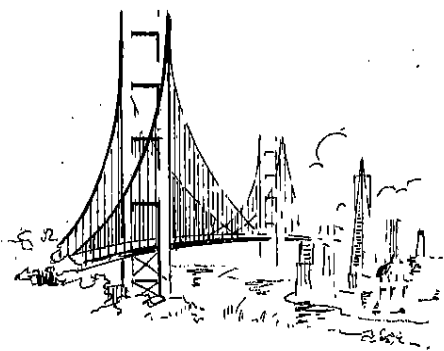
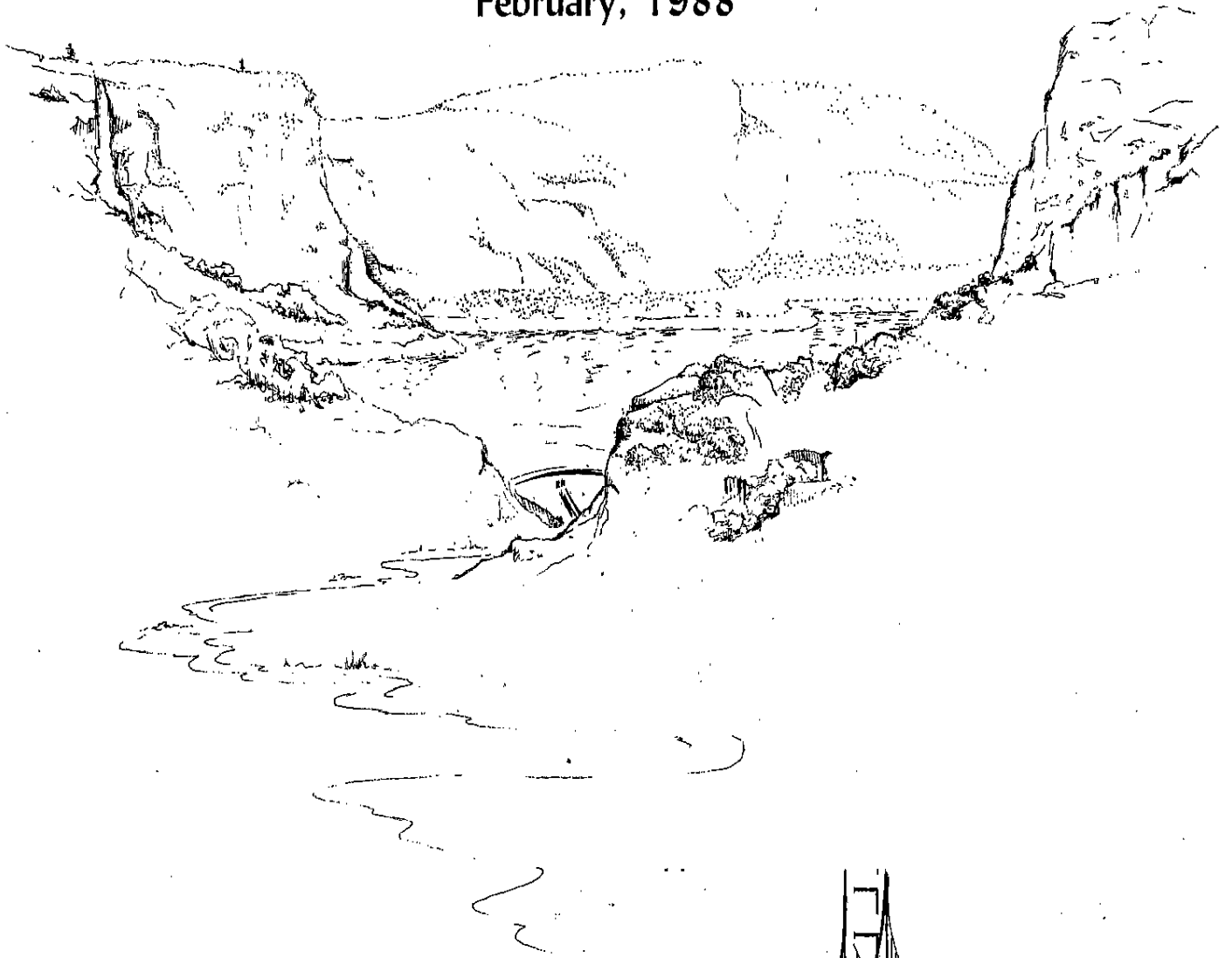


