# Water Management Strategy Excerpts

# Proposed Changes to the Revised Phase II Report

**December 8, 1998**

CALFED
BAY-DELTA
PROGRAM

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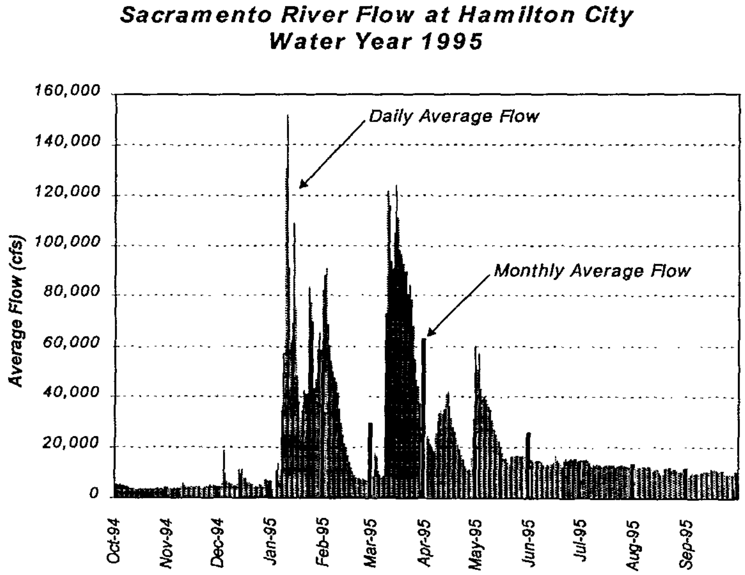
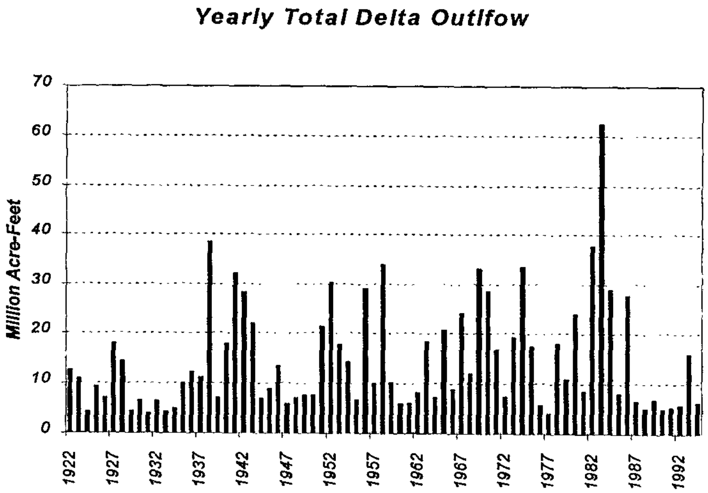
## System Variability - Building a Water Management Strategy

### Variations in Supply and Demand

Any consideration of water management in California must start with a recognition of the immense variability in the availability of and demands for water. The watershed of the Bay-Delta system is subject to a highly variable rain and snowfall pattern. The total amount of precipitation and runoff in the watershed varies widely from month to month and from year to year. Year types are classified from wet to critically dry. Within any given year, whether wet or dry, most of the rain falls in the winter months, while snow pack typically melts in the late spring and early summer. In other months, water flow is typically much lower, leading to dramatically different flow levels for different months. Even within each month, flow can vary widely.




Two figures help illustrate the variability in the hydrologic system. Water flow variability is most notable when daily flows are examined. The first figure presents a graph of daily flows throughout a water year. For comparison, average monthly flows are also shown (thicker black bars). The average monthly flows mask the much greater variation exhibited in daily flows that rise and fall with the passing of each major storm system. It is quite typical for winter and spring storms to produce periodic peaks in flow such as those shown in January, March, and May.




The second figure shows a simulated yearly total Delta outflow for the period from 1922 to 1994. The simulated Delta outflow is based on historical hydrology, but with existing



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storage and conveyance facilities in place and operating to meet 1995 level of demand. The graph reflects the average annual variability that occurs from year to year. Memorable extremes, such as the drought of 1976-77, are quite apparent.

