SUMMARY OF CALFED BAY-DELTA PROGRAM ANALYSIS STRATEGY FOR WATER MANAGEMENT FACILITIES AND OPERATIONS

Several assessment variables have been identified that will be used to evaluate and compare water management effects of CALFED Bay Delta Program (CALFED) alternative components. The existing and proposed surface-water management facilities (e.g., reservoirs, diversions, and canals) together with the current and proposed groundwater capabilities (i.e., available storage volume, pumping capacity, and recharge capacity) for the Sacramento River and San Joaquin River basins must be included to accurately portray likely future Delta channel flows and exports, as well as describe conditions in tributary streams used as habitat for anadromous fish species. The capacities and operating rules for these water management facilities must be as flexible and general as possible so that a full range of potential alternative components and operating priorities can be simulated and evaluated as part of the CALFED programmatic assessment strategy.

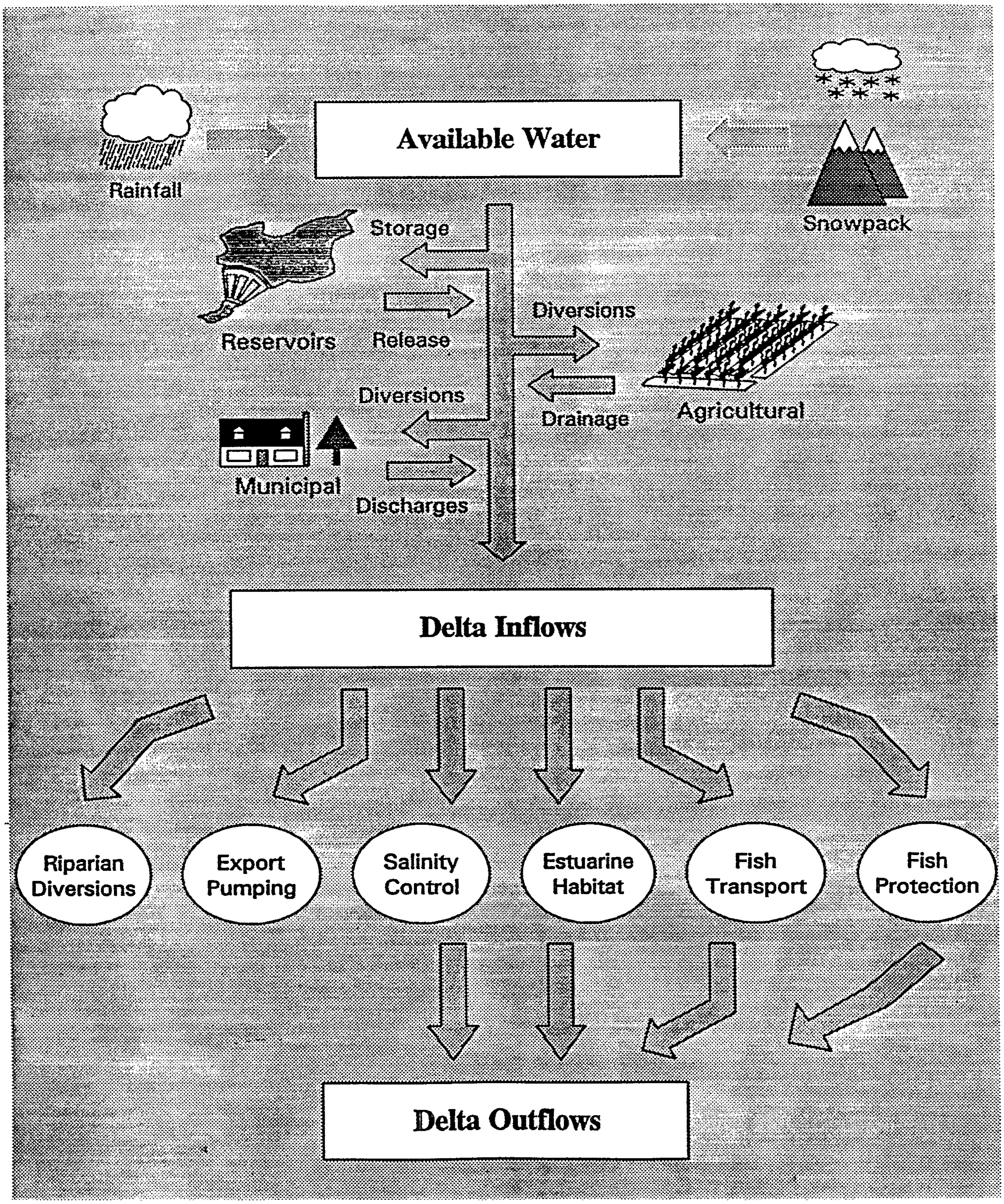
The major characteristic of Central Valley hydrology is the extreme variation in both seasonal and annual runoff that is available for allocation to various beneficial uses. The effects of hydrologic variability are usually included in water management planning by simulating the operation of proposed facilities using the monthly natural (i.e., unimpaired) runoff conditions estimated from measured flows from 1922 to the present (i.e., 1996). The basic water management approach has been to store excess runoff in surface reservoirs and later release the stored water for downstream beneficial uses (e.g., diversions). The recognition of increased requirements for instream flows to protect and promote habitat conditions for fish and wildlife populations (i.e., instream beneficial uses) has created a water allocation dilemma, as illustrated in Figure 1. Allocation of available water for beneficial uses must now include substantial instream flows, as well as traditional diversion and export demands.