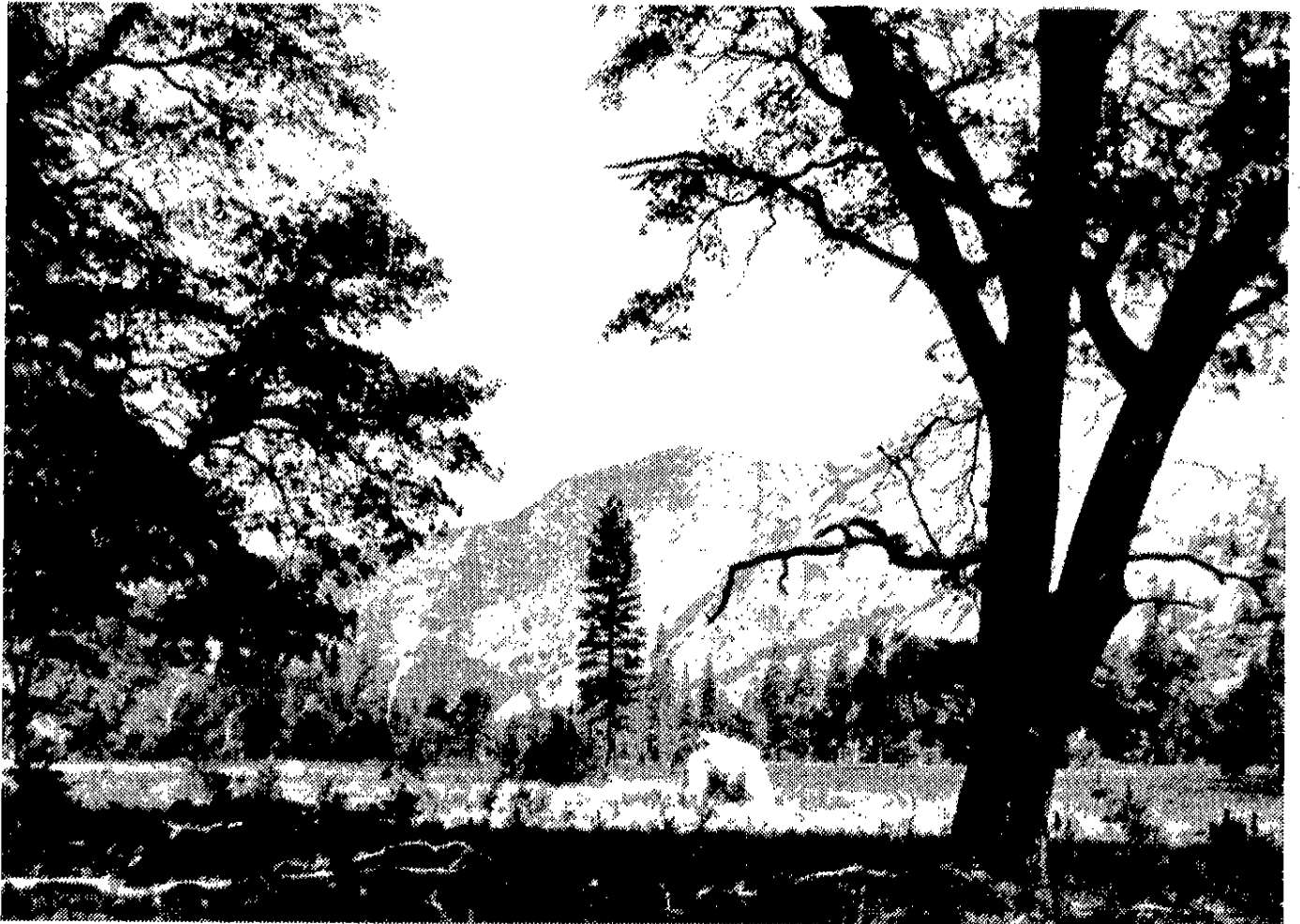
# Hetch Hetchy: Water and Power Replacement Concepts

February, 1988



# SUMMARY

---



*Photograph by Joseph Le Conte*

---

The Hetch Hetchy Valley before the O'Shaughnessy Dam was completed in 1923.

