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State of California
The Resources Agency

DEPARTMENT OF WATER RESOURCES
Division of Operations and Maintenance

STATE WATER PROJECT ANNUAL REPORT OF OPERATIONS 1987

AUGUST 1990

Gordon K. Van Vleck
Secretary for Resources
The Resources Agency

George Deukmejian
Governor
State of California

David N. Kennedy
Director
Department of Water Resources

This is the fourteenth in a series of annual reports summarizing the water and energy operation of the California State Water Project. This report summarizes the operation of Project facilities during 1987, and includes revisions to the data published in the monthly "State Water Project, Operations Data".

Keith G. Barrett

Keith G. Barrett, Chief
Division of Operations and Maintenance

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UNITS AND ABBREVIATIONS

The following names, terms, and units commonly used throughout this report are defined here and when first used in the text.

ft	feet
ac-ft	acre-feet
cfs	cubic feet per second
KW	kilowatt
KWh	kilowatt-hour
Kv	kilovolt
MW	megawatt
MWh	megawatt-hour
DWR	Department of Water Resources
SWP	State Water Project
CVP	Central Valley Project
USBR	U.S.Bureau of Reclamation
SWRCB	State Water Resources Control Board
D-1485	Water Rights Decision 1485
Banks Pumping Plant	Harvey O. Banks Delta Pumping Plant
California Aqueduct	Governor Edmund G. Brown California Aqueduct

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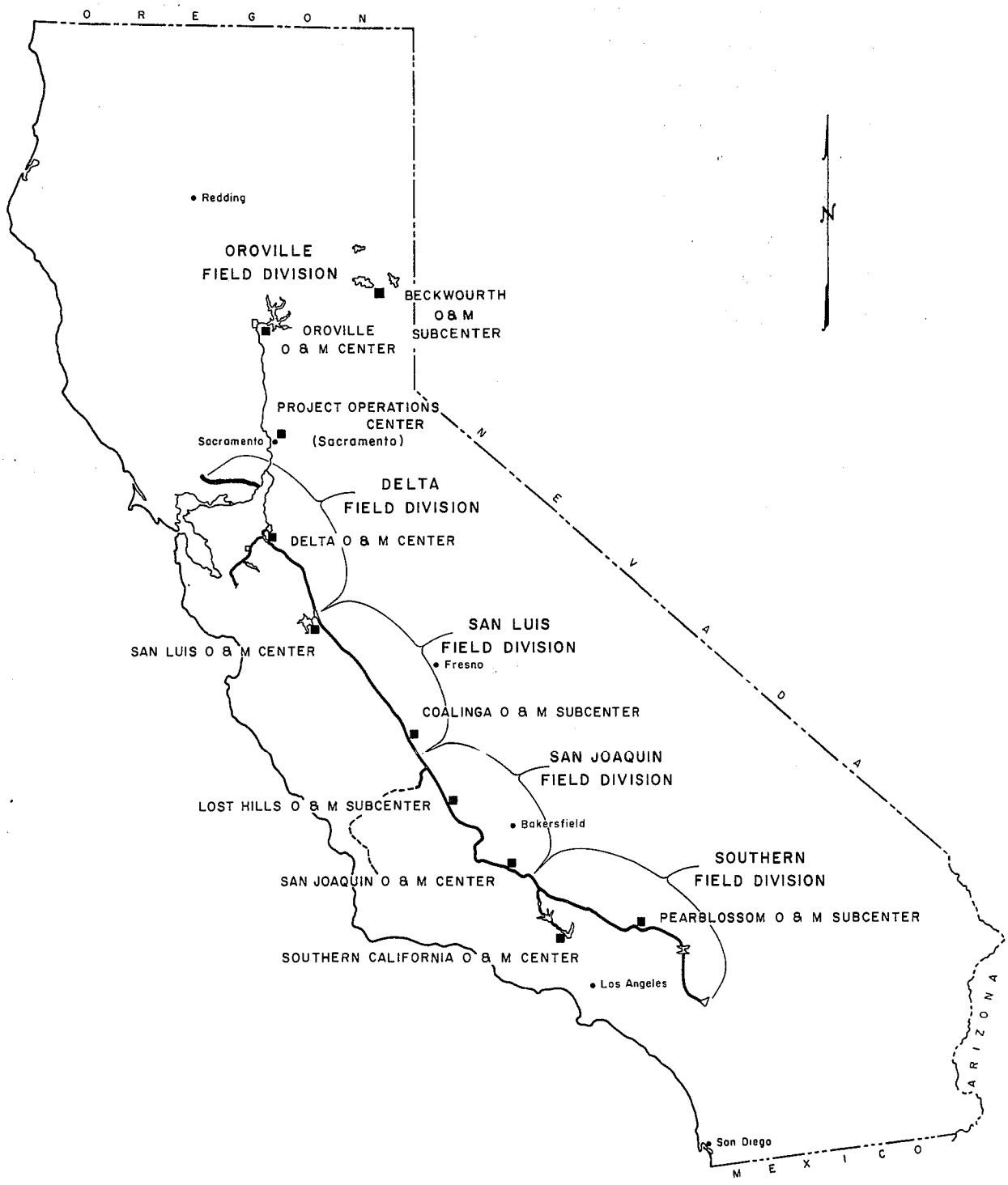
FIELD DIVISION BOUNDARIES



INTRODUCTION

The 1987 Annual Report of Operations for the State Water Project (SWP) is divided into eight parts. The first two parts, "Introduction and Highlights of 1987 Operation" and "Project Status in 1987," cover conditions and events of state-wide significance, in detail where appropriate and in summary when the item is discussed in more detail in the following sections. The next four sections cover water quality, water conditions, water operations, and energy operations in 1987. The seventh part, "Sacramento-San Joaquin Delta Operations," gives special emphasis to Delta operations, a key aspect of the SWP. The last part, "Project Operations By Field Division," provides further detail on operational conditions and activities by field division.

The report also includes two appendices, tabulating and depicting Project operations in 1987. Appendix I covers operations of the Aqueduct. Appendix II covers various types of water quality measurement analyses for selected stations throughout the Project.

HIGHLIGHTS OF 1987 OPERATION

Total precipitation for the 1986-87 water year (October 1, 1986 through September 30, 1987) was well below average in California. Precipitation in the Sacramento and Feather River drainage areas was considerably below average during the first third of the water year. Although February precipitation was near average, and March precipitation was above average in most areas, low precipitation continued through April. As of May 1, statewide average precipitation during the 1986-87 water year was only 60 percent of normal.

Unimpaired runoff to Lake Oroville was well below average for the year (about 50 percent), but above that of the 1976-77 drought years. Unimpaired runoff to Shasta Lake was also well below average for the year (about 42 percent) and below the previous record minimum that occurred during the 1976-77 drought years.

The 1986-87 water year was defined as "critical" under the State Water Resources Control Board's (SWRCB) Decision 1485 (D-1485) criteria. Demands for SWP water increased in 1987 by about 15 percent over the 1986 amounts. Deliveries of entitlement water to long-term contractors were 7 percent higher than 1986 deliveries and were about 83,000 acre-feet (AF) less than the 1987 deliveries requested in the fall of 1986.

For the fourth consecutive year, the SWRCB D-1485 requirements were met and "balanced" water conditions existed in the Delta. The Department of Water Resources (DWR) and the United States Bureau of Reclamation (USBR) declared balanced water conditions from April 6 to December 10, 1987. Balanced water conditions are proclaimed when upstream reservoir storage withdrawals, plus other inflows, approximately equal the water supply needed to (1) satisfy Sacramento Valley and Sacramento-San Joaquin Delta in-basin needs, including Delta water quality requirements, and (2) meet export needs. During balanced water conditions, each agency adjusts it's reservoir storage withdrawals and Delta exports to meet it's share of in-basin uses and Delta outflow. This was the seventh year, out of the last nine, in which balanced water conditions in the Delta were declared.

The SWP delivered 2,430,820 AF of water in 1987, including 2,113,915 AF of entitlement water, 114,907 AF of unscheduled water and 201,998 AF of other water.

The SWP generated a total of 4,370,858 megawatt hours (MWh) of energy (2,705,599 MWh from hydro-electric power plants) in 1987 and used 5,024,412 MWh to deliver water to contractors. The SWP also purchased 478,587 MWh and sold 2,657,594 MWh of energy.

In July, August, and September, 1987, DWR purchased 37,052 AF of water released from Yuba County Water Agency's (YCWA) New Bullard's Bar Reservoir. This release allowed DWR to hold a corresponding amount of water in Lake Oroville, increasing the water supply for the 1987-88 water year.

In March, 1987, DWR, USBR, the Department of Fish and Game (DFG) and the Suisun Resource Conservation District signed the Suisun Marsh Preservation Agreement, which defines marsh water quality standards and provides details for implementing the plan of protection.

After years of controversy, environmental impact analyses, and negotiations, construction work toward installation of the remaining four pump units of the Harvey O. Banks Delta Pumping Plant began in August of 1987. Only seven units were installed when the plant was constructed in the 1960s. The final units are expected to be operational by 1991.

PROJECT STATUS IN 1987

PROJECT FACILITIES

The SWP conserves water for distribution to much of California's population and to irrigated agriculture. It also provides flood control, water quality control, electrical power generation, new recreational opportunities, and enhancement of sport fisheries and wildlife habitat.

The first SWP facilities to become operational were Frenchman Dam and Lake in the Upper Feather River Division and the South Bay Aqueduct in the San Francisco Bay area in 1962. By 1973, construction of the initial facilities of the SWP was complete. This provided for operation of the entire SWP from Plumas County in the north to Riverside County in the south. Additional facilities added later to the Project were: William E. Warne Power Plant that began generation on November 17, 1982; Reid Gardner Unit No. 4 (a coal-fired unit owned jointly with Nevada Power Company) which began operation on July 26, 1983; Bottle Rock Powerplant (a geothermal plant) which began generation on February 26, 1985, and Alamo Powerplant that began operation on July 1, 1986.

The switchyard for the new Cordelia Pumping Plant on the North Bay Aqueduct was activated for the first time on December 2, 1987. Barker Slough Pumping Plant switchyard was energized on December 4, 1987. Both plants were activated for testing only.

SWP facilities in operation during 1987 included: 22 reservoirs with a gross capacity of 6,797,171 AF; seven power plants with a total output capacity of 1,686 megawatts (MW)[1]; 16 pumping plants housing 112 units with a total motor rating of 2,768 MW[2]; and 537 miles of aqueduct.

During 1987, water was delivered from SWP facilities to:

* 26 long-term State water service contractors.
* 3 public agencies receiving recreation water (Department of Fish and Game, Department of Parks and Recreation, and the Los Angeles County Recreation Department).
* Several local agencies and farmers receiving water to satisfy prior water rights.
* 3 Local agencies receiving other water.

In addition, SWP facilities were used to deliver a total of 1,462,359 ac-ft of federal water to USBR customers.

---

1 Includes 202 MW of federal power generation output at William R. Gianelli Pumping-Generating Plant, and excludes 1,036 MW from Castaic Powerplant for LADWP.

2 Includes 261 MW of federal pumping capacity at William R. Gianelli Pumping-Generating Plant and Dos Amigos Pumping Plant.