Figure 2 illustrates the general water management framework consisting of monthly inflows, available reservoir storage capacity, demands for diversions, targets for instream flows, and reservoir spills (i.e., water released from reservoirs that is in excess of downstream requirements for diversions or instream flows). This illustration of the water management framework should be expanded to include the interaction between several tributary reservoirs and common downstream Delta outflow requirements and export demands. This has been generally accomplished using the water planning models such as PROSIM/SANJASM and DWRSIM; however, the existing planning models do not provide a sufficiently comprehensive and flexible allocation and accounting of these competing demands on California's limited water supply. The CALFED programmatic assessment strategy will require some modifications and enhancements of the existing planning models to obtain the necessary flexibility and accounting to support the assessment of all potential future allocation and operation strategies for Delta water resources.

Figure 3 illustrates the suggested CALFED assessment strategy for comprehensive and flexible allocation and accounting of demands for diversions and exports, as well as instream flow and Delta outflow targets. This strategy places emerging objectives for instream flows and Delta outflow on an equal basis with traditional demands for diversions and exports from the Delta. The available runoff and storage capacity is allocated using an adaptive management approach (e.g., recognizing that water supply forecasts and information about the response of fish populations will change during the season) that attempts to balance the competing requirements for diversions and instream flows. The CALFED assessment strategy must include the full range of potential water management facilities, but it must also incorporate the wide range of operating rules and water supply allocation approaches that will be possible under adaptive water management.

This proposed water management assessment strategy will be illustrated with some example relationships using simulations of the 1995 Water Quality Control Plan made with DWRSIM for the State Water Resources Control Board.

