Attachment 1

Use of Economic Risk Model to Investigate Water Transfers

DWR has used the Economic Risk Model as a M&I water management planning tool for feasibility studies and EIR/EIS documentation since 1985. It is currently being used for CALFED project screening and to develop Bulletin 160-98 regional water management plans.

To focus on the effect of water transfers on the reliability benefits of CALFED options or, conversely, the effect of CALFED options on the reliability benefits of transfers (i.e. the demand for transfers), the ERM can be set up to perform the following types of sensitivity analyses:

1. Change in regional M&I benefits of CALFED storage and conveyance options with respect to changes in the costs and availability of transfers.

2. Change in regional M&I benefits of CALFED storage and conveyance options and the quantity of water transferred with respect to changes in water transfer third-party and environmental impact mitigation policies, including mitigation assessments (water surcharges or monetary payments) and restrictions on frequency of transfers and cumulative quantities transferred by region.

3. Change in demand for transfers and quantities transferred with respect to the CALFED storage and conveyance alternative selected.

The ERM uses the concept of least-cost planning to identify the economically optimal mix of Statewide and local urban water management options and exposure to the risk of shortage.

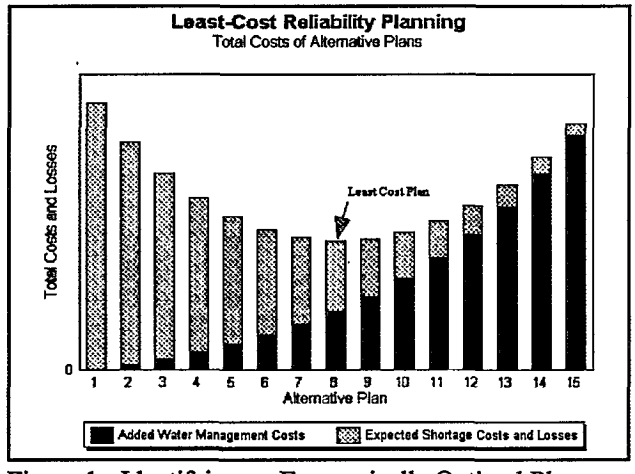

Figure 1 - Identifying an Economically Optimal Plan

Figure 1 depicts a theoretical analysis to identify an economically optimal plan for increasing water service reliability. The top portion of each bar shows the expected shortage losses and costs associated with alternative water management plans. Plan number one represents existing conditions (no additional water management actions.) Plans two through fifteen represent increasing effort to diminish losses and costs associated with shortages through the implementation of additional water management options (both long-term and contingency options, including water transfers). However, associated with these plans are increasing water management expenditures, as illustrated by the lower portion of each bar. The least-cost plan in terms of total costs and losses is plan number eight, where total costs are the lowest. Water management expenditures lower than for plan number eight (plans one through seven) expose the local area to

higher shortage-related costs and losses than necessary. Water management expenditures higher than those for plan number eight (plans nine through fifteen) do not "pay for themselves" in terms of additional reductions shortage-related costs and losses.

Figure 2 depicts the primary planning relationships represented in the Economic Risk Model for evaluating, from an economic least-cost perspective, the cost of alternative plans to increase the reliability of a regional water service system. The link between the investment in long-term water management options and the size and frequency of shortages is shown, as is the link between expenditures to make shortage contingency options available as well as the costs and losses associated with those shortages. The ERM uses a yearly time-step hydrologic and shortage impact simulation to best approximate the actual nature of these links. In general, the larger the investment in long-term water management, the less frequent and less severe will be the shortages experienced. Similarly, making shortage contingency options available for future shortage events will lessen the economic, environmental, or social costs of these shortages when they occur.

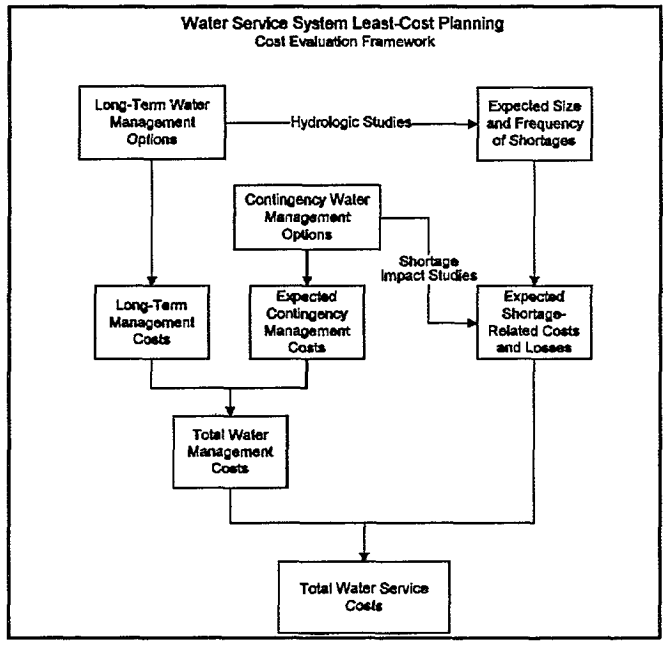

Figure 2: ERM Reliability Modeling Relationships

The capital and operations and maintenance costs of both the long-term and shortage contingency options are included as components of the total water service system costs, the remaining component being the expected costs and losses associated with shortages under those scenarios. Water transfer costs depend upon the quantity transferred during shortages. The price of the transferable water is compared within the simulation to the economic benefit of purchase during each shortage event, thereby affecting the quantity transferred.