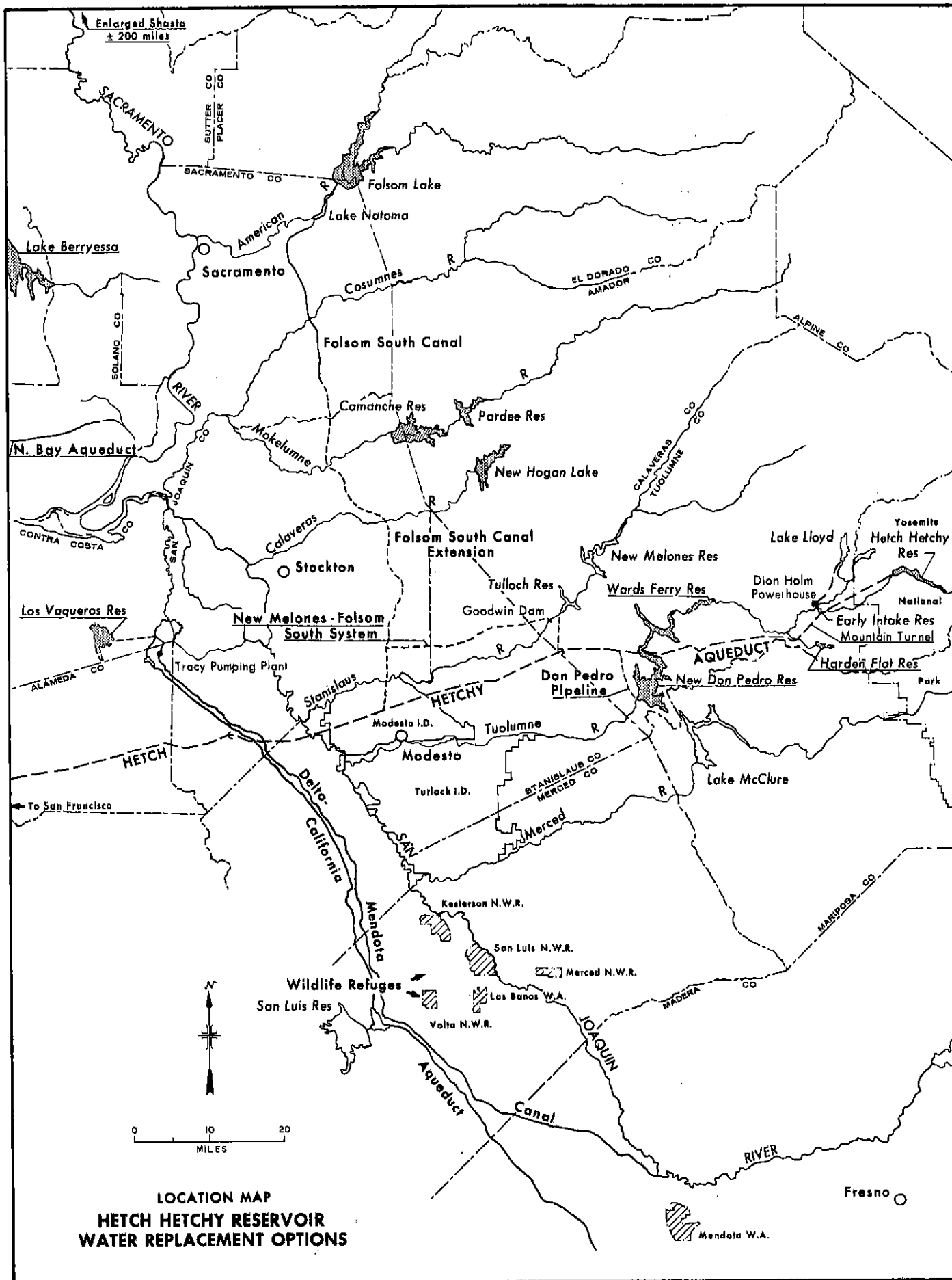


FIGURE 1

# SUMMARY

---

**T**his report presents the results of a preliminary analysis made by the Bureau of Reclamation of the idea of restoring Hetch Hetchy Valley to its natural environment as a unit of Yosemite National Park. The report was prepared on behalf of the National Park Service, with assistance from the City and County of San Francisco, Modesto and Turlock Irrigation Districts, and the Western Area Power Administration, who provided materials and data.

The report also presents the basis for a feasibility study of the restoration of Hetch Hetchy Valley should it be determined that further analyses are warranted. Although concepts for replacing water and power supplies from San Francisco's Hetch Hetchy system were examined cursorily, based on existing information only, several replacement strategies appeared promising for further study. Emphasis in a future study should be on those options and on establishing the specific replacement requirements, which are only generally known at present.

Restoring the 1,970 acres of land presently impounded by Hetch Hetchy Reservoir to National Park uses would generate many long-term environmental benefits, including improving the area's environmental, ecological, and recreational resources. Restoration would, however, eliminate the potential for meeting the water supply provided to San Francisco and nearby cities from the Hetch Hetchy Reservoir; this supply over the past 11 years has averaged about 214,000 acre-feet annually. Restoration would also reduce power benefits from the Hetch Hetchy system.

The Hetch Hetchy system is comprised of three storage reservoirs: Hetch Hetchy (360,360 acre-feet); Lake Eleanor (27,100 acre-feet); and Lake Lloyd (268,800 acre-feet), as well as various hydro-electric power facilities. New Don Pedro Reservoir (2,030,000 acre-feet), located downstream of the Hetch Hetchy system, is owned jointly by the City and the Turlock and Modesto Irrigation Districts. Hetch Hetchy Reservoir is operated to

directly provide water supplies for San Francisco; Lakes Eleanor and Lloyd are operated to generate power, meet instream water requirements, and, in part, to provide inflow into New Don Pedro Reservoir, as part of the City's obligation to the districts.

San Francisco operates its Hetch Hetchy system under authorities provided by the Federal Raker Act of 1913 and water rights granted by the State of California. Agreements with the Turlock and Modesto Irrigation Districts outline water rights and the operation of the City's Cherry Valley Dam, impounding Lake Lloyd, and the New Don Pedro Dam. Agreements with the Department of the Interior on fish releases and with the Corps of Engineers on flood control also govern, in part, operation of the Hetch Hetchy system.

Identifying viable water and power replacement alternatives is critical to the pursuit of any plan to create a "second Yosemite Valley." Although detailed studies of alternatives capable of replacing the Hetch Hetchy water and power supplies have yet to be made, several opportunities appear promising. Among them, and the logical first step toward replacement, is operation of the City's Tuolumne River (Hetch Hetchy) system and the downstream New Don Pedro Reservoir to salvage as much water and power as possible without Hetch Hetchy Reservoir and to keep the Turlock and Modesto Irrigation Districts' water supply intact.