Figure 1
The Delta Water Allocation Dilemma



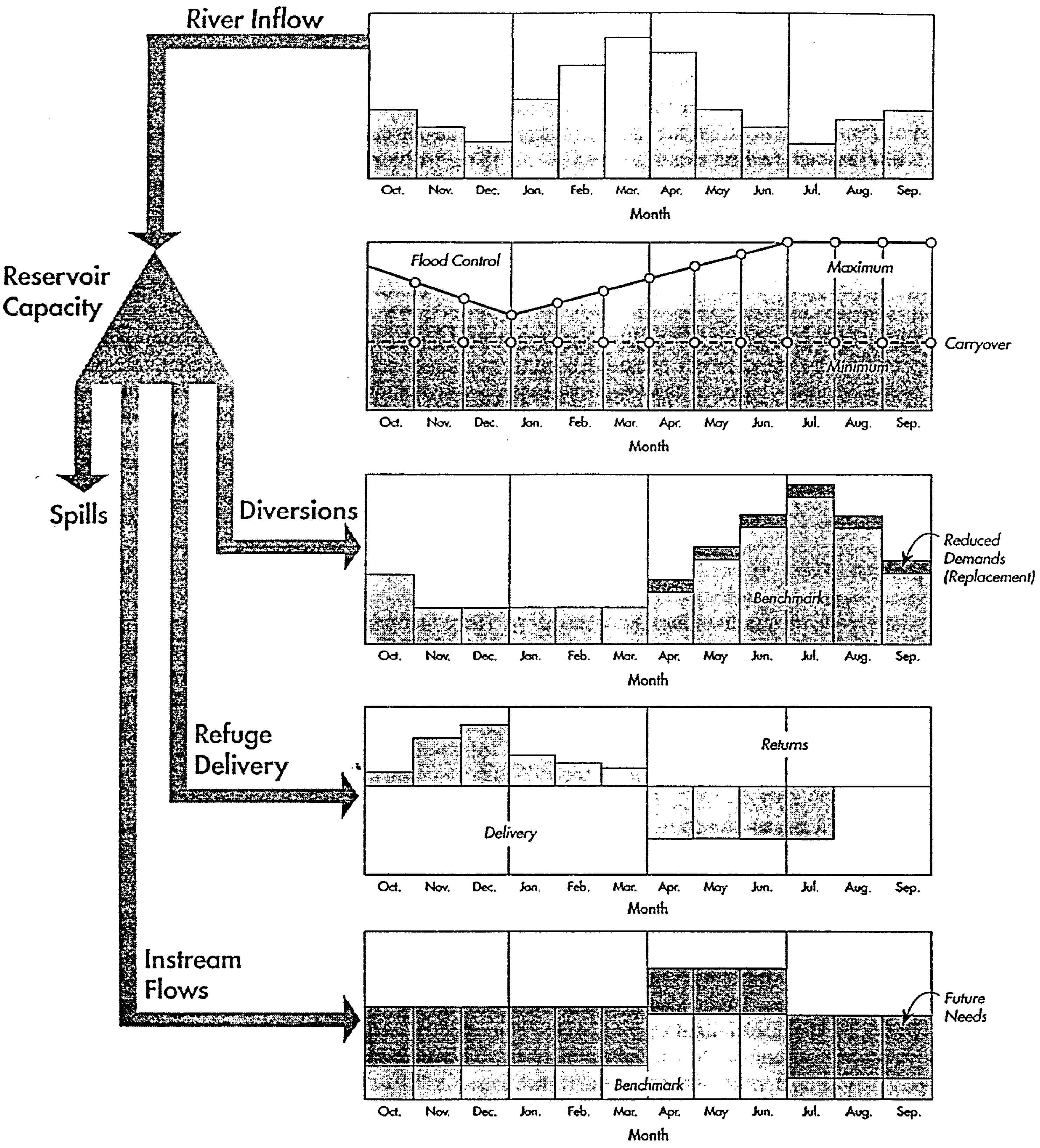
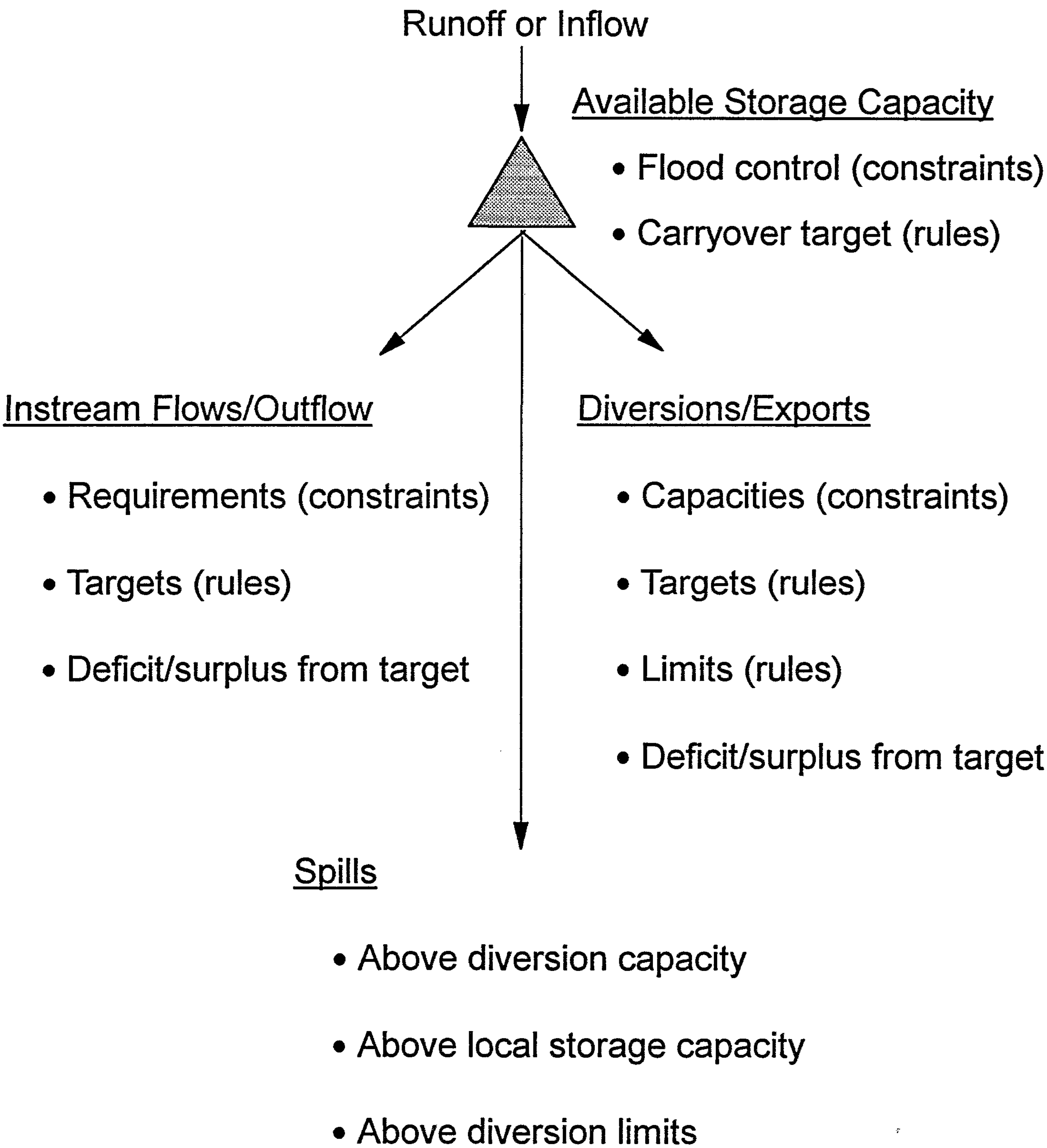