The demand for water also varies over time. Agricultural demands tend to be higher than average in dry years, because there is less natural soil moisture and plants need more irrigation. In addition, local supplies may be more limited in dry years, which imposes further demands on water imported from elsewhere in the system. Agricultural water demand also varies substantially seasonally; the demand is highest in the summer, when natural flows are lowest.

Urban demands for water vary as well. Many urban areas experience substantial seasonal variation in demands for landscaping irrigation. In addition, urban areas dependent on the Bay Delta for some or all of their drinking water supply place a significant premium on the quality of water (in addition to the quantity). In dry years and in dry seasons, increased salinity in the Bay Delta (from both saltwater intrusion and upstream discharges), reduces the usefulness of Bay Delta water to urban users.

The value of water in the ecosystem varies over time. For example, high flows in the early spring have substantial ecosystem benefits, including maintaining river and stream channels and triggering behavioral changes in some species, such as anadromous fish, that have evolved in this variable system. Ecosystem water needs are generally more consistent with the natural seasonal flow pattern than consumptive water demand, but historic changes in the system have resulted in circumstances where existing flows are low during times of high ecosystem need.

Variation in ecosystem demands for water is highlighted in the Figure, below, which illustrates the hypothetical impact of the water diversion system on natural flow patterns.

**[***INSERT GRAPH COMPARING WET AND DRY YEAR FLOWS WITH NATURAL FLOWS***]**

This figure suggests that water diversions have had a relatively higher impact on the natural flow regime in drier water years than in wetter water years. As discussed below, many of the recent environmental protections imposed on the Bay Delta system have tried to reduce this relative stress on the environment during drier years. This discussion of the wide variability of both the supply of and demand for water suggests one important water management conclusion, which is that averages don't tell the whole story.

Averages are misleading because they mask the variability in flows and demands. An increase in Delta outflow in an average year may have only a minor beneficial effect on the environmental health of the system, whereas a similar increase in a dry or critically dry period may yield much greater environmental benefits. Similarly, although average increases in supplies may be desirable for urban and agricultural users, dry and critical year supplies are substantially more important given the higher demand and reduced alternatives. This variation in water supply and demand results in conflicts over water in the state, and conflict increases substantially in dry and critical years when all water uses, both environmental and consumptive, demand more water.

**Institutional and Operational Framework**

In response to the substantial variations in hydrology and in water demands, California has developed an extremely elaborate water diversion, storage, and delivery system. The broad purpose of these system has been to collect water in times of availability and to deliver it at the time and place of need.

In addition to the physical water system infrastructure, California has also created a legal/management structure governing its water resources. This legal/management structure relies on a complex set of rights, regulations, and contractual relationships that define which water users (both consumptive and environmental) will have access to water at particular times. For consumptive users, this system relies heavily on the concept of junior and senior priorities - those water users with more senior rights generally have more reliable water supplies than those with more junior rights.

