diversions (agricultural, Pacific Gas and Electric power plant, Suisun Marsh) and facility operations (Delta Cross Channel and Montezuma Slough gates) should also be reported on a daily basis.

Water Quality Information

Electrical conductivity (EC) and other habitat water quality variables are monitored throughout the Delta as required by D-1485. The SWRCB should require that D-1485 data on observed salinity and other water quality patterns in the Bay-Delta estuary be processed and reported to interested users. Suisun Marsh and Bay EC measurements should be integrated with the Delta EC data.

Daily water quality measurements of Delta inflow should be required to allow more accurate interpretation of the water quality effects in the Delta. Daily measurements of chloride (Cl) and dissolved organic carbon (DOC) should augment the U.S. Geological Survey (USGS) NASQUAN sampling for temperature and suspended sediments. Daily Cl measurements (by titration) should be required at the export pumping plants to allow estimation of the likely contributions of water from different inflow sources, based on the measured Cl/EC ratio.

Basic EC data should be processed to provide estimates of estuarine habitat area for each important aquatic species with known salinity preferences. These estimates could be used as river flows are used to estimate useable riverine habitat areas in the instream flow incremental methodology (IFIM).

Habitat water quality data that are currently collected under D-1485 monitoring requirements should be integrated and reported in daily summary formats (minimum, average, maximum). Such formats would allow accurate description of ambient Delta conditions for subsequent analysis of fishery responses.

Fishery Protection Information

Sampling and processing of fishery information should provide quantitative and geographically referenced estimates of fish distribution and abundance patterns within the Delta. Ultimately, a series of sampling programs would provide daily estimates of distribution and abundance patterns (fish/acre-foot) for fish species of interest in the estuary. Because possible fishery management strategies will focus on protecting early life stages, particular emphasis should be placed on egg, larval, and juvenile sampling methods.

Adaptive management of fishery resources will require quantitative estimates of the benefits of various management actions on fish distribution and ultimately on fish abundance. Fish density estimates by location should become the concept on which adaptive fishery management in the Delta is based. Many of the existing Interagency Ecological

Program (IEP) sampling programs can provide estimates of fish distribution patterns and population abundance.

Minimum Protection Standards

Minimum protection standards should be established to equitably ensure a minimum level of protection for all Delta resources. The minimum protection standards would be used as a foundation on which adaptive allocation objectives would be built. The minimum standards would be relatively fixed, although allowing appropriate variations according to season and water-year type.

To be effective, minimum protection standards may require compliance with relatively strict, short-term criteria (e.g., applicable for days or weeks). Compliance with long-term average criteria might not achieve the purpose of minimum protection standards.

Water Supply Protection

Standards for water supply protection would provide a minimum level of protection for allocation of Delta inflow to high-priority consumptive uses. Riparian diversions from the Delta and Suisun Marsh are used for agricultural and wildlife habitat purposes. These existing uses may be a first-priority water allocation that could be protected with a specified minimum allocation standard. Such a first-priority allocation standard would confirm the importance of these riparian uses and provide a reference level for estimating effects of changes in these riparian uses. Annual Delta net consumptive use consists of about 750 thousand acre-feet (TAF), according to DAYFLOW estimates; Suisun Marsh consumptive use is not included in this estimate.

Similarly, a minimum allocation standard for Delta export pumping could be established to provide a predictable water supply for those uses that require continuous exports. A minimum export pumping rate of 2,000 cubic feet per second (cfs), for example, would provide a minimum export water supply of about 1.5 million acre-feet (MAF) per year.

Water Quality Protection

The mineral content of drinking and irrigation water should be protected with maximum allowable Cl or EC standards. Compliance with such standards may require substantial Delta outflows to control salinity intrusion from Suisun Bay. For example, to maintain a Cl concentration of less than 250 mg/l at Rock Slough may require minimum Delta outflows of approximately 3,000 cfs (2.2 MAF/yr); to maintain a maximum Cl concentration of 150 mg/l at Rock Slough may require minimum Delta outflows of about 4,500 cfs (3.3 MAF/yr).