Figure 2
Schematic of Monthly Patterns of Inflows, Reservoir Capacity, Diversions, Refuge Needs, Instream Flows, and Spills

Figure 3
CALFED Water Management Assessment Strategy



CALFED Analytical Variables and Relationships

Assessment Variable	Supporting Variable		CALFED Action Component*

I. Physical Environment

B. Water Supply Facilities and Operations

Assessment Variable	Supporting Variable		CALFED Action Component*
1. Reservoir storage (10-20 locations)	Capacity		New or expanded storage
	Runoff		INPUTS
	Flood control	Flood storage	FIXED
		Channel capacity	FIXED
	Demands		Demand management, conjunctive use, transfers
	Instream targets		IFIM requirements, pulse flows
2. Instream flows (10-20 locations)	Instream targets		IFIM requirements, pulse flows
	Runoff		INPUTS
	Storage		FLOWS
	Demands		Demand management, conjunctive use, transfers
3. Diversions/exports (10-20 locations)	Runoff		INPUT
	Demands	Water contracts	FIXED
		Water rights	FIXED
		Water costs	FEEDBACK
	Diversion limits		Operation rules
	Reservoir storage		FLOWS
	Groundwater pumping		FEEDBACK
4. Agricultural drainage (10-20 locations)	Rainfall		INPUT
	Irrigation	Crop acres	Land retirement, agricultural conservation
		Applied electrical conductivity	FEEDBACK
	Soils		FIXED
	Drainage facilities		Drainage management facilities