Based on dry-year hydrology, it appears that operation of the Hetch Hetchy system without Hetch Hetchy Reservoir could provide a minimum of 336,000 acre- feet of Tuolumne River water annually to San Francisco through the City's existing system. (At the present time, 336,000 acre-feet per year is the maximum amount that can be conveyed through existing conduits.)<sup>1</sup> Over 100,000 acre-feet of replacement supply could be provided from river level diversion from below O'Shaughnessy damsite and another 250,000 acre-feet from changes in operation in Lakes Eleanor and Lloyd. In total, enough water could be captured to

1 *Capacity of the existing Hetch Hetchy Aqueduct across the San Joaquin Valley is 300 million gallons per day.*

operate the City's existing conveyance system at full capacity and deliver almost 100,000 acre-feet more than is currently being used.

In addition to providing water and power supplies, any reoperation of the Tuolumne River system would consider flood control and instream flow needs, and Sacramento-San Joaquin Delta/San Francisco Bay requirements. Water from the City's facilities without Hetch Hetchy Reservoir could be conveyed through existing City conveyance systems; water, if any, from New Don Pedro Reservoir would require new facilities to introduce and treat replacement supplies into the City's conveyance system.

If needed, additional replacement supplies could be developed through storage of Tuolumne River water in new terminal storage facilities in the City's service area. Previous City studies<sup>1</sup> suggest that the existing San Antonio and Crystal Springs Reservoirs have the potential for increased storage. Long-term reliability of using those sources would be directly related to the seismic potential of the area.

The restoration of Hetch Hetchy Valley would affect the power supplies of the Turlock and Modesto Irrigation Districts and the power supplies and revenues associated with San Francisco's Hetch Hetchy system. Water supplies to the Kirkwood and Moccasin Creek Powerplants would be reduced. These plants presently produce about 1,155 million kilowatt-hours of electricity, or about 60 percent of the Hetch Hetchy system's generation.

Also affected would be the fishery and recreation resources of the Tuolumne River and a reach of the river that is included in the Federal Wild and Scenic River system.

Water supplies for the City not replaced by coordinated or modified operation of present Tuolumne River facilities could be provided from various other sources. These are summarized in the matrix on Table 1. The three most promising options at this

1 *Kennedy/Jenks Engineers. January 1986. Alternative Means of Providing Additional Water to the San Francisco Water Department. "Executive Summary." Report Completed in association with Tudor Eng. Co.*

time appear to be a conjunctive use program for the American, Stanislaus, and Tuolumne River Basins, which drain a portion of the eastern Sierra Nevada foothills; construction of an offstream storage reservoir at the proposed Los Vaqueros damsite in Contra Costa County; and coordination of the Solano Project's Lake Berryessa with the State of California's North Bay Aqueduct.

Conjunctive use of the Tuolumne River Basin could be incorporated into an ongoing Reclamation use study of existing projects, facilities, and river systems between the American and Stanislaus River basins. Replacement water could be delivered through new facilities constructed directly to the City's Hetch Hetchy system. Any water developed, however, would be shared with other users in the area and would not all be available for Hetch Hetchy replacement supplies.

Supplies from either offstream storage or coordinated operation of State- Federal facilities would be delivered to the City from the Delta using either the existing Federal Delta-Mendota Canal or the State Aqueduct to the point where the Hetch Hetchy Aqueduct crosses these facilities.

Capacity in the Federal canal is limited, however, and enlargement would be required. Use of the State Aqueduct would require a wheeling agreement. Quality of water from the Delta would be adequate for municipal uses although it would be less than the quality the City presently enjoys. Use of Delta supplies would also require through-Delta water conveyance improvements as the water that can be moved across the Delta is limited by the capacity of Delta channels.

The role of San Francisco in sharing in the maintenance of Sacramento-San Joaquin Rivers Delta/San Francisco Bay standards may be a consideration in determining future water supplies, but is not considered in this report. Any City responsibility will be a consideration in the present hearings on Bay/Delta water standards now underway by the State Water Resources Control Board.

## MATRIX KEY

The following matrix summarizes 11 concepts for replacing water and power supplies now generated by the existing Hetch Hetchy system on the Tuolumne River. Specific details for each of the concepts, or options, described and the amount of water that would need to be replaced will not be known until more detailed studies are made.

The present system can furnish 300,000 million gallons per day (336,000 acre-feet annually) to its service area as limited by conduit capacity. Past studies indicate the potential to produce up to 400 million gallons per day (448,000 acre-feet annually) if these conveyance restrictions are eliminated. Assuming either value for purposes of discussion, however, it appears that no single replacement option would suffice, and that some combination of options would be required to replace supplies.

### Reoperation 1/ of Existing Tuolumne Facilities.

Replacement concepts and what is known about them from a brief review of existing data are presented on the matrix. The first three listed are not options in the sense that they can be compared one against the other so that one could be selected and another rejected. Rather they would be considered together as a logical first step to recoup as much water and power as possible from the facilities remaining after Hetch Hetchy Valley was restored. They represent a step that must be taken regardless of the overall replacement plan selected.