Minimum water quality protection standards could be developed to ensure estuarine habitat and entrapment zone locations in Suisun Bay and suitable salinity in Suisun Marsh. The operation of the Montezuma Slough salinity control structure can assist in achieving minimum salinity standards for Suisun Marsh, but additional Delta outflow may be required for salinity control in Suisun Bay.

Fishery Protection

SWRCB should establish minimum fishery protection standards to require fish transport flows and controls on diversions to move the majority of fish in migrating or passive life stages to safe habitat areas, beyond the influence of Delta diversions or export pumping. Minimum protection standards could also be established to reduce entrainment of fish by limiting pumping during sensitive periods.

Transport and entrainment standards will be more effectively applied as adaptive management objectives to regulate transport flows, diversions, or export pumping based on real-time observations about fish abundance and distribution. Requirements for water allocations to achieve fishery management standards are much more difficult to estimate than water allocations for water supply or salinity control. Therefore, these types of standards should be applied incrementally and they should be modified over time based on information about fishery population responses.

Adaptive Allocation Objectives

A framework for adaptive management of Delta water allocation should be established to ensure equitable management of all Delta resources in a manner that is both effective and efficient. Annual or monthly allocation of available Delta water should be managed using daily operational rules that respond to actual Delta conditions of flow, habitat, and fish life-stage abundance. Adaptive management based on daily decisions will only be workable if the decisions are made by an informed Delta Master team.

Adaptive management consists of obtaining current system information, establishing explicit management objectives, implementing management actions on an incremental basis, and monitoring system responses to the management actions as a basis for further actions to better achieve management objectives. Compliance with allocation objectives would require rapid operational responses to measured Delta conditions and Delta Master decisions.

Water Supply Allocation Objectives

Adaptive allocation of water supply would place an increased emphasis on accurate knowledge of real-time or daily Delta conditions to determine acceptable levels of export

pumping. Exports are currently limited by monthly standards for Delta outflows, QWEST flows, inflows, and DCC operations.

Rules for allocating Delta inflows to water supply uses might be more effective in integrating salinity and fishery management objectives if the rules application were flexible and responsive to real-time Delta conditions. For example, DCC operations might be governed more exclusively by real-time fish abundance in the Sacramento River by reducing the length of the fixed closure periods and increasing the flood control threshold for closure above 25,000 cfs.

Maximum export pumping limits might be altered in an adaptive management framework to allow increased pumping during periods of high Delta inflows if other salinity control and fishery management objectives were also achieved. Careful monitoring on a real-time daily basis would be needed to confirm that these other objectives were met.

Water Quality Allocation Objectives

D-1485 standards for salinity control are conditional on water-year type and season. Existing salinity control standards require a specified EC or Cl value to be achieved throughout a specified period, however, without consideration of related effects on water supply or fishery management objectives. Salinity control standards could be given additional flexibility to allow for more effective and efficient overall water allocation for salinity control strategies.

The U.S. Environmental Protection Agency (EPA) proposal to protect estuarine habitat conditions in the February-June period of maximum biological activity is a reasonable adaptive allocation approach. The proposed EPA standards attempt to maintain the average historical position of the estuarine habitat zone. It will be difficult to measure the benefits that this water allocation may provide to estuarine species, however, unless the actual daily sequence of fish distribution and abundance patterns are carefully tracked. For example, control of estuarine habitat salinity prior to major spawning activity would not likely benefit fish populations; therefore, use of inflow for such control would not be an efficient water allocation.

An adaptive allocation strategy for estuarine habitat management might specify that a fraction of reservoir storage (e.g., as determined by the Delta Master team) be reserved for estuarine habitat salinity control. Releases of water to augment natural hydrologic patterns would then be scheduled during the most critical period following actual spawning of fish populations to be benefitted. Alternatively, estuarine habitat controls might be conditional on unimpaired flows to preserve some of the natural habitat availability during the most critical life stages.