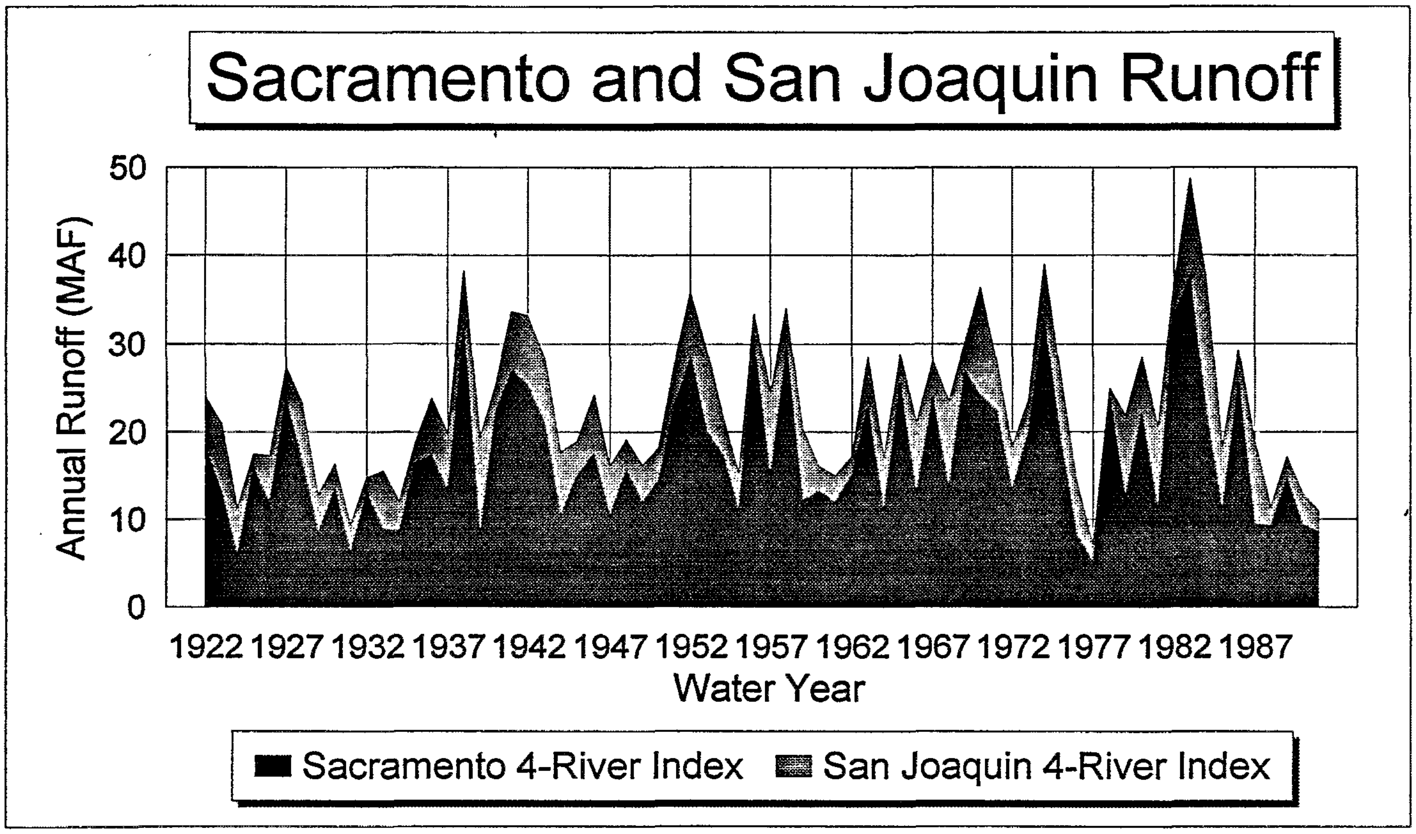
CALFED Analytical Variables and Relationships

Assessment Variable	Supporting Variable	CALFED Action Component*

* FIXED = relationship is assumed to not change.
INPUT = monthly hydrologic or meteorologic conditions.
FEEDBACK = relationship is addressed elsewhere in table.
FLOWS = water management control.
IFIM = Instream Flow Incremental Methodology
BMP = Best Management Practices