MAJOR OUTAGES AND LIMITATIONS

Major outages and operating limitations of SWP facilities during 1987 were:

* Vandals broke into the Kern River Intertie facilities on March 10, activated the site, and opened one gate completely and another gate about a foot. Roughly 600 AF of water from the California Aqueduct spilled into the intertie collection basin before the gates could be closed. The spilled water was contained in the basin.

* On May 26, embankment damage occurred down-stream from check 49 of the California Aqueduct, in the Quartz Hill area of Palmdale. A water leak developed at a water level measurement well. The leakage washed away some of the embankment and caused the concrete stilling well to topple. Flows in the aqueduct pools above Pearblossom Pumping Plant were first reduced to 580 cfs, then gradually increased to 870 cfs by June 24, when repairs to the eroded embankment were completed.

* Water levels were lowered in pools 38, 39 and 40 to allow repairs to the California Aqueduct at Grapevine Creek from October 19 to October 30. During that time, Edmonston Pumping Plant's operation was limited to one unit at 315 cfs.

* Alamo Powerplant Unit No. 1 was returned to service on December 21. It had been out of service since October 19 to remove corrosion from the wicket gates. On December 22, a maximum load restriction of 4 MW was imposed on the unit until problems with lower guide bearing runout and shaft vibration on load rejection were eliminated. A consultant was hired to investigate the problems and recommend corrective measures.

* A.D.Edmonston Pumping Plant Unit No. 9 was returned to service on June 9. It had been out of service since July of 1985. The unit had been totally disassembled for repair of the stand still seal and for complete overhaul. Unit No. 7 returned to service on December 23. It had been out of service for two months while oil was cleaned from the stator.

WATER QUALITY STANDARDS

SWP and Sacramento-San Joaquin Delta water quality conditions are summarized below. A more detailed report appears in Appendix E to Bulletin 132, published separately as *Water Operations in the Sacramento-San Joaquin Delta*, and in DWR's monthly *State Water Project Operations Data*.

Water quality and SWP operations in the Delta are governed by SWRCB's D-1485 that protects beneficial uses of the Delta by water quality standards, export limitations, and minimum flow rates. These standards are based on the water year type. Classification of the 1986-87 water year was "critical" under the Sacramento River Index (formerly the Four Basin Index) of D-1485. In dry years, the allowable salinity levels are higher, and flow minimums are lower than in wet years. The year type classification is established based on runoff forecasts in the May edition of DWR Bulletin 120, and remains in effect through January 31 of the following calendar year. Preliminary determinations of the year type are made in February, March, and April through forecasts of future runoff based on assumptions of normal precipitation for the remainder of the year water conditions.

Water quality standards are categorized by the beneficial uses they are intended to protect and include municipal and industrial standards, agricultural standards, and fish and wildlife standards.

Two other standards that the SWP must meet are the North Delta Water Agency (NDWA) Contract and the South Delta Water Agency (SDWA) Agreement.

The Delta Outflow Index (DOI) is a calculated approximation of the Delta fresh water outflow past Chipps Island near Pittsburg. During 1987, both the minimum DOI standard and minimum flow in the Sacramento River at Rio Vista required by D-1485 were met.

The average DOI was about 16,000 cfs from January through March. During April and May the sparse Sierra snowpack and runoff reduced the DOI to about 6,000 cfs. From June through November the average DOI dropped to about 2,000 cfs, but finally increased in December to about 8,000 cfs because of early winter rainfall. The lowest DOI was 730 cfs in September and the highest was nearly 37,000 cfs in March.

The Suisun Marsh Protection Plan under D-1485 implemented an extensive monitoring network and study component for the protection of wildlife and other beneficial uses for the Suisun Marsh system. On March 2, 1987, a new Suisun Marsh Preservation Agreement, implemented to insure adequate wetlands water quality, became effective. An EC standard at Chipps Island was established for the January through May period of 12.5 mS/cm (28 day mean). The standard was relaxed to 15.6 mS/cm (28 day mean) for the period of October through December because of continuing critical conditions. Standards were not exceeded during either period in 1987.

Construction began on the Suisun Marsh Salinity Control Structure Gates in 1987. The tidal gate, boat lock, and flashboard structures were completed at the construction yards. The gate was barged and installed directly upstream of Beldon's Landing in September. The gate will be operated from September through April with operational schedules tied to daily tidal fluctuations in order to retain riverine inflow while repelling tidal salt intrusion.

For the benefit of municipal and industrial water users, mean daily chloride standards have been established at four monitoring stations in the Delta area. The stations are at Clifton Court, Tracy Pumping Plant, Contra Costa Canal Intake, and Cache Slough. On December 1, 1987, the daily chloride concentration at Contra Costa Intake Canal equaled the 250 mg/L standard. By December 12, it was exceeded with a 251 mg/L concentration despite increased flows resulting from storms that began on November 30. High tides, wind, and drainage return flows from Delta islands into Rock Slough Channel all contributed to the high chloride level. Chloride concentration at Contra Costa Canal Intake decreased precipitously after the 12th.

An additional D-1485 chloride standard requires that chlorides not exceed 150 mg/L for at least 155 days during a "critical" year at either Contra Costa Canal Intake or the Antioch Water Works Intake. This standard was met on a daily basis for a total of 232 days at Contra Costa Canal. Because the standard is achieved through the sum of daily chloride levels less than 150 mg/L for the best of the two stations, the 155-day standard was met in 1987.

D-1485 established electrical conductivity standards at Emmaton, Jersey Point, San Andreas Landing, and Terminous to protect Delta agriculture during the irrigation season from April 1 to August 15. 1987 was classified as "critical" under the Sacramento River Index of D-1485, permitting relatively low water quality standards for the Delta.

In dry years, the standards are relaxed during the latter part of the irrigation season to reflect the quality of water that would have occurred in the absence of the CVP and SWP. Under critical year conditions the standards reflect salinity intrusions expected with low flows. The 14-day mean EC allowed under the critical year standard during the April 1 through August 15 irrigation season is allowed to be as high as 2.78 mS/cm at Emmaton and 2.20 mS/cm at Jersey Point. Standards for Terminous and San Andreas Landing are 0.54 and 0.87 mS/cm, respectively. All D-1485 agricultural standards for electrical conductivity were met in 1987.

To protect the fish and wildlife of the Suisun Marsh and other Delta areas, D-1485 established electrical conductivity standards for Prisoner's Point, Antioch, and Chipp's Island, and set flow standards for Chipp's Island, Rio Vista, Tracy Pumping Plant, and Banks Delta Pumping Plant. The standards were established in part to encourage spawning and survival of striped bass, and to protect migrating salmon.

Mean daily fish and wildlife standards for EC are 0.55 mS/cm at Prisoner's Point from April 1 to May 5, and 1.5 mS/cm at Antioch from April 15 to May 5 to protect striped bass during their spawning period. Chipp's Island has a 28-day mean EC standard of 12.5 mS/cm from January through May and October through December. These EC standards were met in 1987.

Fish and wildlife standards also include export operational constraints, minimum Delta Outflow Index (DOI) at Chipp's Island and minimum Sacramento River flow at Rio Vista. All SWP Delta export limitations and flow standards were met in 1987.

The NDWA contract with DWR was established to assure a dependable supply of water in the north Delta area that is of suitable quality for agricultural, municipal, and industrial uses. Under the established agreement, water quality standards for electrical conductivity at the Emmaton site may be more stringent than in D-1485. During 1987, the running 14-day mean NDWA Emmaton EC standard of 2.79 mS/cm was exceeded from October 31 through December 12. The highest 14-day mean EC was 4.0 mS/cm on December 4, 1987, and the average for this period, based on the running 14-day mean, was 3.55 mS/cm. In order to help alleviate this situation, the Delta Cross Channel gates were frequently closed (forcing more Sacramento River flows past Emmaton) and Delta exports were reduced.

In June, 1986, the Department of Water Resources and the SDWA signed an agreement regarding mitigation for the adverse water level and circulation impacts resulting from the construction and operation of the SWP. Under specific terms of the agreement, dredging of Tom Paine Slough, a dead-end irrigation waterway near Tracy, was completed in the latter part of 1986. A Middle River Weir was installed in May of 1987, and the center portion removed at the end of irrigation season in September. Plans for the reinstallation of the weir's middle section for the 1988 irrigation season and the construction of irrigation siphons were made in late 1987.

Under the SDWA agreement, Clifton Court Forebay intake gates are regulated on a three-tier priority basis. The highest priority minimizes the duration of gate opening and establishes a schedule of timing within the tidal cycle to maximize the south Delta circulation and water levels. The conditions of the second and third priority schedules become successively effective when it is estimated that the scheduled water deliveries cannot be met under the more stringent priority one. During 1987, all Old River water withdrawals through Clifton Court Forebay intake gate were achieved using priority one criteria. The agreement is considered a short-term solution as negotiations continue with the SDWA, DWR and the USBR through the on-going South Delta Water Management Program (SDWMP) process. Long term planning and cost-share provisions may include releases from the New Melones Reservoir to improve South Delta water supply.

DWR has contracts with the Contra Costa Water District (CCWD) and the City of Antioch. Under these contracts, both entities are compensated for additional cost of purchasing a substitute water supply because of loss of offshore Delta water supplies resulting from SWP operations. The water year based period of contract standards for usable water is in effect 142 days for CCWD and 208 days for the City of Antioch. During the 1987 water year, the City of Antioch and CCWD had above average usable water for only 15 days and 84 days, respectively, during the standard period.

A water entitlement contract was executed on November 16, 1987, between DWR and Fibreboard Corporation to compensate for loss of offshore Delta water supply because of SWP operations. The agreement standards are based on a graphic schedule of "agreed upon days of availability" of water of 150 mg/L chloride or better at Antioch using the Sacramento River Index water year class.