Although studies will be required to confirm the amount of supplies that could be generated by reoperating existing facilities on the Tuolumne River without Hetch Hetchy Reservoir, it is believed that the bulk of the replacement of the present water supply could be provided through options 1 through 3. These supplies would be available in many years, particularly if supplemental storage for Tuolumne water could be found (Option 4).

### Options to Supplement Reoperation of Tuolumne System.

Water Replacement. The remaining options (4-11) represent actions that might be taken to supplement supplies derived from reoperation of the present Tuolumne system without Hetch Hetchy Reservoir if further replacement is needed. These options are not equal in terms of potential accomplishments, costs, impacts, or ease of implementation, and they must be compared one against the other to determine which one, or combination, should be selected as part of an overall replacement plan.

Power Replacement. Reoperation of the City of San Francisco's Tuolumne facilities will not recoup power losses caused by dewatering Hetch Hetchy although enough power would be produced under reoperation to meet the City's power uses. Some additional generation could occur at New Don Pedro because of increased inflow into the reservoir after Hetch Hetchy storage is removed. The remaining water replacement options will be net power users and, hence, will contribute nothing toward replacement of the power lost. No replacement power project is suggested in the matrix. It is suggested, however, that net losses could be replaced by purchase from existing power supplies. Long-term replacement cost, however, would have to be weighed against the amortized cost of initial capital replacement.

1/ The term "reoperation" refers to the manner in which existing facilities might be operated after Hetch Hetchy Reservoir is removed. Some physical modification of or addition to the existing facilities would be required.

Options	Potential Replacement Capability 1, 2			
	Water			Power
	San Francisco	Turlock and Modesto ID's	Tuolumne Instream Uses	
<p><b>I. TUOLUMNE RIVER SYSTEM: Logical First Steps Toward Replacement</b></p> <p>1. Reoperation of remaining San Francisco facilities on main Tuolumne River. Assumes only reoperation of diversion capabilities at Mountain Tunnel.</p>	- Partial replacement of present supply. Amount available would depend on how much would be provided for instream uses.	- Unknown until studies are made.	- Potential depletion depending on share allocated to other uses.	- Partial replacement assuming that power would be incidental to water operations.
<p>2. Reoperation of remaining San Francisco facilities including the Lake Lloyd - Lake Eleanor - Holm P.F. with modified facilities to permit routing the water through Mountain tunnel.</p>	- Increased partial replacement of present supply over 1 above. Amount available would depend on how much would be provided for power at Holm and instream uses.	- Unknown until studies are made.	- Potential depletion to above.	- Same as in 1 above. - Could result in reduction with reoperation of Cherry Lake - Lake Eleanor system.
<p>3. Reoperation of New Don Pedro Reservoir and additional conveyance provided to Hetch Hetchy Aqueduct.</p>	- Further increase over 1 and 2 above of partial replacement of present supply. - Amount available dependent on assumptions and redirection upstream for City.	- Unknown until studies are made.	- No change from 1 and 2 above.	- No change from 1 and 2 above. - Some possible additional power at New Don Pedro available from additional inflow to new Don Pedro.

<sup>1</sup> Measured from the condition as it would be without Hetch Hetchy Reservoir and no diversions to San Francisco.

<sup>2</sup> Options 1, 2, and 3 are measures that will be taken together.

**TABLE 1**

**Matrix of Potential Replacement Concepts**

Costs/Issues/Impacts				
New Facilities Required	Relative Cost	Institutional Issues	Water Quality Considerations	Environmental Considerations
- None - Assumes no modifications to existing facilities.	- None since no new or modified facilities	- Issues on instream uses in Tuolumne River, i.e., municipal fish hatchery, rafting, wild and scenic river.  - Issues on New Don Pedro Reservoir and its water and power supplies	- Water would be of the same quality as present supplies.	- Impacts on flows in Tuolumne River.  - Impacts on rafting and wild and scenic river.  - Downstream impacts to Tuolumne and San Joaquin River and the Delta.
- Facilities to permit Hoim P.P. discharges to be diverted through Mountain Tunnel.	- Low cost for these facilities yet to be determined from studies.	- Same as in 1 above plus issues related to Cherry and Eleanor Creeks.	- Water would be of the same quality as present supplies.	- Increase impacts to 1 above from increased diversion of Tuolumne River flows and impacts to Cherry and Eleanor Creeks.  - Impacts of construction of new facilities.
- New pumping plant and conveyance facilities to Hetch Hetchy Aqueduct. Treatment may be required.	- Costs yet to be determined from studies.	- Same as in 1 and 2 above.  - Issues on present agreements including water banking.	- Water would be slightly lesser quality than upstream source.	- No change to 1 and 2 above from New Don Pedro reoperation.  - Additional decreased flow in San Joaquin River and into the Delta from the Tuolumne River.  - Impacts of construction of new facilities.  - Impacts of increased fluctuations in New Don Pedro.