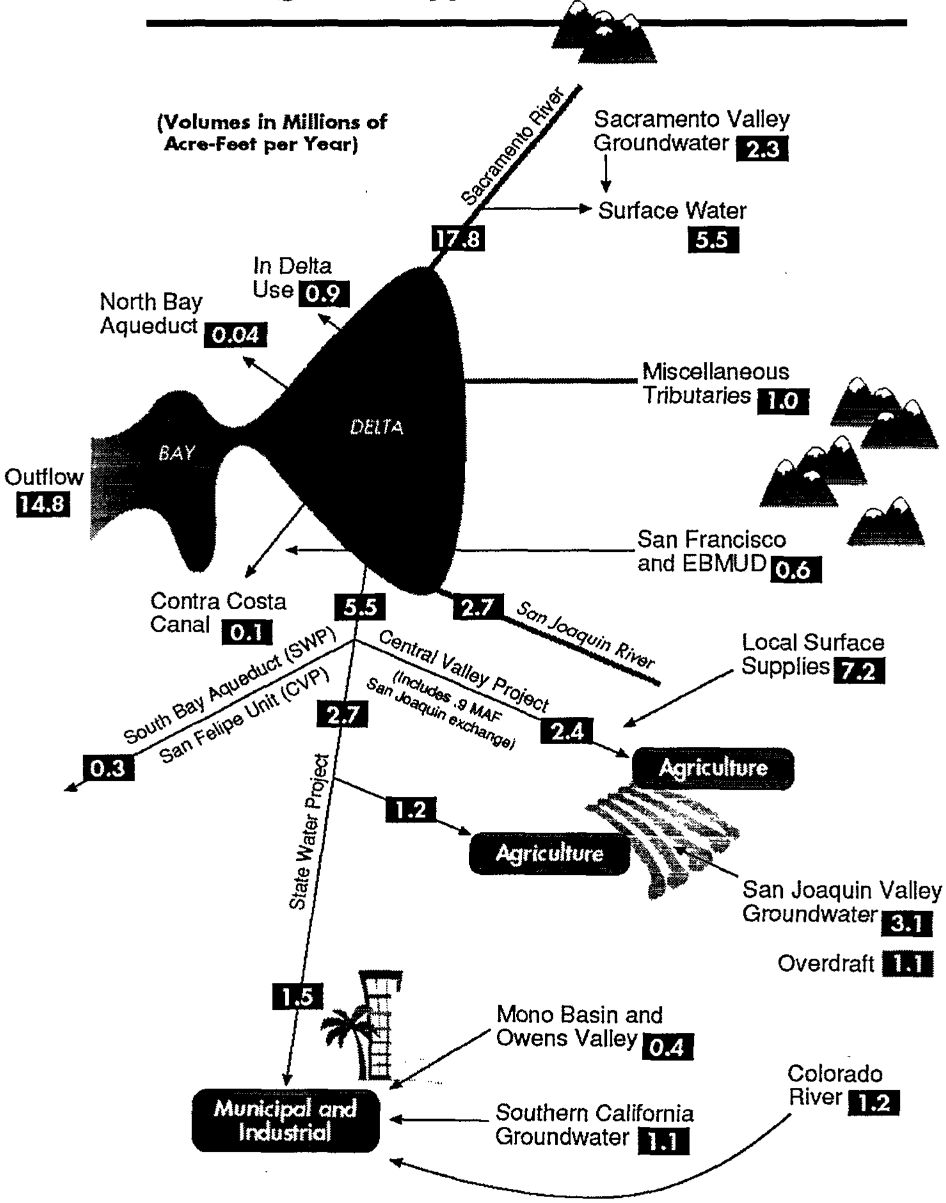
In addition to allocating shortages, the legal/management system also allocates water savings. For example, if an upstream diverter introduces some water saving management techniques, the next downstream diverter with senior rights can have more access to water. Sometimes the allocation of savings is more complicated. In the State Water Project, water savings by one project user (Southern California urban users, for example) go back to the Project and are allocated by contractual rights to the next contractual project user (Kern County, for example).

The following two figures illustrate how the physical water delivery system interacts with the institutional management structure to determine water use in the Bay Delta system. These figures provide a simplified view of water use in (1) an average year, and (2)in a dry year.