FIGURE A: MEAN DAILY CHLORIDE LEVELS AT DELTA STATIONS
1987

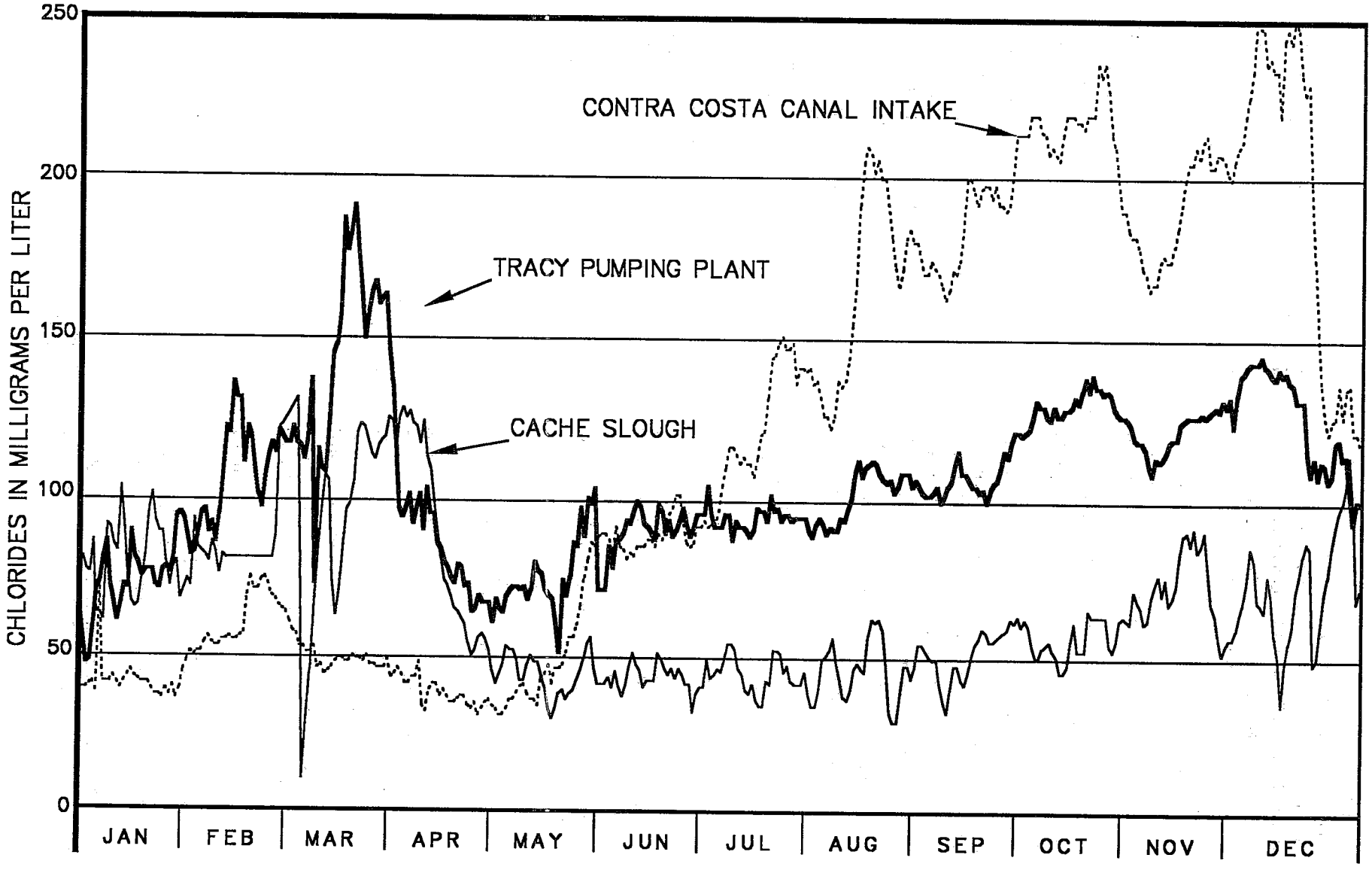
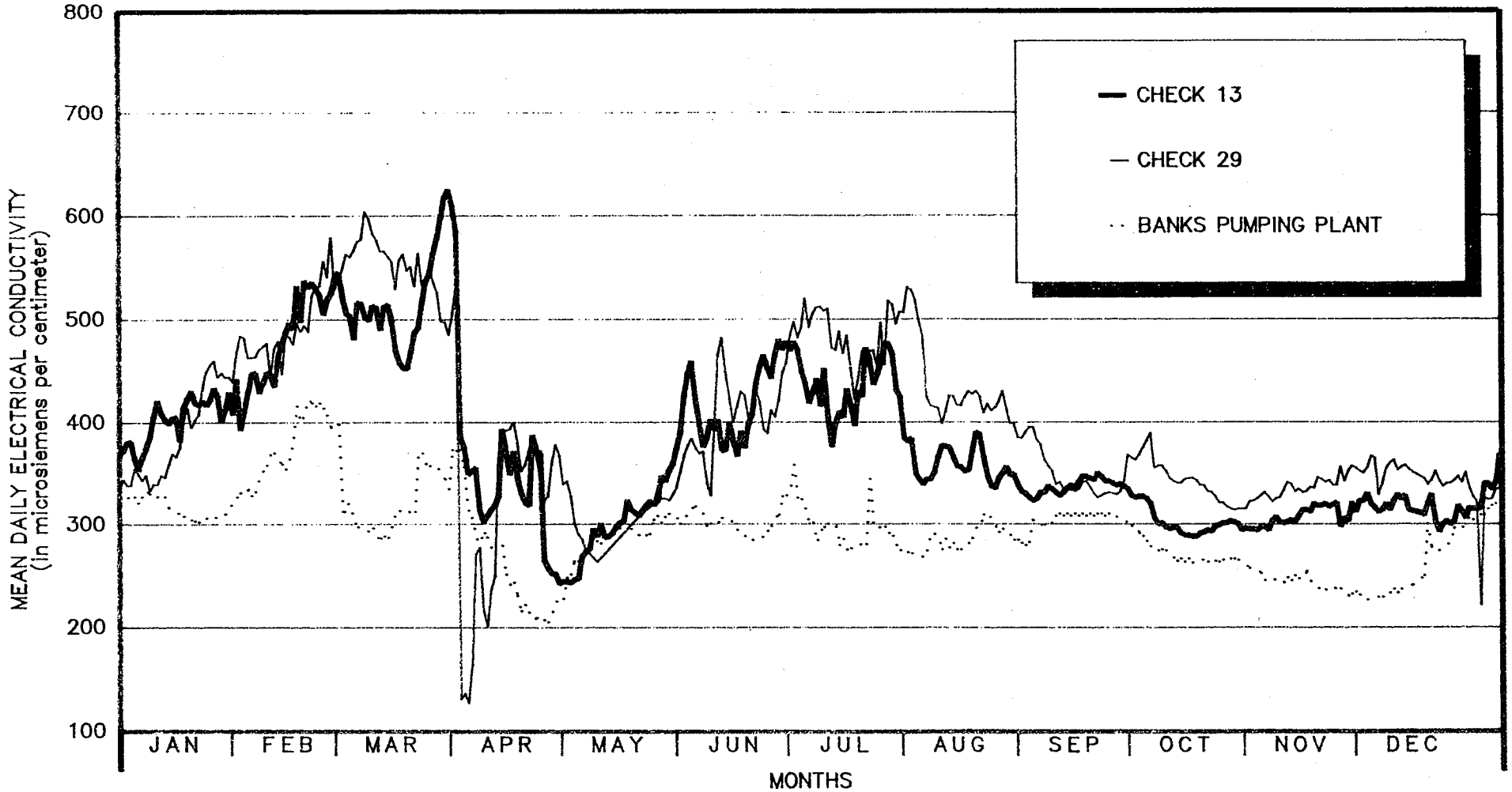


FIGURE B: MEAN DAILY ELECTRICAL CONDUCTIVITY AT SWP LOCATIONS
1987



Note: Estimated values are shown for days when no data was available.

WATER CONDITIONS

Based on criteria in D-1485, the 1986-87 water year was classified as a "critical" year. The final determination of year classification is made in May, based on current water year forecasts of the "Sacramento River Index" (formerly known as the "Four Basin Index"), which is the sum of the Sacramento Valley's unimpaired runoff at the following four locations: Sacramento River above Bend Bridge, near Red Bluff; Feather River, total inflow to Lake Oroville; Yuba River at Smartville; and the American River, total inflow to Folsom Lake. D-1485 also includes a snowmelt classification based on the May 1 result of the April through July forecast of unimpaired runoff. During a wet, normal, or below normal year classification, a subnormal snowmelt would be defined as 5.9 million AF. The May 1 forecast (and actual, in parentheses) of unimpaired runoff for these basins was 9,275,000 (9,202,000) AF for the 1986-87 water year, which was 51 (50) percent of average for the four basins [3/]. The combined May 1 forecast was 9.2 million AF, only 50 percent of normal and in the range classified as "critical" in D-1485. However, this amount was above the 8.1 million AF index in 1976, and well above the 5.1 million AF index in 1977.

Sacramento Valley	59% of average
San Joaquin Valley	59% of average
South Coastal	54% of average

Actual unimpaired runoff for the 1986-87 water year was well below average throughout the State of California, except in the Colorado Desert hydrographic area, which showed above average amounts. Unimpaired runoff, state wide for the water year, was 84 percent of average, ranging from 32 percent of average in the South Coastal hydrographic area to about 117 percent of average in the Colorado Desert area. Total volume of actual runoff for the water year in the Central Valley was only 17.5 million ac-ft.

In the Feather River basin, the primary source of water supply for the State Water Project, water year total precipitation was 59 percent of average, and the total unimpaired runoff for 1987 was about 32 percent of average. Maximum snowpack water equivalent [4/] was 83 percent of average.

State-wide precipitation to May 1, during the 1986-87 water year, was 65 percent of average, compared with 135 percent of average for the corresponding 1985-86 period. Several of the hydrographic areas that represent these conditions are shown in the graphic below.

May 1 snow surveys showed snow-stored water amounts that were well below average on most of the snow courses measured. Snowpack water equivalent measurement in Sacramento Valley watersheds was 30 percent of average. San Joaquin Valley watersheds were higher at forty percent of average.

3/ Unimpaired runoff and precipitation averages are based on the 50-year period 1931-1980. Snowpack averages are based on the 45-year period 1931-1975.

4/ Snowpack water equivalent is the amount of water contained in a snow sample using selected snow courses and sensors.

WATER OPERATIONS

RESERVOIR OPERATIONS

On January 1, storage in the principal SWP reservoirs (Lake Oroville, Lake Del Valle, San Luis Reservoir, Pyramid Lake, Castaic Lake, Silverwood Lake, and Lake Perris) was slightly below average. The combined storage of these reservoirs on January 1 was about 1 million AF below their combined operational capacity. At the end of 1987, this combined storage was about 70,000 AF (16 percent) less than the combined storage at the end of 1986. The tabulation below compares 1986 and 1987 year-end storage in the principal SWP reservoirs.

Lake Oroville storage started the year above 1986 levels and roughly paralleled 1986 until April 13, when storage peaked at 3,139,394 AF, or 89 percent of total capacity. Then storage dropped substantially until it reached it's lowest level at 1,967,234 AF on October 23. Storage showed a moderate recovery in November and December and reached 2,388,007 AF on December 31.

Reservoir	Storage (ac-ft) 12/31/86	12/31/87
Lake Oroville	2,564,058	2,388,007
Lake Del Valle	25,050	24,440
San Luis Reservoir *	1,062,504	569,636
Pyramid Lake	163,980	160,585
Castaic Lake	299,296	286,567
Silverwood Lake	72,226	68,400
Lake Perris	123,851	112,496
Total	4,310,965	3,610,131
Total difference	-700,834	

* SWP share.

San Luis Reservoir started 1987 at near capacity for State storage and at about 95 percent of total storage. Total storage peaked on March 12, 14, and 15 at 2,026,819 AF. Rapid State and federal drawdown began around mid-April. State drawdown occurred at a lower rate than the federal drawdown. The lowest total storage for the year, 529,199 AF, occurred on August 27. Total storage increased to 1,267,855 AF (about 63 percent of maximum) by December 31.

Lake Del Valle storage is normally held to a maximum of 39,914 AF between Memorial Day and Labor Day for recreational purposes. In 1987, The Corps of Engineers approved an additional 2,000 AF of storage during this period. Seasonal storage in Lake Del Valle topped out at 41,273 AF on May 20.

The SWP southern reservoirs (Pyramid, Castaic, Silverwood, and Lake Perris) started the season at above-average levels (about 96 percent of operational capacity). After normal operation throughout the summer months, the combined totals of the southern reservoirs returned to within 61,000 AF of full storage.