Use of different long-term and shortage contingency options affects total water service costs not only directly but also indirectly through their influence on the size and frequency of shortages as well as the costs and losses associated with those shortages. (Because they can also affect costs through their influence on the quality of water provided to users and/or water agency treatment processes, the ERM will be extended to incorporate water quality costs.)

Expected Year 2020 conditions are used to evaluate the potential contribution to regional urban water service reliability of identified water management options for the South Coast and Bay Regions. The option categories capable of being evaluated within the ERM framework from an economic standpoint are:

Fixed Yield Projects and Programs
- Water Reclamation
- Groundwater Recovery
- Conservation Beyond Urban BMP's
- Long-Term Water Transfers
- Ocean Water Desalting

Variable Yield Projects
- Central Valley Reservoirs
- Local Reservoirs

Contingency Yield Programs
- Shortage-Related Water Transfers
  - Colorado River Region
  - Central Valley Regions
- Development of Groundwater Carryover Storage Capacity

The overall conveyance, treatment, and local delivery costs of each option are estimated to the extent possible. When available, data from previously made operations studies are used to measure the yearly contribution of reservoir deliveries to meet both current-year use needs and carryover storage requirements. Shortage-related water transfer options are based on information from pending agreements about total quantities to be made available over the life of the agreement and the yearly quantities that can be made available. In-force agreements on shortage-related water transfers are modeled in the base. Third-party impacts concerns are reflected in assumptions regarding regional restrictions on the frequency of transfers and the total quantity transferred over a specified number of years.

Ideally, because of the hydrologic and operational interdependencies of all the options evaluated, an evaluation of all possible combinations and permutations of the options would be needed to identify a preferred least-cost plan. In lieu of this impractical strategy, the ERM is run for specific reservoir storage supply and Delta conveyance facility scenarios in the context of local water management scenarios which specify three discrete levels of implementation of local water transfer and groundwater carry-over storage options. The economically optimal use of local fixed-yield options and the accompanying exposure to the risk of shortage are then identified for each combination of scenarios.

Appendix

Sources of Model Data: DWRSIM output, local hydrologic modeling studies, water management option cost and availability studies done for Bulletins 160-93 and 160-98, shortage management studies re: 1976-77 and 1987-92 droughts, residential customer water price and contingent value surveys. Specific ERM data needs are as follows:

Hydrologic Parameters

- Surface Reservoir Operations
  - Available Carryover Storage Capacity
  - Carryover Storage Supply Curve

- Groundwater Operations
  - Available Carryover Storage Capacity
  - Recharge Capacity (adjusted for efficiency)
  - Extraction Capacity
  - Carryover Storage Supply Curve

- Conveyance Operations
  - Local Aqueduct Capacities
  - State and Federal Aqueduct Capacities

Local Water Management Strategies

- Carryover Storage Programs
  - Use Rules
  - Refill Priorities

- Shortage Management Programs
  - Supply/Storage Status Triggers
    - Contingency Conservation
    - Rationing
  - Expected Effects
    - Overall Use Reduction
    - Use Reduction by User Type

Demand Parameters

- Average Year Demand
  - Current Year Consumptive Use (Includes BMP's)
  - Carryover Storage Use
    - In-Lieu Recharge
    - Direct Recharge
  - Non-M&I Uses
    - M&I Supplied Agricultural
      - M&I Delivery Dependent
      - Contingency Self-Service Capability
    - Salinity Barrier

- Climate-Related Demand Variation
  - Current Year Consumptive Use Variance
  - Regional Precipitation History (100+ years)

Percentage Distribution of Urban Customers by Type
- Core (Industrial)
- Semi-Core (Commercial and Governmental)
- Non-Core (Residential)

Supply Parameters

Imported and Local Surface Supply
- Average Year Deliveries (sources without time series data)
- Annual Deliveries from Simulation Studies

Contingency Transfer Supply
- Conveyance Facility Constraints
- Frequency/Quantity Constraints (third-party considerations)

Amount of Carryover Storage Capacity Filled at Start of Simulation

Operations Cost Parameters

Conveyance

Treatment and Delivery

Ground Water Operations
- Recharge
- Extraction

Shortage Cost and Loss Parameters

Unit Cost of Transferred Water During Shortages

Contingency Program Implementation Costs
- Conservation
- Rationing

Residential User Loss Function

Unit Non-M&I Loss
- M&I Supplied Agricultural Deliveries
- Salinity Barrier Use