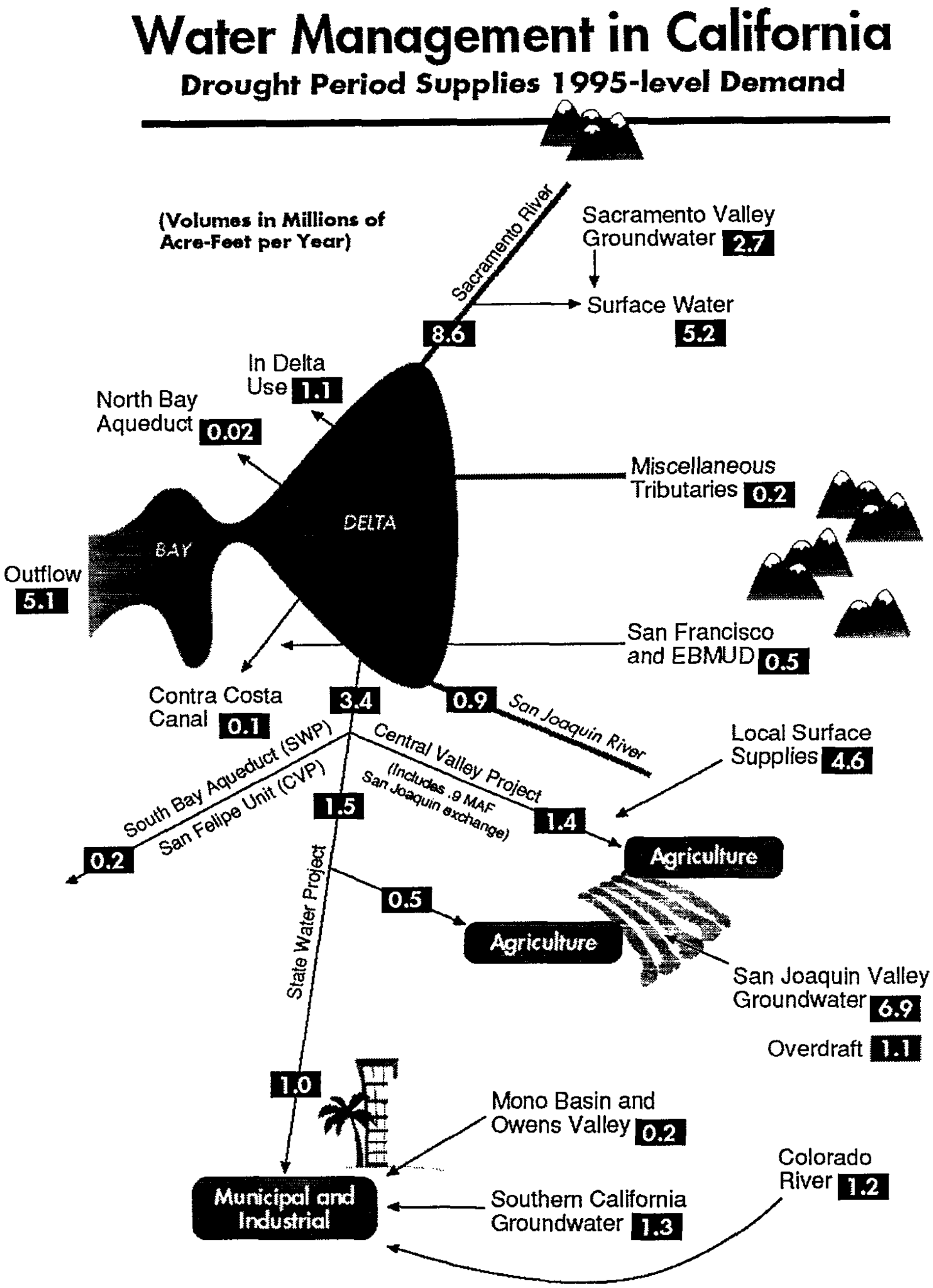
Two aspects of these graphs are worth highlighting. First, Delta water use throughout the system is substantially lower during the simulated dry year period. This is true for urban and agricultural users which shift to other sources to meet their demand. It is also true for the environmental uses (as represented by the decreased Delta outflow).

## Water Management in California

### Long Term Supplies 1995-level Demand



Second, the figures show clearly an ongoing problem with groundwater overdraft in the San Joaquin Valley. This is especially true in the dry year scenario, where groundwater pumping has been used to make up for significant shortfalls of imported water. The problem of groundwater overdraft is critical to long term water management in California. Overdraft can cause both land subsidence and the collapse of valuable underground storage capacity. In addition, concerns about groundwater depletion and degradation are frequently voiced in the debate over water transfers in the State.