A detailed description of the individual reservoirs is presented in the "Project Operations By Field Division" Section under their respective divisions, beginning on page 33.

AQUEDUCT OPERATIONS

In 1987, a total of 1,462,359 AF of Central Valley Project (CVP) water was delivered from the San Luis Joint-Use Facilities to the federal San Luis service area. The Department of Water Resources operates and maintains the joint-use facilities, including the 102 miles of aqueduct between O'Neill Forebay and Kettleman City.

Releases from Lake Del Valle into the South Bay Aqueduct began on August 18, at the request of the South Bay Aqueduct water service contractors. These releases continued through August and totaled 1,682 AF. The released water was part of the additional 2,000 AF of storage approved earlier in the year by the U.S. Army Corps of Engineers. The releases were used to reduce the high Delta water chloride levels to improve water quality in the South Bay Aqueduct.

TABLE 1: PROJECT PUMPING PLANTS
1987
(in acre-feet)

PUMPING PLANTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
Hyatt	47,726	4,768	18,400	545	12,605	4,862	1,930	21,966	19,150	8,092	51,564	46,690	238,298
Thermalito	56,500	6,225	20,593	1,315	17,487	7,574	2,585	20,741	19,322	11,022	52,290	51,561	267,215
Cordelia	322	125	162	450	681	848	926	913	903	816	760	787	7,693
South Bay	11,496	9,221	15,907	15,879	16,946	16,675	16,779	14,258	7,312	6,729	8,359	6,362	145,923
Del Valle*	0	0	5,661	5,752	2,564	0	0	1,814	6,561	6,313	248	0	28,913
Banks													
State	132,326	151,234	176,445	131,210	122,880	118,977	218,157	200,288	184,990	60,117	81,555	279,535	1,857,714
Federal	0	0	13,201	22,072	0	0	46,965	104,945	87,243	43,974	0	18,669	337,069
San Luis 1/													
State	141	731	4	-16	2,383	0	0	237	31,870	13,362	21,558	152,181	222,451
Federal	82,556	25,198	5,256	1,567	0	0	0	16,870	138,740	102,274	185,519	196,569	754,549
O'Neill 2/													
State	0	0	0	0	0	0	0	0	0	0	0	0	0
Federal	208,002	160,614	69,874	84,611	6,148	0	5,996	42,296	110,857	117,548	208,305	244,338	1,258,589
Dos Amigos 1/													
State	113,964	145,386	156,259	185,455	245,485	271,812	311,002	274,669	160,528	96,089	57,179	118,734	2,136,562
Federal	128,023	134,226	77,295	126,698	156,937	254,397	273,277	208,859	49,633	41,301	24,318	58,420	1,533,384
Las Perillas	6,005	6,168	7,762	14,291	20,290	23,860	26,312	18,786	8,878	8,252	907	944	142,455
Badger Hill	6,005	6,168	7,750	14,291	20,290	23,830	26,195	18,738	8,878	8,252	909	944	142,250
Buena Vista	59,266	81,934	92,796	108,997	122,554	83,665	108,932	112,874	103,477	48,663	44,143	75,061	1,042,362
Wheeler Ridge	57,721	72,495	78,538	101,738	111,245	62,196	81,450	89,483	100,078	46,280	43,888	74,798	919,910
Ira J. Chrisman Wind Gap	57,240	70,798	74,183	96,655	103,140	55,114	73,296	84,023	95,994	42,226	42,966	72,697	868,332
A.D. Edmonston	56,949	70,221	72,719	94,589	100,379	52,455	70,527	82,505	94,304	41,883	43,198	72,588	852,317
Oso	41,299	36,675	53,132	46,870	34,776	9,942	30,890	28,860	54,117	12,810	36,159	62,294	447,824
Castaic	0	215	2,471	1,215	8,714	20,831	27,882	22,974	2,046	12,374	9,196	5,670	113,588
Pearblossom	15,744	33,556	18,042	46,026	65,053	38,150	34,009	48,331	37,653	27,458	6,348	10,682	381,052

1/ Joint State-Federal Facility.
2/ O'Neill Pumping Plant is a Federal facility.
* Total includes amounts pumped into Lake and flow into South Bay Aqueduct.

Total State: 9,814,859
Total Federal: 3,883,591
Total Project: 13,698,450

WATER DELIVERIES

The total amount of water delivered by the SWP in 1987 was 4,729,254 AF. Included in this total: 2,260,490 AF of SWP water (an 11 percent increase over the 1986 amount); 836,720 AF to satisfy prior water rights (listed on page 34); 22,551 AF of local supply water (a 47 percent decrease from the 1986 amount); 147,779 AF of CVP water delivered through SWP facilities, and 1,461,714 AF of CVP water delivered through joint-use facilities. The table below shows these various water deliveries by water type, and a discussion of these different types follows the table.

Type	Amount (ac-ft)
Entitlement Water	2,113,915
Unscheduled Water	114,907
SWP Banking	7,501
1982 Exchange Water	6,171
Local In/Out water	324
Recreation Water	7,672
Subtotal	2,250,490
Local Supply Water (non-project)	22,551
Total	2,273,041

In the Fall of 1986, 25 long-term contractors requested 2,717,215 AF of entitlement water and 43,705 AF of deferred entitlement (wet weather) water. In December of 1986, DWR approved 2,255,000 AF of 1987 entitlement water deliveries, based on the 1987 risk analysis criteria and then-prevailing water supply forecast. No wet weather water was approved. The initial approved schedule reflected a 462,215 AF reduction for all agricultural entitlement requests. Early in 1987, MWDSC decreased it's 1987 entitlement request by 379,500 AF, which decreased the agricultural entitlement reduction to 82,715 AF. In March, following several storms and improved water supply forecasts, all agricultural entitlement delivery requests were approved in agreement with water delivery risk analysis criteria. Deliveries of SWP entitlement water surpassed the two million ac-ft mark in 1987 and was the largest amount yet delivered by the SWP. This amount (2,113,915 AF) was 8 percent higher than 1986 entitlement deliveries.

Actual entitlement water delivered in 1987 to the 25 contractors requesting deliveries totaled 2,113,915 AF. This amount includes 425 AF of 1988 advance entitlement water to Oak Flat Water District, 214 AF of 1988 advance entitlement water to Antelope Valley East Kern Water Agency, and 16,171 AF of water recaptured from ground water storage (6,171 AF by the Metropolitan Water District of Southern California and 10,000 AF by San Bernardino Valley Municipal Water District).

San Gorgonio Pass Water Agency requested 1,427 AF of entitlement water but took no deliveries. Mojave Water Agency did not initially request any entitlement water but took 17 AF at a temporary turnout for construction use. Eleven contractors took less entitlement water than initially requested, and six contractors took all their initially requested Table A entitlements.

The following contractors increased their requested deliveries within 1987 entitlement amounts during the year:

Contractor	Requested Increase (acre-feet)
Alameda County Flood Control and Water Conservation District	224
Antelope Valley-East Kern Water Agency	742
Castaic Lake water Agency	422
Crestline-Lake Arrowhead Water Agency	298
Littlerock Creek Irrigation District	481
Mojave Water Agency	17
Palmdale Water District	2,379
San Gabriel Valley Municipal Water District	130

Recreation water is used both at SWP recreation facilities and for fish and wildlife mitigation and enhancement. In 1987, a total of 7,672 AF was conveyed under this category.

Table 2 on Page 12, shows water deliveries from SWP facilities by years, with totals to date, for individual agencies. Figure C on Page 13, shows annual totals for California Aqueduct deliveries. Water deliveries by field division are presented in Map 2 on Page 14.

147779
1,461,714
1,609,493

2260490
836,720
22551
3,119,761
1,609,493
4,729,254

TABLE 2: WATER DELIVERIES 1962-1987

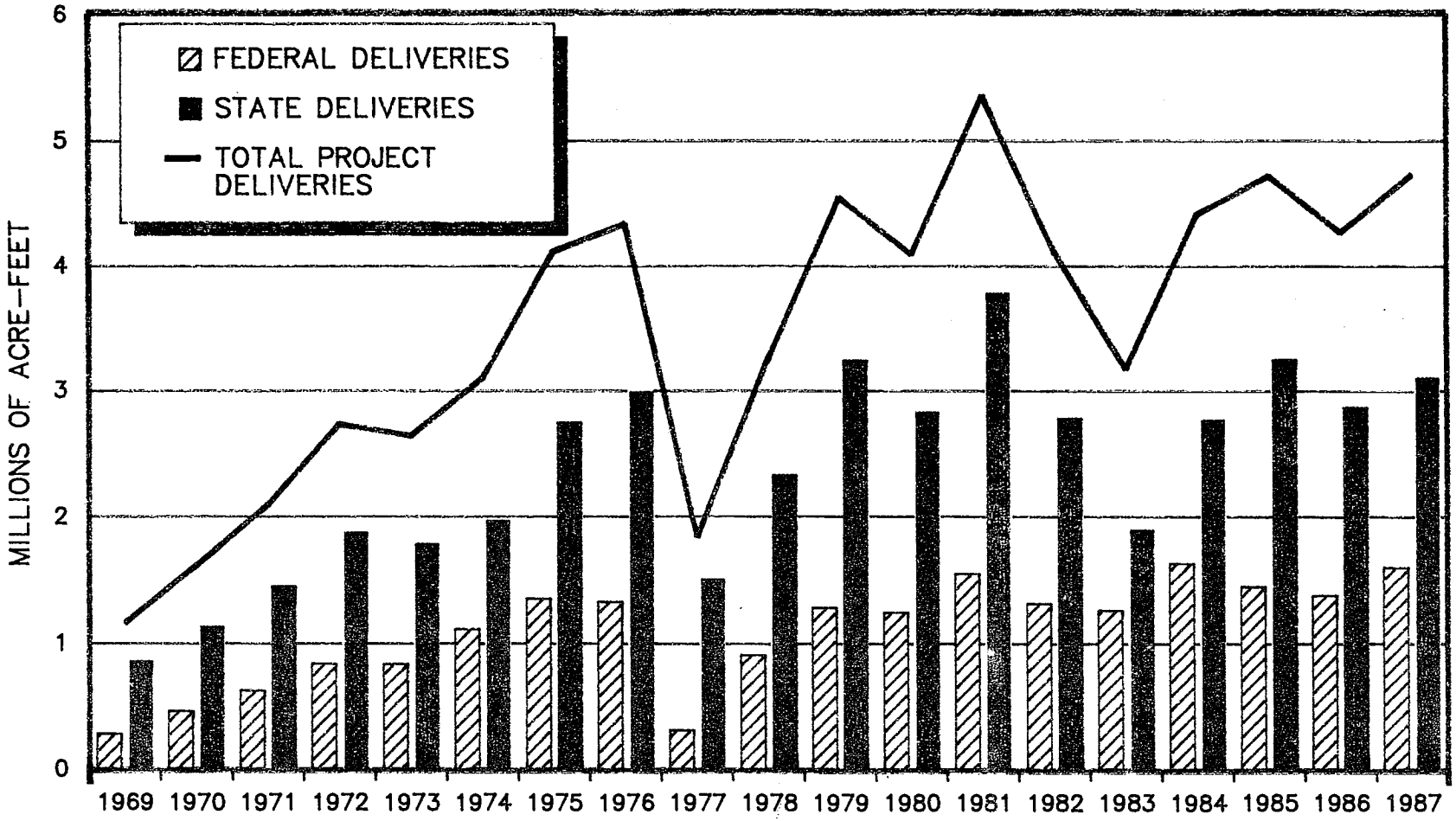
(in acre-feet)