Operation of the Montezuma Slough salinity control structure since 1989 has controlled salinity in Suisun Marsh, as required by D-1485. Effects of the diversions to Suisun Marsh on estuarine salinity habitat in Suisun Bay, salinity intrusion at Chipps Island, or fish transport and survival patterns have not been determined. An adaptive allocation strategy

for operation of the Montezuma Slough gates might provide a basis to increase the overall benefits for water supply, salinity control, and fishery management purposes.

Existing standards for San Joaquin River salinity at Vernalis require releases from New Melones Reservoir to maintain an acceptable minimum flow. An adaptive allocation strategy might limit the allowable recycling of San Joaquin River drainage salt into the Delta Mendota Canal and back to the San Joaquin River at Mendota Pool.

Fishery Management Allocation Objectives

Existing fishery management standards are relatively general controls on flows and exports during potentially sensitive periods. Fishery management would be more effective as an adaptive management strategy that adjusts water allocations to match the observed distribution and abundance of sensitive life stages.

Two major challenges face establishment of a successful adaptive allocation strategy for fishery management:

- Quantitative information about fish distribution and abundance is more difficult to obtain and interpret than similar information about water supply or salinity conditions in the Delta.

- Fish populations are important biological components of a complex and dynamic ecosystem characterized by great variability and uncertainty. Therefore, we have much less ability to manage fish populations than to manage water supply and salinity resources.

Adaptive allocation strategies for fishery management purposes would combine primary management controls and evaluation activities that interpret available data to provide guidance for the primary controls. Figure 4 identifies five examples of primary fish management controls as:

- control of the salt gradient and entrapment zone location,
- specification of timing and magnitude of transport flows,
- control of facility operations,
- reduction in export pumping, and
- scheduling hatchery releases.

The following evaluation activities would increase the effectiveness of these primary controls by providing adequate information for managing Delta operations:

- estimating Delta channel transport and mixing patterns,
- evaluating ambient habitat conditions,
- estimating location and timing of spawning events,
- estimating the distribution and abundance of fish, and
- estimating fish entrainment losses.

The efficiency of the fishery management controls will be increased relative to their water allocation requirements if the flow, diversion, and pumping controls are conditional on daily estimates of fish habitat needs, distribution, abundance, and likely transport patterns.

Several adaptive allocation objectives have been established by existing Delta standards and requirements (Figure 5). Additional adaptive allocation objectives for fish management might be established. Establishing adaptive fishery objectives might require that the following management linkages be implemented:

- Fish distribution and abundance thresholds would trigger management responses, such as DCC closure, transport flows, or pumping reductions.

- Fish survival goals would limit the allowable cumulative entrainment losses as a percentage of the estimated population.

- Habitat maintenance goals would establish target percentages of estimated habitat needs to support achieving population abundance goals.

REQUIREMENTS FOR SUCCESSFUL ADAPTIVE RESOURCES MANAGEMENT

Successful adaptive resource management must recognize that Delta operations affect water supply, water quality, and fish distribution and abundance throughout the Delta simultaneously. The combined effects of Delta operations on channel flows, salinity, and fish reproduction, growth, migration, and survival should be accurately accounted for in each Delta management decision. Successful adaptive management of Delta resources must also recognize that these resources are integrated and must be managed comprehensively throughout the Bay-Delta Estuary and its watershed.

Full implementation of successful adaptive management will require:

- mechanisms to facilitate the exchange of current information on Delta conditions and resource management objectives,

- analytical tools to simulate and evaluate the likely effects of alternative Delta operations or facilities on a daily basis, and

- procedures for demonstrating daily compliance with the minimum protection standards and adaptive allocation objectives.

SWRCB is intending to release a draft water quality control plan for the Bay-Delta Estuary in December 1994. Jones & Stokes Associates believes that adequate time is available for that draft plan to incorporate the initial elements of an adaptive management framework for Bay-Delta resources. In particular, that plan could establish daily information

needs to be satisfied, minimum protection standards to be met, and a plan to develop adaptive allocation objectives and analytical tools within a short time frame.