Options	Potential Replacement Capability <sup>1</sup>			
	Water			Power
	San Francisco	Turlock and Modesto ID's	Tuolumne Instream Uses	
<b>ii. OPTIONS TO PROVIDE BALANCE OF REQUIRED REPLACEMENT</b> <b>A. Tuolumne River System</b> 4. New Reservoir closer to San Francisco (enlarge the city's San Antonio and Crystal Springs Dam.)	- Unknown but probably only minor replacement supplies.	- Would reduce inflow to New Don Reservoir.	- Partial replacement. Could reduce instream flow depending on share allocated to instream flows.	- Partial replacement.
5. New storage on Tuolumne River. (Wards Ferry and Harden Flat Dams).	- Partial replacement of present supply. Amount available unknown until studies are made.	- Unknown until studies are made.	- Wards Ferry would inundate part of designated wild and scenic river. - Harden Flat could provide some replacement.	- Partial replacement assuming power features would be included.

<sup>1</sup>Measured from the condition after implementation of options 1, 2 and 3.

**Table 1**

Costs/Issues/Impacts				
New Facilities Required	Relative Cost	Institutional Issues	Water Quality Considerations	Environmental Considerations
<ul style="list-style-type: none"> <li>- Enlargement of two dams.</li> <li>- Pumping facilities.</li> </ul>	<ul style="list-style-type: none"> <li>- Enlargement of the dams, approximately \$8 million.</li> </ul>	<ul style="list-style-type: none"> <li>- Possible seismic considerations related to the enlargements.</li> <li>- Additional issues on instream uses in Tuolumne River, i.e., municipal, fish hatchery, rafting, wild &amp; scenic rivers.</li> <li>- Additional issues on New Don Pedro Reservoir and its water and power supplies.</li> </ul>	<ul style="list-style-type: none"> <li>- Same high Tuolumne River quality as the present supply would be blended with local runoff.</li> </ul>	<ul style="list-style-type: none"> <li>- Increased impacts to 1 above and less water available for instream use above and below New Don Pedro.</li> <li>- Unknown impacts associated with reservoir enlargements.</li> </ul>
<ul style="list-style-type: none"> <li>- New storage reservoirs - Wards Ferry and Harden Flat. New pumping and conveyance to Hetch Hetchy Aqueduct. Some treatment may be required.</li> </ul>	<ul style="list-style-type: none"> <li>- High.</li> <li>- Conveyance facilities need to be identified and costs determined.</li> </ul>	<ul style="list-style-type: none"> <li>- Wards Ferry would be in designated wild and scenic portion of river.</li> <li>- Issues on other instream uses similar to 1, 2, &amp; 3 above.</li> </ul>	<ul style="list-style-type: none"> <li>- Water at Wards Ferry would be slightly lesser quality upstream source.</li> </ul>	<ul style="list-style-type: none"> <li>- Increased impacts to 1 above with reduced flows available to lower system (i.e., San Joaquin River and Delta and New Don Pedro.</li> <li>- Impacts of new reservoirs to: Recreation Wildlife Habitat Endangered Species Cultural Resources.</li> <li>- Wild and Scenic River System.</li> </ul>

Options	Potential Replacement Capability 1			
	Water			Power
	San Francisco	Turlock and Modesto ID's	Tuolumne Instream Uses	
<p><b>B. <u>Sierra Nevada Supplies</u></b></p> <p>6. Eastside optimization conjunctive use concepts extended to Tuolumne River.</p>	<ul style="list-style-type: none"> <li>- Might provide balance of replacement required for present supplies. Studies are required.</li> <li>- Might provide supplemental supplies to San Francisco. Studies are required.</li> </ul>	<ul style="list-style-type: none"> <li>- Might provide some water directly to irrigation Districts and thereby reduce new Don Pedro's requirements.</li> </ul>	<ul style="list-style-type: none"> <li>- Might provide fishery flows through exchange below New Don Pedro.</li> </ul>	<ul style="list-style-type: none"> <li>- None. Alternative would consume power with pumping required for ground water and to export from the collection conveyance system into the San Francisco system.</li> </ul>
<p><b>C. <u>Delta Supplies</u></b></p> <p>7. Los Vaqueros Reservoir.</p>	<ul style="list-style-type: none"> <li>- Could provide balance of replacement required for present supplies.</li> </ul>	<ul style="list-style-type: none"> <li>- None.</li> </ul>	<ul style="list-style-type: none"> <li>- None.</li> </ul>	<ul style="list-style-type: none"> <li>- None. System would be a major net power consumer. Pumping would be from the Delta into the reservoir and from the export canal into the San Francisco system.</li> </ul>

<sup>1</sup> Measured from the condition after implementation of options 1, 2, and 3.