AGENCY	1962-1982	1983	1984	1985	1986	1987	TOTALS
OROVILLE FIELD DIVISION							
LAST CHANCE CREEK W.D. (Local Supply)	106,290	9,073	13,782	13,117	14,379	9,444	166,085
PLUMAS CO. F.C. & W.C.D.	4,618	262	272	254	317	452	6,175
PALERMO CANAL 1/	115,815	6,761	6,850	7,195	7,970	8,612	153,203
COUNTY OF BUTTE	3,747	325	177	308	313	459	5,329
THERMALITO I.D. (Local Supply)	7,153	1,459	1,869	2,229	2,051	2,338	17,099
THERMALITO AFTERBAY 1/	11,781,241	594,409	822,721	861,554	786,489	825,905	15,672,319
UPPER FEATHER RIVER LAKES 1/	106,294	797	1,803	2,019	2,041	2,203	115,157
YUBA CITY	0	0	108	62	328	88	586
DELTA FIELD DIVISION							
NAPA CO. F.C. & W.C.D. (Local Supply)	74,093	2,287	2,923	4,039	3,519	7,693	94,554
ALAMEDA CO. W.D. (Local Supply)	346,932	12,470	13,723	22,289	21,170	25,475	442,059
A.C.F.C. & W.C.D., ZONE 7 (Local Supply)	250,095	15,460	20,340	21,773	23,468	26,397	357,533
PLEASANTON TOWNSHIP W.D.	674	0	0	0	0	0	674
SANTA CLARA VALLEY W.D.	768,093	86,733	91,663	101,938 7/	90,595	94,949	1,233,971
MARIN W.D.	4,594	0	0	0	0	0	4,594
SAN FRANCISCO W.D.	4,345	0	0	0	0	0	4,345
SKYLONDA M.W.D.	10	0	0	0	0	0	10
OAK FLAT W.D.	86,162	3,822	7,344	6,197	5,354	5,880	114,759
MUSTANG W.D.	4,256	0	0	0	0	0	4,256
TRACY GOLF & COUNTRY CLUB	1,436	364	525	463	454	491	3,733
GRANITE CONSTRUCTION	120	0	0	0	0	0	120
LAKE DEL VALLE (E.B.R.P.D.)	831	132	158	152	130	137	1,540
ORESTIMBA CREEK	100	0	0	0	0	0	100
MUSCO OLIVE (C.V.P. water)	0	0	10	18	9	19	56
SOLANO CO. F.C.W.C.D.	0	0	0	0	1,400	1,550	2,950
SAN LUIS FIELD DIVISION							
DEPT. PARKS & REC. (STATE)	446	45	55	10	10	8	574
DEPT. FISH & GAME (STATE)	3,104	381	472	485	440	590	5,472
FED. CUSTOMERS (REC.+ JOINT-USE)	13,505,193	1,269,901	1,540,707	1,295,647	1,371,722	1,462,359	20,445,529
FED. CUSTOMERS (MISC.)	61,059	0	0	28,000	0	9,335	98,394
SAN JOAQUIN FIELD DIVISION							
TULARE LAKE BASIN W.S.D.	1,713,861	1,006	5,743	206,678	92,143	144,290	2,163,721
EMPIRE WEST SIDE I.D.	56,699	0	0	5,197	2,300	4,401	68,597
COUNTY OF KINGS	24,150	3,550	3,100	3,400	3,700	4,000	41,900
HACIENDA W.D. 2/	75,895	0	0	0	0	0	75,895
KERN CO. W.A.	9,778,738	595,112	1,099,391	1,083,749	929,278 9/	1,028,124	14,514,392
KERN WATER BANK	0	0	0	0	0	7,501 11/	7,501
DUDLEY RIDGE W.D.	811,330	55,919	64,600	62,009	51,152	46,288	1,091,298
DEVILS DEN W.D.	223,249	12,659	20,845 5/	18,194	17,271	14,394	306,612
J.G. BOSWELL	86,705	0	30,725	0	0	0	117,430
SHELL CAL PROD. 3/	70,316	6,071	7,924	0	1,603	0	85,914
GREEN VALLEY W.D.	8,331	0	2,557	166	0	0	11,054
U.S.D.R. (FISH & WILDLIFE)	11,700	0	0	0	4,000	0	15,700
U.S.B.R. (CVP WATER)	316,306	0	95,406	130,763	13,050 10/	137,289	692,814
WHEELER RIDGE W.S.D.	92	0	0	0	0	0	92
SOUTHERN FIELD DIVISION							
A.V.E.K. W.A.	377,229	32,961	32,662	37,064	32,449	34,089	546,454
M.W.D. OF S.C.	4,921,347	371,985	457,582 6/	729,209 8/	708,840	712,424	7,901,387
LITTLEROCK CREEK I.D.	4,800	38	1	0	163	1,085	6,087
MOJAVE W.A.	23,233	34,356	0	0	0	17	57,606
DESERT W.A.	129,300	23,000	25,000	27,000	29,000	31,500	264,800
COACHELLA VALLEY W.D.	83,262	14,547	15,768	16,989	18,210	19,431	168,207
CRESTLINE-LAKE ARROWHEAD W.A.	10,919	911	1,128	1,422	1,506	1,849	17,735
SAN GABRIEL VALLEY M.W.D.	46,493	734	7,656	5,028	9,454	10,630	79,995
SAN BERNARDINO VALLEY M.W.D.	136,223	6,675 4/	5,556	7,390	6,421	19,075 12/	181,340
DEPT. PARKS & REC., L.A. CO. REC. DEPT.	7,896	3,098	3,977	3,386	3,285	6,937	28,579
PIRU CREEK FISH ENHANCEMENT	2,915	0	0	0	0	0	2,915
CASTAIC LAKE W.A.	16,494	9,476	11,477	12,401	13,928	16,167	79,943
PALMDALE W.D.	0	0	0	1,558	3,096	5,379	10,033
UNITED WATER C.D. (Local Supply)	0	0	0	0	998	0	998
TOTALS	46,174,184	3,176,779	4,416,600	4,719,352	4,274,006	4,729,254	67,490,175

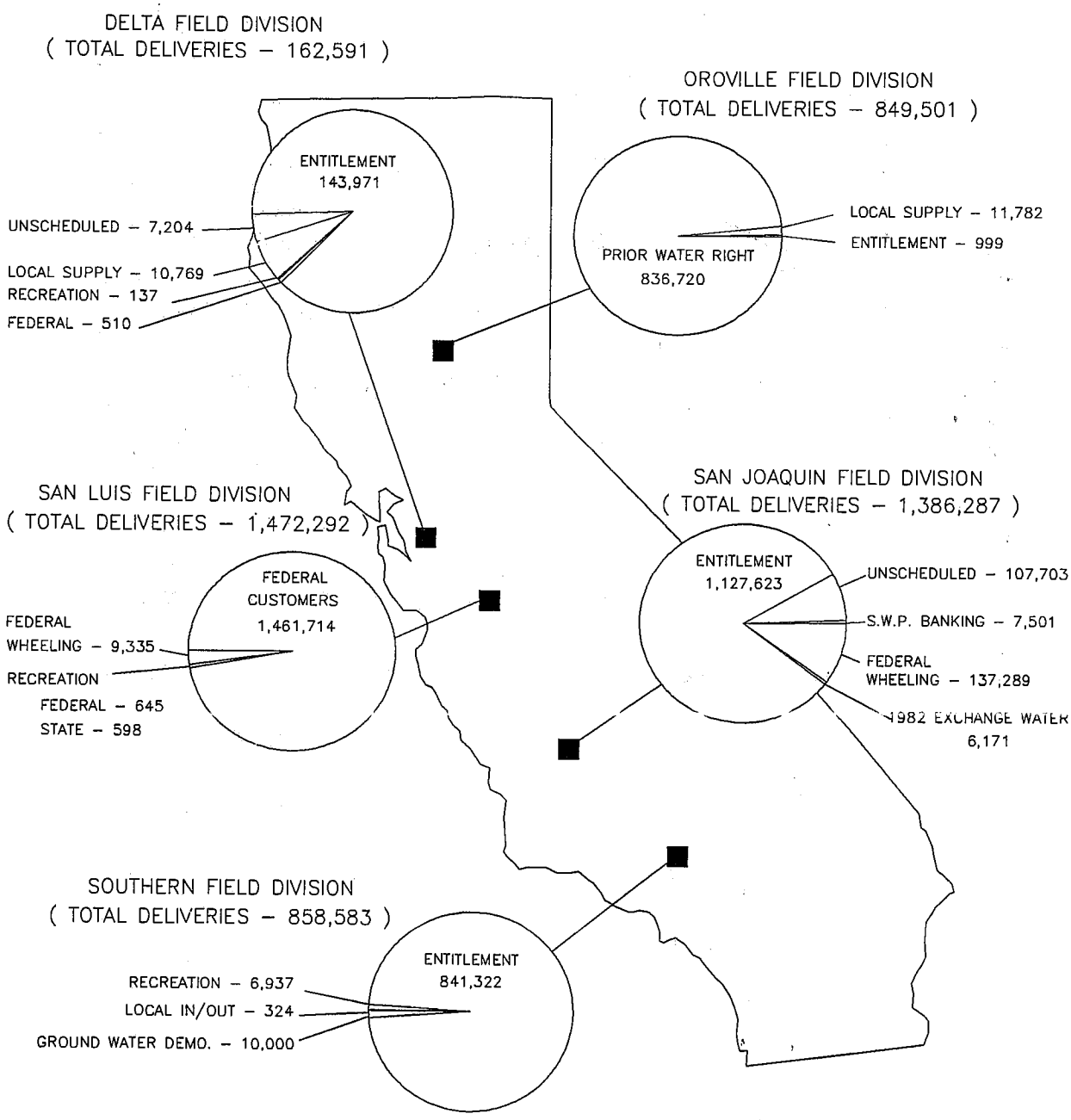
1/ Prior water right entitlement.
2/ Hacienda Water District was annexed by Tulare Lake Basin W.S.D. in 1981.
3/ Repayment of preconsolidation water.
4/ Includes 681 acre-feet delivered and stored at state expense, charge to be made upon withdrawal.
5/ Includes 559 acre-feet of 1982 Exchange water stored in Lake Oroville and 126 acre-feet stored in a MWDSC ground water basin.
6/ Billed for 126 acre-feet of 1982 Exchange Water, but not included here. Includes 3,111 acre-feet of local-out through reach 30.
7/ Includes 4,300 acre-feet of C.V.P. exchange water.
8/ Includes 45,584 acre-feet of Local-Out.
9/ Include 1,703 acre-feet transferred to Tulare Lake Basin W.S.D.
10/ Includes 6,500 acre-feet to K.C.W.D., 6,500 to Lakeside I.W.D., and 50 to Green Valley W.D.
11/ Advance storage of ground water, by agreement between K.C.W.A. and D.W.R.
12/ Includes 324 acre-feet of Local-Out.