JSA CONTRIBUTIONS TO ADAPTIVE MANAGEMENT

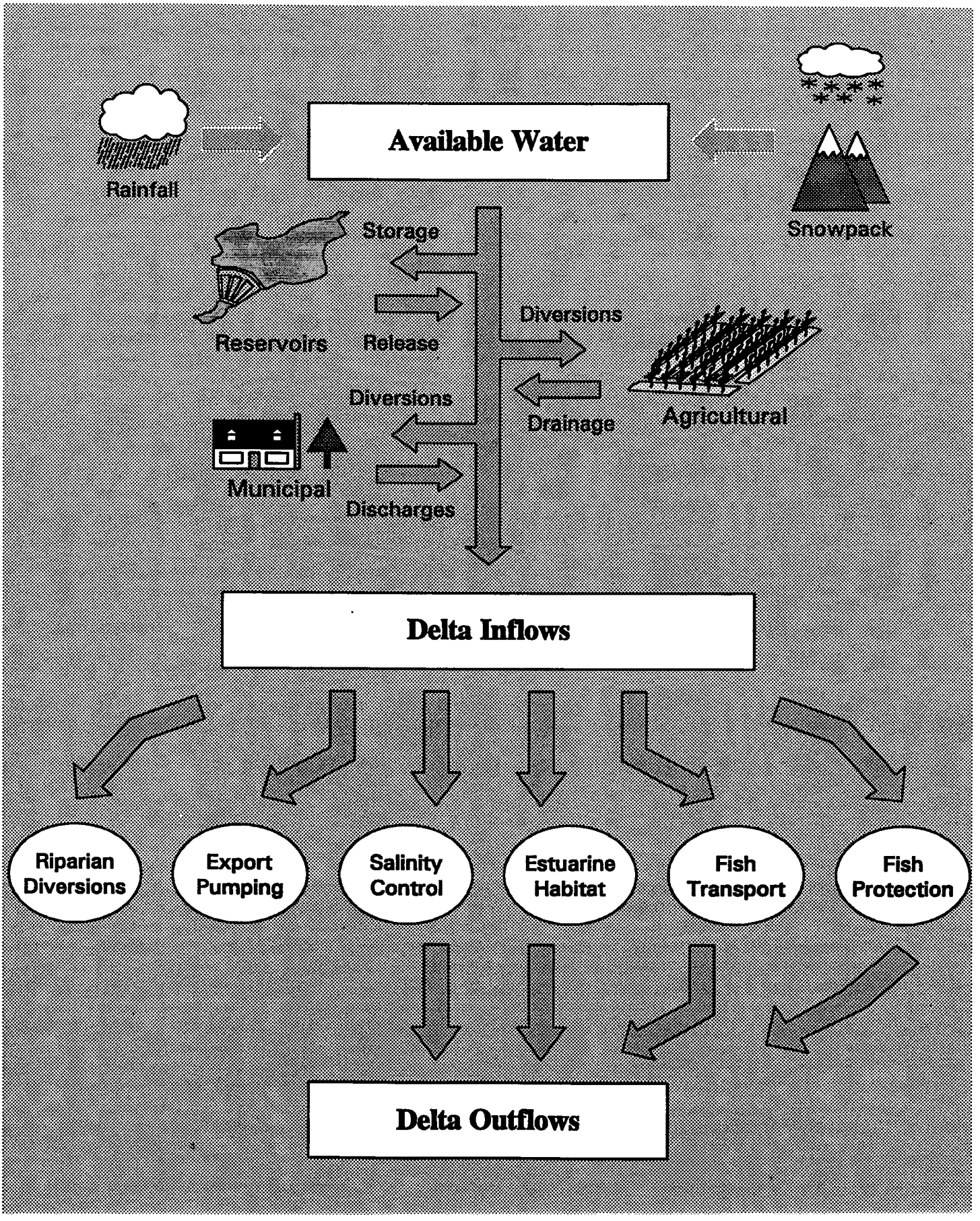
Jones & Stokes Associates would like to contribute to SWRCB staff analysis of alternative Delta standards for fish and wildlife. We can also assist in identifying needs for daily resource information and tools to analyze and interpret that information.

Jones & Stokes Associates is available to cooperatively demonstrate the use of historical daily data files and analytical tools (e.g., DailySOS and fish transport modeling) that we described at the May and June workshops. These data and tools can be effectively used to evaluate alternative standards within the short period of time available for staff analysis.