The preceding discussion of the hydrological and institutional framework of California water management is useful in understanding the current conflicts over water resources in the State. In recent years, the water management systems has experienced increasing stress as the regulatory process has started addressing the environmental degradation evident in the Bay Delta system. In effect, these regulatory measures have increased Delta outflow and reduced diversions, forcing consumptive water users to turn to other sources (groundwater pumping, water transfers, etc.) Given that the last several years have generally been wet water years, the impacts of these environmental measures have generally been muted.

The following table is a modeled example of how the recent changes in the regulatory regime would reduce water deliveries by the state and federal water projects in the driest of water years and is generally an indicator of reduced operational flexibility.

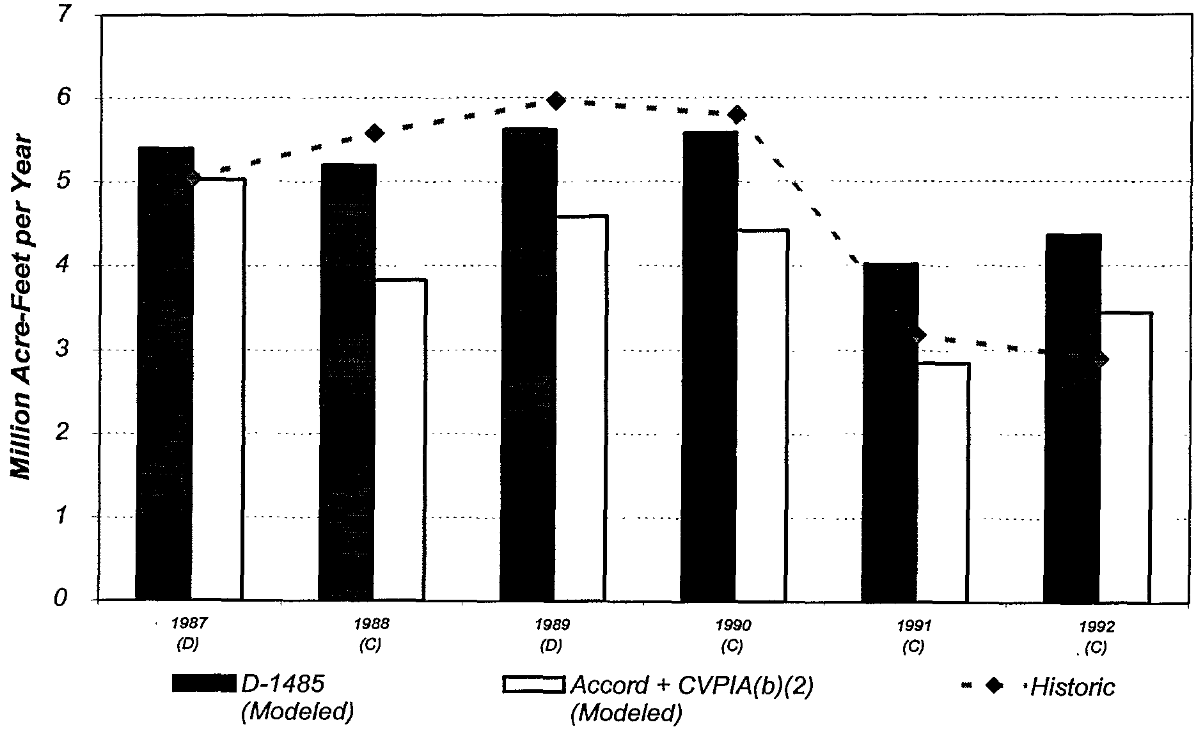
**Modeled State and Federal Water Contract Deliveries**
**Impacts of Protective Operating Criteria**
(in 1,000 Acre-Feet per Year)

| | | Long-Term Average Oct 1921 to Sep 1994 | | | Dry Period Average Jun 1986 to Sep 1992 | | |
|---|---|---|---|---|---|---|---|
| **Study** | **Condition** | **SWP** | **CVP** | **Total** | **SWP** | **CVP** | **Total** |
| 1. | Deliveries under D-1485 | 3,067 | 2,822 | 5,889 | 2,545 | 2,457 | 5,003 |
| | Incremental Water Supply Impacts Under: | | | | | | |
| 2. | 1994 Accord | -98 | -231 | -329 | -357 | -513 | -870 |
| 3. | 1994 Accord + CVPIA (b)(2) | -6 | -171 | -177 | 61 | -283 | -222 |
| | Cumulative Water Supply Impacts: | -104 | -402 | -506 | -295 | -796 | -1,092 |