FIGURE C: TOTAL PROJECT DELIVERIES

ANNUAL TOTALS



MAP 2
PROJECT WATER DELIVERIES
1987
(in acre-feet)



Total Project Deliveries
4,729,254

ENERGY OPERATIONS

ENERGY SOURCES

Energy generation from the State Water Project's (SWP) seven hydroelectric plants (Hyatt, Thermalito, Gianelli, Alamo, William E. Warne, Castaic, and Devil Canyon) during 1987, totalled about 2,705,599 megawatt hours (MWh), as illustrated in Figure D on page 16. This is a 27 percent decrease from that generated in 1986, and was sufficient to meet only about 52 percent of SWP energy requirements in 1987. The decrease in generation is because of the continuing drought that has reduced the capabilities of the hydroelectric plants. Monthly generation totals for each plant are shown in Table 3 on page 17.

Edward Hyatt and Thermalito Power plants supplied 1,380,522 MWh in 1987, which is 44 percent below the amount generated in 1986, and well below the estimated average annual output of about 2,380,000 MWh at these plants. Generation at Edward Hyatt and Thermalito Power plants is shown in Figure E on page 18.

The combined energy generation at the SWP energy recovery plants (Gianelli, Alamo, William E. Warne, Castaic, and Devil Canyon) totaled 1,325,077 MWh in 1987. This is a 5 percent increase over the amount generated in 1986.

Bottle Rock Powerplant, a 55-MW geothermal plant, began commercial operation on February 26, 1985. The powerplant supplied the SWP with a total of 240,718 MWh in 1987, which is a 33 percent increase over the amount supplied in 1986.

Reid Gardner Unit No. 4 supplied the SWP with 1,005,030 MWh of energy in 1987, a 26 percent increase over the amount supplied in 1986. This amount included the return of 12,000 MWh that was banked with Nevada Power Company during start-up of the unit in 1983. There was no balance of banked energy due to DWR on December 31, 1987.

Under a 50-year contract with the Kings River Conservation District, DWR receives all the output of the 165-MW Pine Flat Powerplant. The plant furnished 255,898 MWh to the SWP in 1987 (only 31 of that furnished in 1986).

DWR has a contract with TERA Corporation for purchase of the energy from two hundred 50-KW wind turbines to be constructed at Bethany Wind Park near the South Bay Pumping Plant. Only forty five wind turbines were operational at the end of 1987, and delivered 3,554 MWh to the SWP during the year.

Energy generation as a part of all SWP energy sources in 1987 is illustrated in Figure D on page 16.

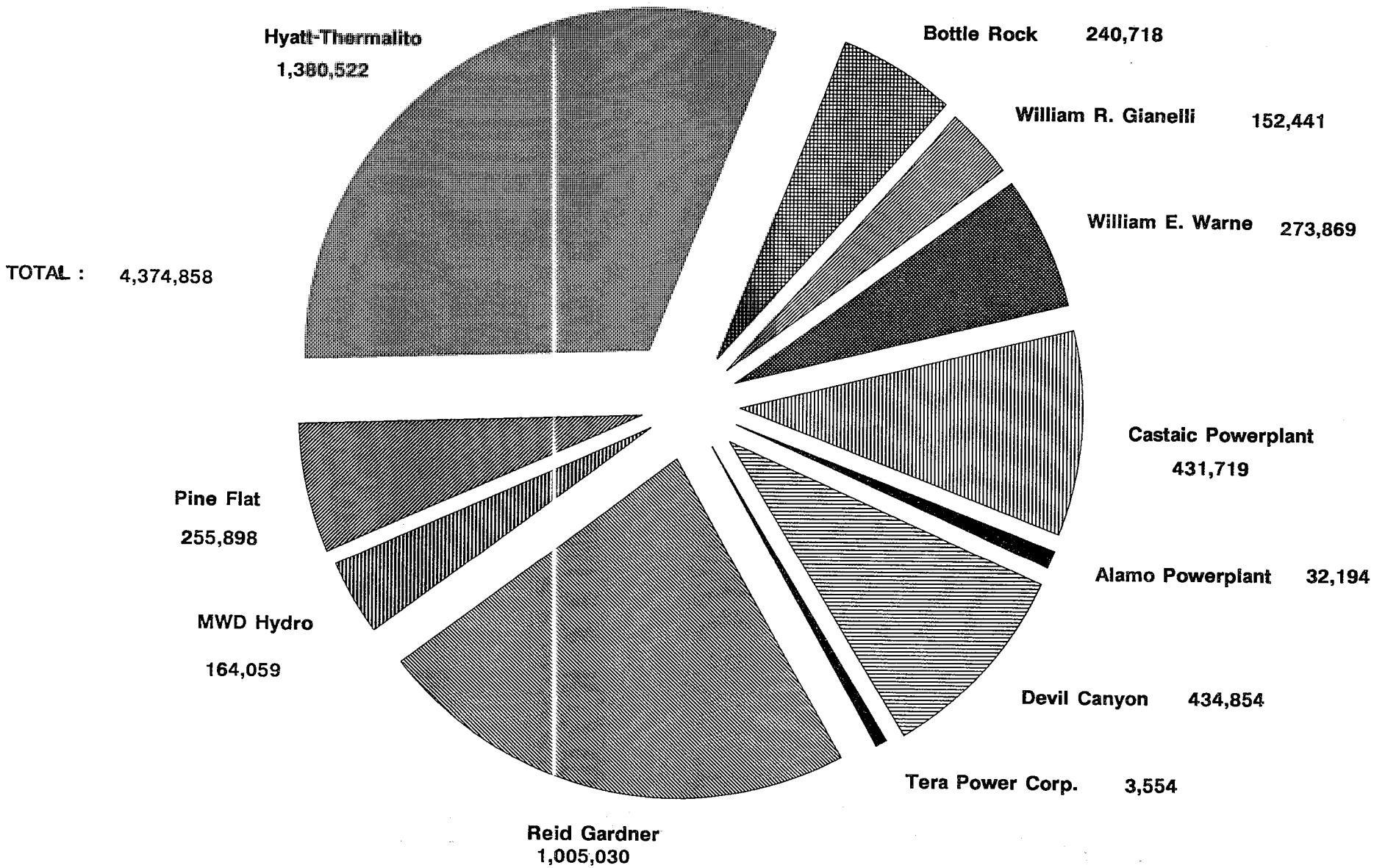
The SWP receives energy under contract from five small hydroelectric facilities (total capacity of 30 MW) owned and operated by The Metropolitan Water District of Southern California. In 1987, these plants furnished 164,059 MWh of energy to the SWP. DWR has exchange arrangements with Southern California Edison (SCE) and the Los Angeles Department of Water and Power to simplify transmission of this energy.

The DWR-SCE Power Contract has been in effect since April 1983. Under this contract, part of the Hyatt-Thermalito Power plants' generation and all the output of Devil Canyon Power Plant and Alamo Power Plant are delivered to SCE. The energy is generally delivered during on-peak periods and a greater amount of energy is returned during off-peak periods. SCE return additional to the SWP during 1987 was 2,929,574 MWh.

DWR purchased 478,587 MWh from various utilities in 1987. Most of the energy purchased came from the Pacific Northwest via DWR's contracted 300 MW of transmission capacity in the extra high voltage Pacific Northwest Intertie.

FIGURE D: SWP ENERGY SOURCES
1987

(in megawatthours)



Note: These are SWP locations only. Purchases, Other Sources, and SCE Return Additional are not shown here. All values are metered readings at plants and are not adjusted for transmission losses. Pine Flat and Warne include station-service energy.

TABLE 3: PROJECT ENERGY RESOURCES

1987

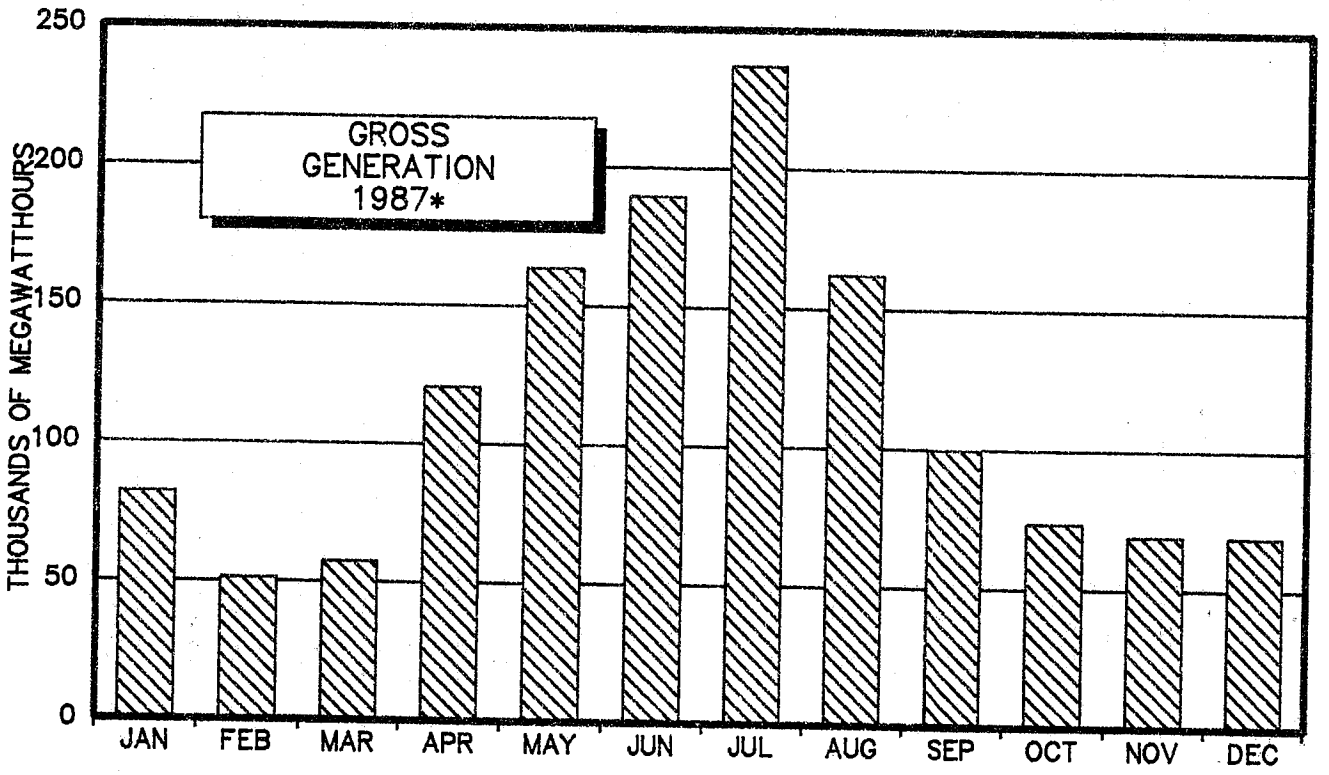
(in megawatthours)