Table 1

Costs/Issues/Impacts				
New Facilities Required	Relative Cost	Institutional Issues	Water Quality Considerations	Environmental Considerations
<ul style="list-style-type: none"> <li>- Extend new conveyance from Folsom South Canal and New Melones Reservoir to San Francisco system.</li> <li>- This would require pumping. Some treatment would be required.</li> </ul>	<ul style="list-style-type: none"> <li>- Medium</li> <li>- Cost for conveyance and pumping facilities to be determined from studies</li> <li>- Treatment costs.</li> </ul>	<ul style="list-style-type: none"> <li>- Water developed would have to be shared with users from the American to the Tuolumne which would limit supplies available to replace Hetch Hetchy water.</li> <li>- Agreement with various districts and entities from American River to Turlock and Modesto to make plan workable.</li> <li>- CVP authority required.</li> <li>- Water rights.</li> <li>- American River instream flow issues would have to be resolved.</li> <li>- Agreements with fishery entities on tributary streams from American to Tuolumne Rivers.</li> </ul>	<ul style="list-style-type: none"> <li>- Fairly high quality but less than that of San Francisco's present Tuolumne River supply.</li> </ul>	<ul style="list-style-type: none"> <li>- Impacts on instream flow uses in American River, Stanislaus River, Tuolumne River, and other tributary streams, i.e., Mokelumne and Calaveras Rivers.</li> <li>- Impacts of new facilities to: Recreation, Vegetation and Wildlife, Endangered Species, Cultural Resources.</li> </ul>
<ul style="list-style-type: none"> <li>- Los Vaqueros Dam, Reservoir, pumping and power facilities.</li> <li>- Cross Delta Conveyance.</li> <li>- Export capacity through enlarged Delta-Mendota Canal or wheeling agreement for use of State Aqueduct.</li> <li>- Connection from export canal to City's Coast Range Tunnel.</li> <li>- Full treatment would be required.</li> </ul>	<ul style="list-style-type: none"> <li>- Very high.</li> <li>- Los Vaqueros facilities approximately \$825 million would be shared with partners in the project.</li> <li>- Cross Delta facility would be shared with DWR.</li> <li>- Enlarged Delta-Mendota Canal approximately \$25 million would be shared with other users.</li> </ul>	<ul style="list-style-type: none"> <li>- Delta water quality standards.</li> <li>- Competition for Los Vaqueros water with other potential participants in the project.</li> <li>- Agreements with "partners" in Los Vaqueros, export conveyance and cross Delta projects.</li> <li>- Water rights for Los Vaqueros.</li> <li>- Authority (BOR) to participate in Los Vaqueros and other required actions.</li> <li>- Delta and related San Francisco Bay and export issues are extremely complex, involve a wide range of interests, and are not likely to be resolved soon.</li> </ul>	<ul style="list-style-type: none"> <li>- Water quality is suitable for municipal uses after treatment and is so used by Contra Costa County and most of southern California. The quality would not be as high as the City's present Tuolumne River supplies.</li> </ul>	<ul style="list-style-type: none"> <li>- Impacts of additional diversions in the Delta to: <ul style="list-style-type: none"> <li>Fisheries</li> <li>Vegetation</li> <li>Wildlife</li> <li>Recreation</li> <li>Cultural Resources</li> </ul> </li> <li>- Impacts of Cross Delta Conveyance.</li> <li>- Impacts of Los Vaqueros Reservoir to endangered species and riparian habitat.</li> </ul>

Options	Potential Replacement Capability <sup>1</sup>			
		Water		Power
	San Francisco	Turlock and Modesto ID's	Tuolumne Instream Uses	
8. Enlarged Shasta.	<ul style="list-style-type: none"> <li>- Could provide up to full replacement for present supplies.</li> <li>- Could provide supplemental supplies to San Francisco.</li> </ul>	- None.	- None.	- Unknown. Some partial replacement, theoretically, possible but not a likely source of replacement power.
9. Wildlife refuges in the San Joaquin Valley (used as offstream storage).	- Might provide balance of replacement required for present supplies.	- None.	- None.	- None. Alternative would consume power by pumping from the Delta to the export canal and from the canal into the San Francisco system.

<sup>1</sup> Measured from the condition after implementation of options 1, 2, and 3.