We are confident that a valuable start to establishing an adaptive management framework can be made by December 1994. Please contact us if we can assist the SWRCB staff with this important evaluation of alternative Delta standards.

Jones & Stokes Associates, Inc.

The Delta Water Allocation Dilemma



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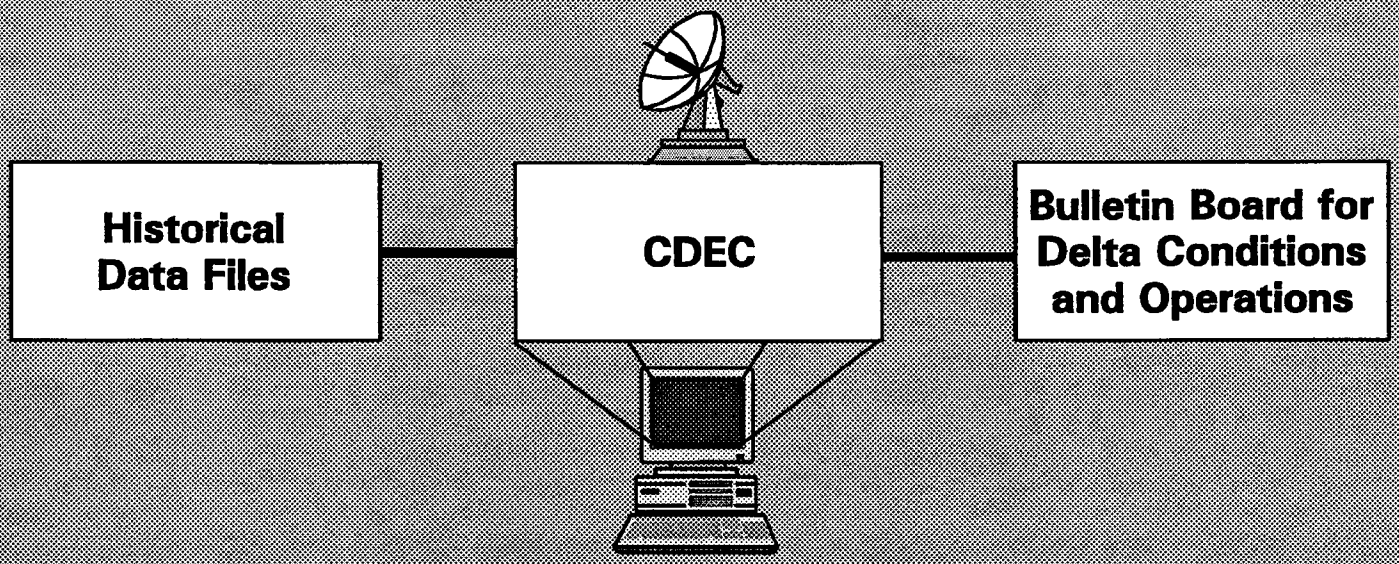
Daily Information Delta Standards



Water Supply Information

- DAYFLOW extended to channel flows
- Tributary flows & reservoir releases
- Tidal excursion flows
- Delta diversions & discharges (agriculture, PG&E)

Habitat Water Quality Information

- Daily inflow water quality (Cl/EC, T, DOC)
- Daily export water quality (Cl/EC, T, DOC)
- Estimates of estuarine habitat area (like IFIM)
- Temperature, DO, pH, turbidity, chlorophyll, C-14 (PP)

Fishery Information

- Spawning, egg and larvae monitoring network
- Abundance and distribution patterns (fish/AF)
- Entrainment, salvage and hatchery records
- Hydro-acoustic monitoring network