RESOURCE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
Hyatt-Thermalito Powerplants 1/	82,617	51,729	57,869	120,871	163,864	190,229	237,272	162,645	100,238	74,113	69,733	69,342	1,380,522
Bottle Rock	23,976	22,314	23,262	21,721	21,739	19,370	19,887	19,335	18,366	17,858	17,047	15,843	240,718
William R. Gianelli Generation													
State	0	-17	0	21,852	35,671	45,445	25,507	12,947	2,259	6,821	1,956	0	152,441
Federal	0	408	0	8,394	50,018	67,260	42,170	16,444	0	0	0	0	184,694
Total	0	391	0	30,246	85,689	112,705	67,677	29,391	2,259	6,821	1,956	0	337,135
William E. Warne Powerplant 2/	25,437	22,545	32,099	27,567	21,056	6,217	19,225	17,865	32,992	7,356	23,287	38,223	273,869
Castaic Powerplant State	40,008	35,112	51,912	43,855	33,264	8,880	31,800	26,496	55,320	10,560	35,016	59,496	431,719
Alamo Powerplant	1,900	4,113	2,342	5,412	7,095	3,878	4,560	0	20	2,542	0	332	32,194
Devil Canyon Powerplant	19,697	38,234	20,925	50,077	71,836	42,862	39,826	54,469	42,259	31,598	7,430	15,641	434,854
Tera Corp.	38	117	199	481	457	478	519	447	374	235	104	105	3,554
MWD Hydro	10,848	11,208	14,340	16,574	18,912	17,400	16,440	15,120	15,024	11,846	8,198	8,149	164,059
Reid Gardner Powerplant	70,270	31,070	71,698	71,349	73,133	89,014	83,152	102,024	82,640	93,282	88,716	148,682	1,005,030
Pine Flat	0	2,112	19,785	1,194	41,577	112,616	68,823	9,791	0	0	0	0	255,898
Purchases 3/	99,204	49,176	8,294	19,926	158,166	32,697	9,524	36,885	37,621	20,693	5,651	750	478,587
Other Sources 4/	7,639	4,770	1,621	2,197	17,968	3,081	3,703	12,939	13,053	6,943	6,073	9,788	89,775
SCE Return Additional	213,841	203,685	253,944	235,134	74,056	81,979	155,348	216,508	267,457	314,377	471,920	441,325	2,929,574
TOTALS	595,475	476,576	558,290	646,604	788,812	721,406	757,756	703,915	667,623	598,224	735,131	807,676	8,057,488

1/ Includes Table Mountain and Hyatt out adjusted to Tesla. Does not include 46,587 MWh of pump credit.
2/ Includes station-service energy.
3/ Includes Bonneville Power Authority, Portland General Electric, Salt River Project, Los Angeles Dept. of Water and Power, Seattle City Light, British Columbia Hydro Power Authority, Idaho Power Co., and Washington Water and Power Co.
4/ Includes Southern California Edison, Western Area Mid-Pacific, Los Angeles Dept. of Water and Power, Bonneville Power Authority, and Pacific Gas and Electric.

State:	7,872,794
Federal:	184,694
Total Project:	8,057,488

FIGURE E: OPERATION OF EDWARD HYATT AND THERMALITO POWERPLANTS



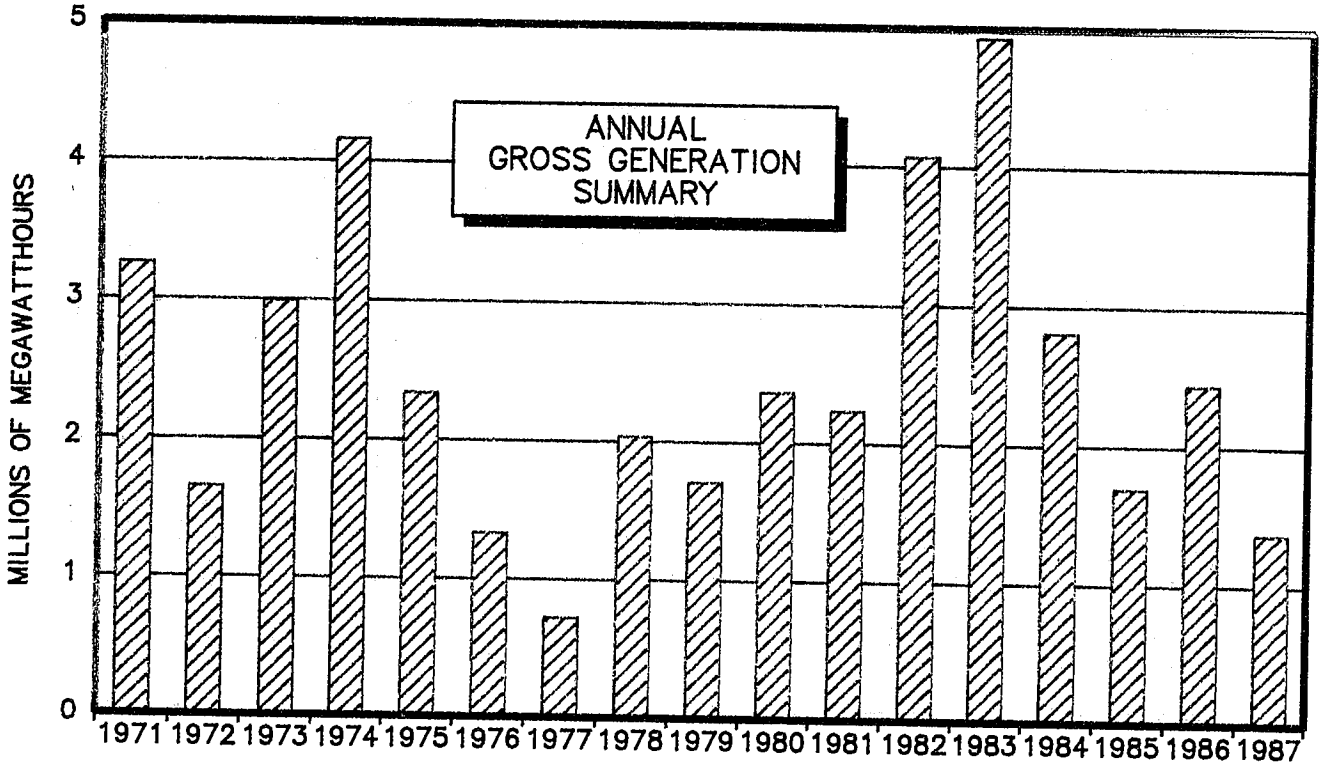
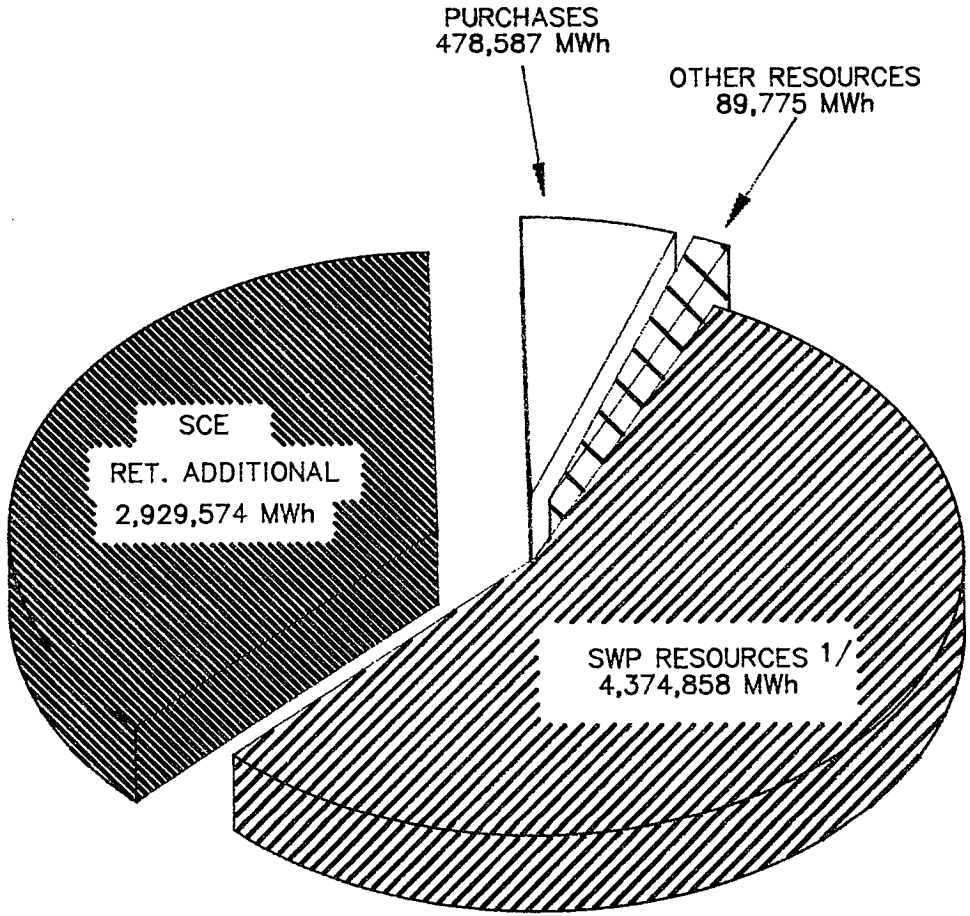


FIGURE F: ENERGY RESOURCES
(STATE ONLY)
1987



TOTAL: 7,872,794 MWh

PURCHASES

1. Bonneville Power Authority	216,957 MWh
2. Salt River Project	121,178 MWh
3. Portland General Electric Company	86,224 MWh
4. British Columbia Hydro Power Authority	46,830 MWh
5. Idaho Power Company	4,326 MWh
6. Seattle City Light	1,484 MWh
7. Los Angeles Dept. of Water and Power	1,040 MWh
8. Washington Water and Power	548 MWh
	478,587 MWh

OTHER RESOURCES

1. Southern California Edison	70,170 MWh
2. Pacific Gas and Electric	7,364 MWh
3. Bonneville Power Authority	5,655 MWh
4. Los Angeles Dept. of Water and Power	4,581 MWh
5. Western Area Mid–Pacific	2,005 MWh
	89,775 MWh

SCE RETURN ADDITIONAL

1. Total Received from SCE	4,131,058 MWh
2. SCE Hyatt–Thermalito Entitlement	–570,377 MWh
3. SCE Devil Canyon Entitlement	–434,854 MWh
4. SCE Alamo Entitlement	–32,194 MWh
5. MWD Hydro Entitlement	–164,059 MWh
	2,929,574 MWh

1/ See Figure D for a breakdown of this source.