**Table 1**

<b>Costs/Issues/Impacts</b>				
New Facilities Required	Relative Cost	Institutional Issues	Water Quality Considerations	Environmental Considerations
<ul style="list-style-type: none"> <li>- Enlarged Shasta Dam and related facilities.</li> <li>- Cross Delta Conveyance.</li> <li>- Export capacity through enlarged Delta-Mendota Canal or wheeling agreement to use State Aqueduct.</li> <li>- Connection from export canal to City's Coast Range Tunnel.</li> <li>- Full treatment would be required.</li> </ul>	<ul style="list-style-type: none"> <li>- Extremely high.</li> <li>- Enlarged Shasta facilities would exceed \$3 billion which would be shared with partners.</li> <li>- Cross Delta facility would be shared with State.</li> <li>- Enlarged Delta-Mendota Canal approximately \$25 million would be shared with other users.</li> <li>- Full treatment costs.</li> </ul>	<ul style="list-style-type: none"> <li>- Enlarged Shasta is an extremely large undertaking which involves many interests. The needs related to the replacement of Hetch Hetchy would be only a minor factor.</li> <li>- Delta issues related to Cross Delta conveyance and export conveyance.</li> <li>- Water rights for Enlarged Shasta.</li> <li>- Authority to participate in Enlarged Shasta Cross Delta projects.</li> </ul>	<ul style="list-style-type: none"> <li>- Same as for 7 above.</li> </ul>	<ul style="list-style-type: none"> <li>- Impacts of Enlarged Shasta to:                             <ul style="list-style-type: none"> <li>Wildlife habitat inundated</li> <li>Endangered species</li> <li>Sacramento River Recreation</li> <li>New roads</li> <li>Cultural Resources</li> </ul> </li> <li>- Impacts of additional diversions on the Delta to:                             <ul style="list-style-type: none"> <li>Fisheries</li> <li>Vegetation</li> <li>Wildlife</li> <li>Recreation</li> <li>Cultural Resources</li> </ul> </li> <li>- Impacts of Cross Delta Conveyance.</li> </ul>
<ul style="list-style-type: none"> <li>- Cross Delta Conveyance</li> <li>- Export capacity through enlarged Delta-Mendota Canal or wheeling agreement to use State aqueduct.</li> <li>- Connection from export canal to City's Coast Range Tunnel.</li> <li>- Facilities on refuges to manage and recapture the stored water.</li> <li>- Full treatment would be required.</li> </ul>	<ul style="list-style-type: none"> <li>- High.</li> <li>- Cross Delta facility would be shared with State.</li> <li>- Enlarged Delta Mendota Canal approximately \$25 million would be shared with other users.</li> <li>- Cost of facilities required to recapture the supplies stored on the refuges and to transmit them to the ultimate users.</li> <li>- Full treatment costs.</li> </ul>	<ul style="list-style-type: none"> <li>- Delta issues related to Cross Delta conveyance and export conveyance.</li> <li>- Water rights for the storage of water on the refuges.</li> <li>- Authority (Reclamation) to participate in the storage program and the required actions.</li> <li>- Exchange Agreements with users of Central Valley Project water to accept the water from the refuges to free up the water for San Francisco.</li> </ul>	<ul style="list-style-type: none"> <li>- Water delivered to San Francisco would be from the Delta with quality consideration the same as 7 above.</li> <li>- The quality of the water stored on the refuges is unknown but there is the potential for quality degradation by the process.</li> </ul>	<ul style="list-style-type: none"> <li>- Impacts to:                             <ul style="list-style-type: none"> <li>Shore bird habitat on refuges.</li> <li>Endangered species.</li> </ul> </li> <li>- Impacts of additional diversions on the Delta to:                             <ul style="list-style-type: none"> <li>Fisheries</li> <li>Vegetation</li> <li>Wildlife</li> <li>Recreation</li> <li>Cultural Resources</li> </ul> </li> <li>- Impacts of Cross Delta Conveyance.</li> </ul>

Options	Potential Replacement Capability <sup>1</sup>			
10. Coordination of Lake Berryessa with the State's North Bay Aqueduct.	Water			Power
	San Francisco	Turlock and Modesto ID's	Tuolumne Instream Uses	
	<ul style="list-style-type: none"> <li>- Might provide balance of replacement required for present supplies.</li> <li>- Might provide supplemental supplies to San Francisco.</li> </ul>	- None.	- None.	- None. Pumping would be required to pump from the Delta and into the San Francisco system.
III. PURCHASE REPLACEMENT POWER	- N/A	- N/A	- N/A	- Fully compensate for lost net generation after implementation of water supply options through purchase of power on the market.

<sup>1</sup> Measured From the condition after implementation of options 1, 2 and 3.

**Table 1**

<b>Costs/Issues/Impacts</b>				
<b>New Facilities Required</b>	<b>Relative Cost</b>	<b>Institutional Issues</b>	<b>Water Quality Considerations</b>	<b>Environmental Considerations</b>
<ul style="list-style-type: none"> <li>- Cross Delta Conveyance</li> <li>- Export capacity through enlarged Delta-Mendota Canal or wheeling agreement for use of State Aqueduct.</li> <li>- Connection from export canal to City's Coast Range Tunnel.</li> <li>- Full treatment would be required.</li> </ul>	<ul style="list-style-type: none"> <li>- High.</li> <li>- Cross Delta facility would be shared with State.</li> <li>- Enlarged Delta-Mendota Canal approximately \$25 million would be shared with other users.</li> <li>- Facilities to develop and convey the new supplies to the Delta.</li> </ul>	<ul style="list-style-type: none"> <li>- Delta water quality standards.</li> <li>- Agreements with the various districts and entities regarding sharing of new supplies and costs.</li> <li>- Central Valley Project authority required.</li> <li>- Water rights.</li> </ul>	<ul style="list-style-type: none"> <li>- Same as for 7 above.</li> </ul>	<ul style="list-style-type: none"> <li>- Additional diversions on the Delta:               <ul style="list-style-type: none"> <li>Fisheries</li> <li>Vegetation</li> <li>Wildlife</li> <li>Recreation</li> <li>Cultural Resources</li> </ul> </li> <li>- Impacts of Cross Delta Conveyance</li> <li>- Impacts on Lake Berryessa</li> </ul>