This table highlights that conflicts over water in the state intensify in the driest water years, when all uses, both environmental and consumptive, are competing for a drastically reduced natural water supply. In addition, the regulatory regime itself has had another effect. By restricting the use of the water delivery system at certain times, the regulatory processes have reduced the overall flexibility of the water management system.

The following figure shows the results of the application of these measures during the 1987-92 drought. The environmental measures were not yet in force during that period. The figure shows that their application would have resulted in decreased deliveries and loss of flexibility. This is a current matter of concern, one that is not dependent on projected water demand.

***Delta Exports Under Various Protective Operating Criteria June 1986- September 1992 Dry Period***




## Defining water supply reliability

CALFED has identified water supply reliability as one of the major problem areas it will address. Unfortunately, this term means different things to different people. Some interpret the term as meaning average water deliveries or average deliveries during dry periods. As shown above, average deliveries don't adequately account for the extreme variation in California hydrology. Further, a focus on dry period deliveries is generally just another way of restating the fact that conflicts over water are most intense during dry periods. Some stakeholders have suggested that the proper measure of water supply reliability is the ability of the system to provide for both a sustainable urban and agricultural economy and a healthy ecosystem.

CALFED believes that an appropriate working definition of success in water supply reliability is the following list of objectives:

- Reduce water diversion conflicts between instream beneficial uses (environmental uses) and out-of-stream beneficial uses (consumptive uses).
- Decrease drought impacts, both for the environment and for other water users.
- Increase water supply availability by providing means for water users and the environment to acquire additional water at high priority times and places.
- Increase operational flexibility by improving the ability of the system to respond appropriately to unforeseen or unpredictable future events.
- Increase the utility of the water used for all beneficial uses by improving water quality.

CALFED's water supply reliability goal is to develop and implement a water management strategy that achieves each of these five qualitative objectives.

**Water management tools**

There are seven general categories of tools that can be used to manage water in the California system. Each of these tools is already being implemented in California to some degree. The tools are:

- Water conservation
- Water recycling
- Water transfers, both short term and long term
- Storage, both groundwater and surface water
- Watershed management
- Water quality control
- Monitoring and real-time diversion management

In evaluating these tools, there are three fundamental factors to consider: (a) costs, (b) flexibility, and (c) environmental impacts.

Costs - The different tools differ substantially as to cost. One important measure of cost is the estimated cost per acre-foot of water supply. Some estimates of this cost measure have been generated by CALFED and are shown in the following table. This table illustrates the wide differences in the costs of tools, both between types of tools (recycling versus transfers) and within a particular tool (conservation, for example).

Although cost per acre-foot is an important cost measure, other cost factors must also be assessed. For example, to achieve a particular water quality objective (salinity, mercury, etc.), there is usually a difference between the costs of source control measures and treatment measures. These cost differences are important in deciding the proper mix between watershed actions and treatment actions to attain the water quality goals.