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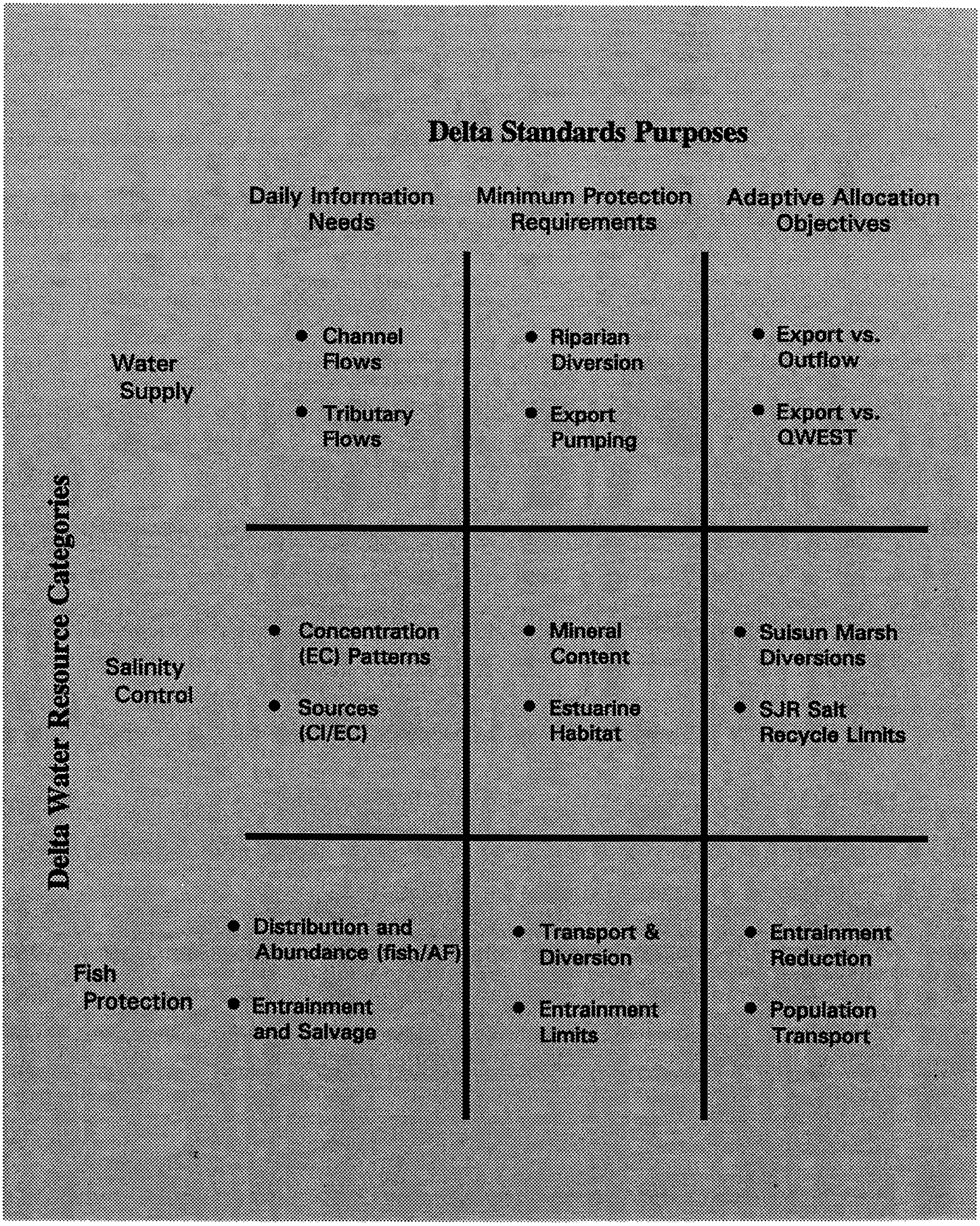
Multi-Purpose System of Delta Standards