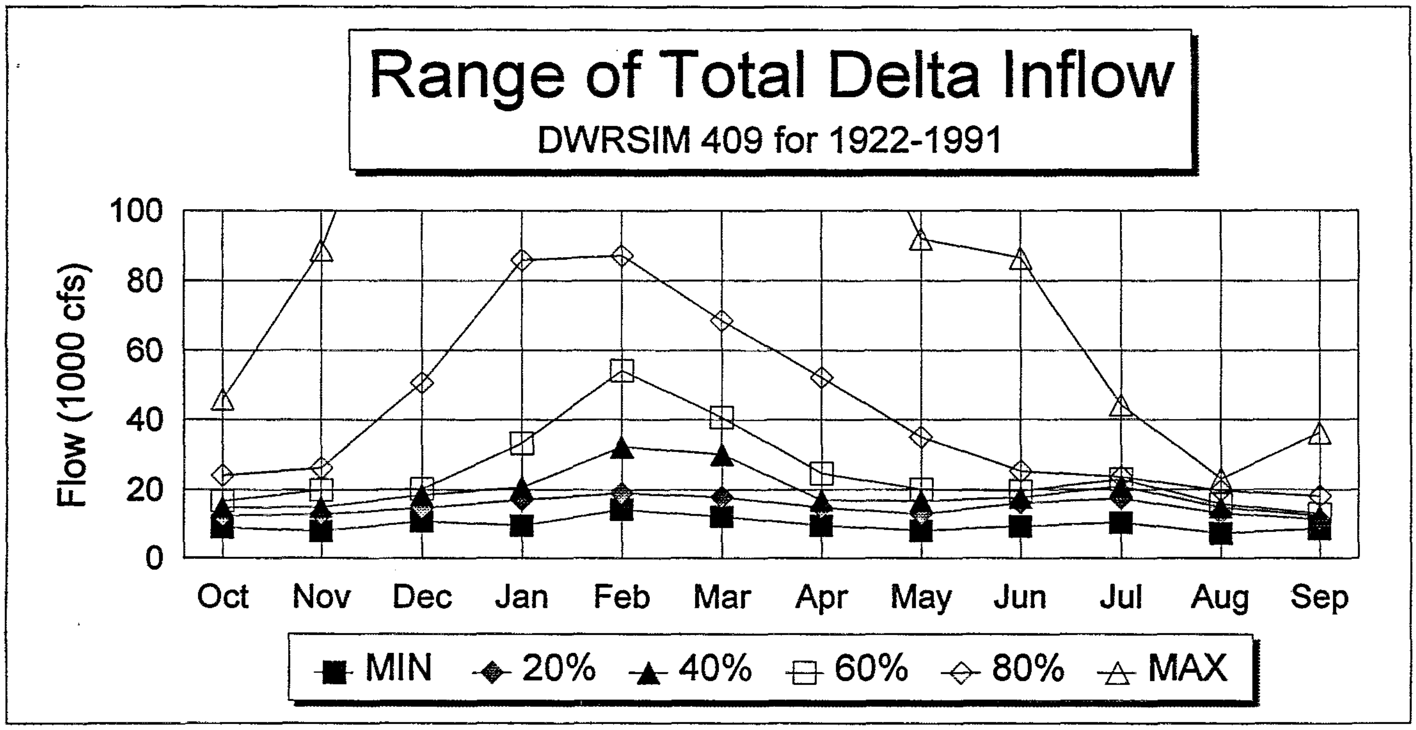
RELATIONSHIP 1

"Available Annual Runoff for 1922-1991" (water year) indicates that the available runoff for the Sacramento River (i.e., 4-River Index) and San Joaquin River (i.e., 4-River Index) varies from as low as 7 million acre-feet (MAF) to as high as 48 MAF. Although drought sequences are present in the historical record (i.e., 1929-1934 and 1987-1992), there is not much correlation between years; therefore, water management agencies must always be prepared for a low runoff year. Several proposed CALFED alternative components will boost the available storage or reduce the demands for water supply in dry years. Additional CALFED components will support adjustments in reservoir operations to change the allocation and scheduling of reservoir releases during dry years.



RELATIONSHIP 2

"Monthly Total Delta Inflow" indicates the simulated range of monthly Delta inflow for 1922-1991 needed to satisfy 1995 Water Quality Control Plan objectives and provide Delta exports. The range of Delta inflows is shown with the minimum, 20%, 40%, 60%, 80%, and maximum flow values for each month. The range of annual runoff is sometimes classified with water-year types, although the monthly Delta inflow pattern is only partially determined by the annual runoff or water-year type. The ability to change (increase) the Delta inflow in a particular month is limited by the unimpaired runoff and the upstream storage capacity because some of the available runoff must be stored to provide later releases for demands and instream flow requirements.



RELATIONSHIP 3

"Annual Delta Exports Distribution" indicates that the ability to provide Delta exports while satisfying the 1995 WQCP objectives for Delta outflow and maximum limits on the percent of Delta inflow that can be exported (i.e., export ratio) is often less than the assumed maximum annual demand of 6.7 MAF/year. Available storage, export pumping limits, and other operational constraints included in DWRSIM sometimes reduce the simulated exports. If some of these assumed operational constraints are modified, the simulated monthly export pumping patterns would shift (e.g., reservoir releases might change) and the resulting annual export distribution would change (e.g., increases and decreases are possible). Several CALFED alternative components include potential changes in water management facilities, changes in the monthly allocation of water for instream flows and Delta outflows, as well as changes in habitat features within the Delta and estuary that may require different objectives for protection of multiple beneficial uses within the Delta pool. Changes in the location of the Delta exports and diversions may allow some of the maximum export limits to be modified. Physical pumping and conveyance capacities will continue to constrain the maximum exports during periods of high Delta inflow. Export storage capacity will limit the maximum possible exports in other periods of sustained high inflows.