**Potential Water Supply Reliability Measures**
**(with 1995-Level Population and Water Deliveries)**

| Reliability Measures | Potential Water Supply (MAF per Year) | Estimated Cost Range ($/acre-foot) |
|---|---|---|
| Urban Conservation (Irrecoverable Loss Portion) | 1.1 - 1.5 | $50 - $1,600 |
| Agricultural Conservation (Irrecoverable Loss Portion) | 0.25 - 0.50 | $50 - $850 |
| Urban Recycling | 0.5 - 1.0 | $800 - $1,500 |
| Storage (Stage 1)[1] | 0 - 0.32 | $250 - $500 |
| Water Transfers[2] | 0.6 -1.2 | $50 - $250 |

Notes:
1 Dry period water supply with 1.3 MAF of storage (small Shasta enlargement, Madera Ranch, enlarged Kern Water Bank, and In-Delta storage) plus increasing SWP export capacity and joint use of facilities.
2 From *Least-Cost CVP Yield Increase Plan*

**Flexibility** - Water management tools also differ as to their flexibility. For example, many water conservation measures have substantial benefits in reducing overall demand, but, once implemented, don't provide flexibility to react to changes in hydrological circumstances. Similarly, surface storage facilities are very effective at providing a rapid reaction in either releasing or collecting large amounts of flow. Although groundwater storage may hold more volume, it would have to be operated in conjunction with surface storage to attain the same level of flexibility.

**Environmental Impacts** - Finally, water management tools differ as to their potential negative effects on environmental resources. Generally, water conservation measures are viewed as more environmentally benign, given that they may reduce the overall demand for water diverted out of the environment. Nevertheless, even here, there may be adverse environmental effects. For example, substantially increasing farm or landscape irrigation efficiency may reduce water runoff that currently sustains aquatic or aquatic-dependent ecosystems.

Water storage facilities also differ in their potential negative effects on environmental resources. Many believe that groundwater storage facilities impose fewer negative impacts than surface storage, and that off-stream storage imposes fewer impacts than on-stream storage. Further, additional storage of any kind, by its very nature, raises the possibility of increased net overall diversions from the system, and it remains a subject of scientific debate whether, how, and to what extent, additional diversions can be made out of the Bay Delta system without imposing additional stress on environmental resources.

In evaluating any particular set of water management tools, CALFED will consider the relative value of the tools as to these three fundamental factors of cost, flexibility, and environmental impacts.

## CALFED's Water Management Strategy

In light of the substantial variability of demand and supply, as well as the different utility of the various water management tools, CALFED believes that the appropriate water management strategy will not be a single approach, but the proper combination of all of the available tools. This concept is best portrayed as a matrix of measures, shown in the following figure.

**Integrated Water Management Strategy**

| Water Management Objectives | Water Management Tools | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Transfers | | Conservation | | | | Storage | | | | |
| | Long-Term | Drought Water Bank | Agricultural | Urban | Wetlands | Recycling | Groundwater | Surface | Watershed Management | Water Quality Control | Monitoring and Real-Time Diversion Management |
| Reduce Diversion Conflicts | | | | | | | | | | | |
| Decrease Drought Impacts<br>- Environmental Flows<br>- Ag/Urban supply | | | | | | | | | | | |
| Increase Supply Availability<br>- Drought<br>- Average | | | | | | | | | | | |
| Increase Operational Flexibility | | | | | | | | | | | |
| Increase Supply Utility (WQ) | | | | | | | | | | | |

As it moves to fill in the values of this Water Management Matrix, CALFED is relying on a number of important principles, including:

- The recognition that water is a scarce resource in California, and that it must be used wisely for all beneficial purposes
- A desire to rely on market mechanisms and market approaches wherever possible
- The recognition of the variability in the value of water for all uses (both environmental and consumptive)
- As discussed in more detail below, the need to adaptively respond to new information or new conditions in the system

The details of CALFED's water management strategy are described as part of the Draft Preferred

Alternative in Chapter 4. The first steps CALFED proposes are detailed in the list of Stage 1 actions in Chapter 5. As to particular water management tools, Stage 1 will do the following:

- A high level of water use efficiency (both conservation and recycling) must be achieved.
- Substantial progress in refining the water transfers institutional framework must be demonstrated.
- Storage, both groundwater and surface storage, must be thoroughly investigated and implemented, where appropriate.
- Watershed management studies and projects must be implemented to improve the timing, volume and quality of water resources.
- Water quality source control and other management measures must be implemented to address salinity in the system.
- Monitoring and diversion management improvements must be evaluated and implemented on an ongoing basis.