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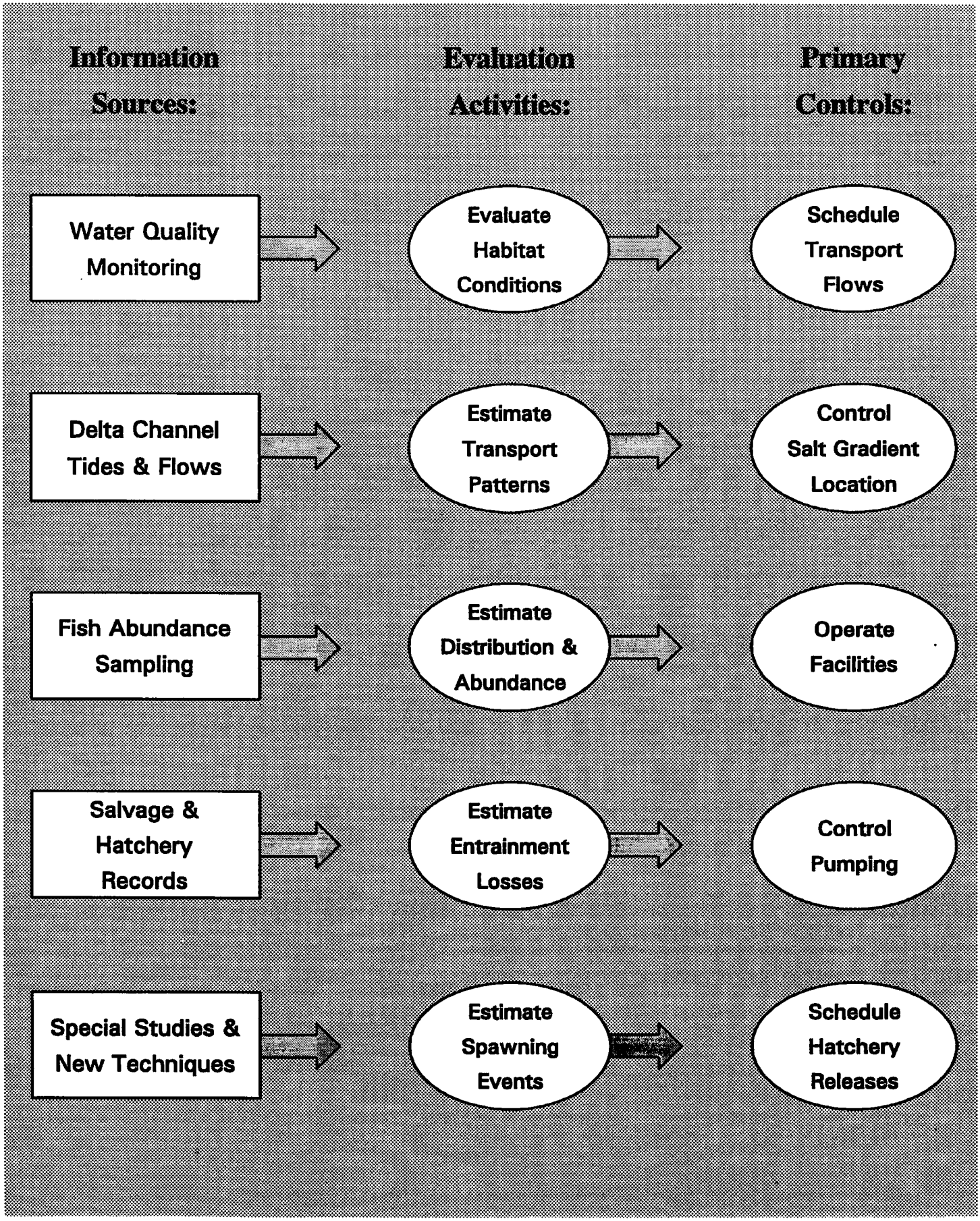
Delta Fish Adaptive Management Strategies



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Adaptive Delta Allocation Standards

D-1485

- Water quality to be "at least as good" as without CVP or SWP operations (comparison)
- Adjustments in level of protection to reflect changes in hydrologic conditions (water year type)
- DCC operation for salmon and striped bass (at discretion of DFG), if Delta outflow > 12,000 cfs

Draft D-1630

- SJR transport flows (spring & fall) magnitude and schedule
- Sacramento River spring transport flows magnitude & schedule
- Real-time DCC operation
- Water transfers scheduling (QWEST & exports)

ESA Requirements & EPA Proposed

- Export pumping take limits linked to population estimates
- Outflow magnitude & duration linked to water year type