ENERGY LOADS

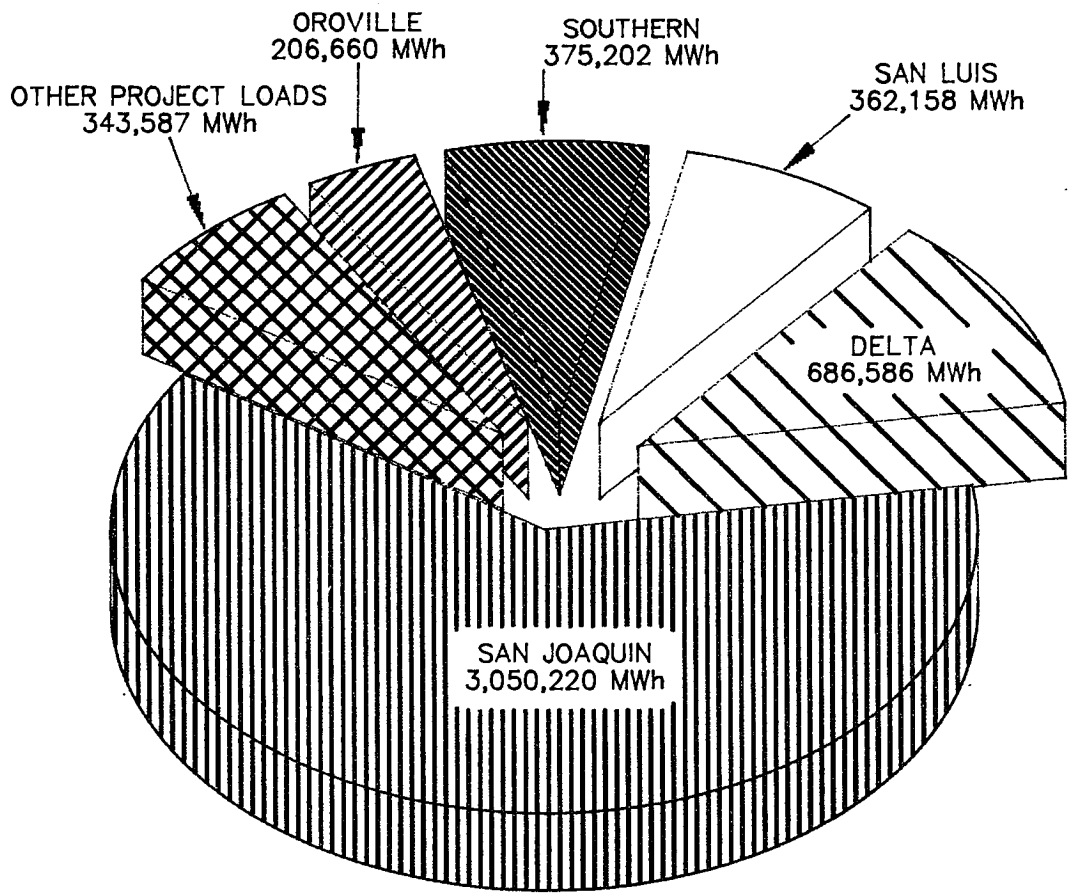
Total energy used by the SWP during 1987 was 5,024,429 MWh, not including 143,157 MWh for system losses. This amount was a 2 percent decrease from that used in 1986. SWP energy use was nearly evenly distributed between the Pacific Gas & Electric Company service area and the SCE service area. SWP energy loads by field division are shown in Figure G on page 21, and also are listed in Table 4 on page 22.

During 1987, SWP energy supplies (including substantial purchases under contractual obligations) exceeded SWP needs, and DWR sold the excess energy under power sale contracts to 15 utilities at current market rates. The total sale of energy during 1987 was 2,657,594 MWh. The decision to sell the power, or to wait for a more opportune time, took into consideration projected SWP operations and changes in the power market as well as energy losses, transmission costs, and dispatching costs. DWR's computerized accounting system quickly monitors the status of the power purchases and sales operation. The revenue from these energy sales during 1987 exceeded expenditures for purchases and transmission services. This reflects only the cash transactions during 1987, and is not directly indicative of the true net cost of SWP energy, which includes such other costs as:

* debt service and operation, maintenance, and replacement (OM&R) costs associated with SWP owned hydroelectric facilities.
* debt service and OM&R costs associated with the output of Pine Flat Powerplant.
* debt service, OM&R, and fuel costs associated with Reid Gardner Unit No. 4 and other SWP owned generation facilities.

Energy loads in 1987 are illustrated in Figure H on page 23. Table 1 on page 10 presents totals for monthly pumping throughout the SWP.

FIGURE G: PROJECT ENERGY LOADS
(BY FIELD DIVISION)
1987



TOTAL: 5,024,412 MWh

OROVILLE FIELD DIVISION

1. Hyatt–Thermalito Complex (Pump–back and Station Service)	206,660 MWh

DELTA FIELD DIVISION

1. North Bay	3,658 MWh
2. South Bay	123,631 MWh
3. Del Valle	1,024 MWh
4. Harvey O. Banks Delta	558,167 MWh
5. Bottle Rock (Station Service)	105 MWh

SAN LUIS FIELD DIVISION

1. William R. Gianelli	67,117 MWh
2. Dos Amigos	293,449 MWh
3. Pine Flat (Station Service)	1,592 MWh

SAN JOAQUIN FIELD DIVISION

1. Las Perillas	10,290 MWh
2. Badger Hill	27,555 MWh
3. Buena Vista	255,196 MWh
4. Wheeler Ridge	256,939 MWh
5. Wind Gap	558,554 MWh
6. A.D. Edmonston	1,941,686 MWh

SOUTHERN FIELD DIVISION

1. Oso	123,585 MWh
2. Pearblossom	251,107 MWh
3. William E. Warne (Station Service)	510 MWh

OTHER PROJECT LOADS

1. Exchange Energy	336,472 MWh
2. Bonneville Power Authority	5,655 MWh
3. Nevada Power	1,249 MWh
4. South Bay Pumping Plant	193 MWh
5. Net Exchange at Gianelli	17 MWh

TABLE 4: PROJECT ENERGY USES
1987
(in megawatthours)

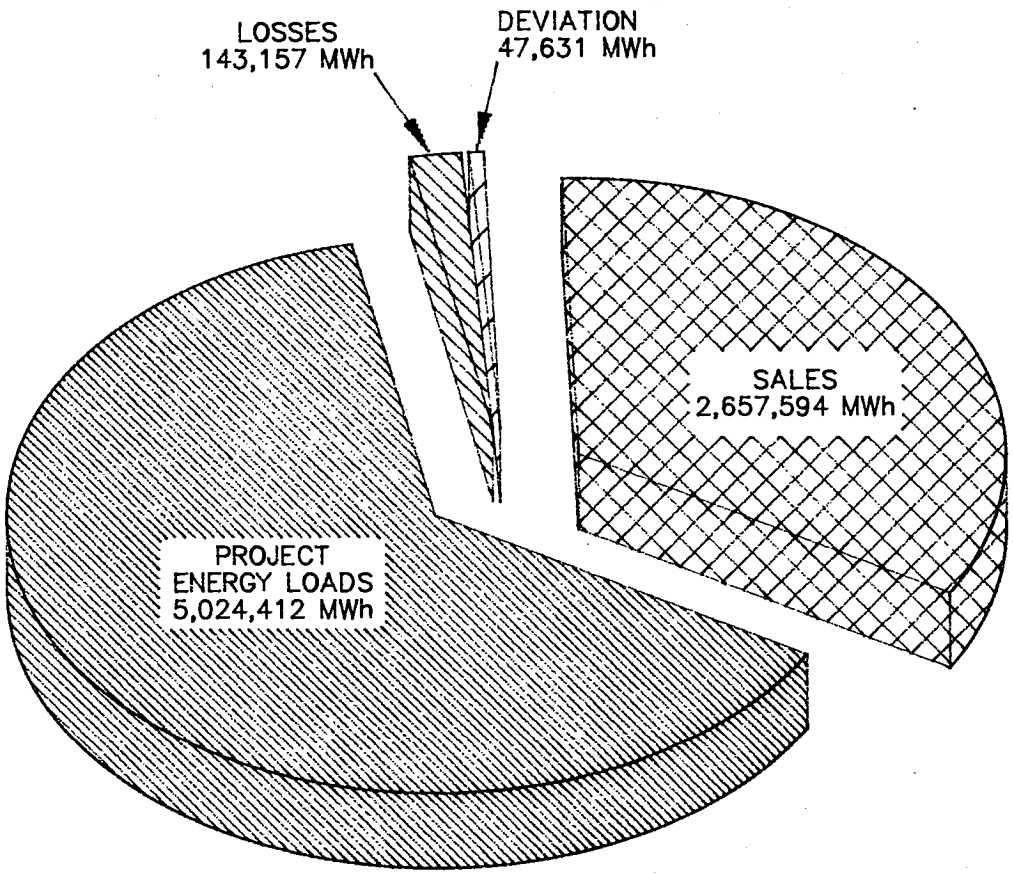
SOURCE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
Hyatt-Thermalito Pumpback and Station Service	41,295	5,005	17,665	1,087	12,923	5,190	1,941	17,959	15,244	7,974	41,122	39,255	206,660
North Bay	151	60	70	218	322	403	435	447	436	386	358	372	3,658
South Bay	9,618	7,609	13,199	13,398	14,591	14,429	14,613	12,315	6,227	5,655	6,941	5,036	123,631
Del Valle	6	7	370	425	172	5	6	5	6	8	7	7	1,024
Banks Pumping Plant													
State	40,036	45,445	52,985	39,605	37,059	35,719	65,074	59,744	55,212	18,754	24,898	83,636	558,167
Federal	0	0	3,920	6,556	0	0	13,950	31,167	25,912	13,060	0	5,544	100,109
Bottlerock 1/	12	6	10	0	0	12	29	16	0	0	0	20	105
Gianelli P-G Plant													
State	462	910	738	363	1,122	51	185	390	8,125	3,886	5,976	44,909	67,117
Federal	37,569	9,794	2,040	561	0	0	0	3,567	33,882	26,986	51,117	57,396	222,912
Dos Amigos													
State	16,523	19,358	21,475	25,613	31,579	37,866	42,882	38,843	22,629	12,203	8,245	16,233	293,449
Federal	16,724	18,705	10,469	17,421	23,061	34,374	37,768	27,492	5,733	6,331	3,001	8,013	209,092
Pine Flat 1/	246	186	3	202	0	0	0	44	216	227	229	239	1,592
Las Perillas	418	446	543	1,001	1,483	1,738	1,933	1,368	616	578	79	87	10,290
Badger Hill	1,078	1,196	1,426	2,722	4,077	4,668	5,100	3,674	1,704	1,557	174	179	27,555
Buena Vista	14,749	20,142	22,710	26,551	29,856	20,478	26,580	27,534	25,219	12,012	10,883	18,482	255,196
Wheeler Ridge	16,372	20,479	21,921	28,293	30,854	17,204	22,584	24,784	27,828	13,007	12,447	21,166	256,939
Wind Gap	36,874	45,221	47,493	61,588	66,056	35,381	46,950	54,084	61,570	28,068	28,155	47,114	558,554
Edmonston Pumping Plant	130,041	160,230	166,123	215,216	228,501	117,516	160,363	188,219	215,591	95,785	98,376	165,725	1,941,686
Oso	11,446	10,147	14,764	12,820	9,620	2,879	8,486	7,978	14,723	3,723	9,943	17,056	123,585
Pearblossom	10,583	22,163	12,145	30,078	42,422	25,037	22,427	31,609	24,641	18,155	4,461	7,386	251,107
Warne Powerplant 1/	45	45	37	45	34	89	49	46	0	97	21	2	510
Other Project Loads 2/	177	1,296	154	37,966	36,149	39,851	45,364	37,894	37,898	39,704	34,291	32,843	343,587

1/ Station Service only.
2/ Includes Nevada Power Company and Project Emergency Service, deviation adustment for Pacific Gas and Electric.

Total State:	5,024,412
Total Federal:	532,113
Total Project:	5,556,525

FIGURE H: TOTAL ENERGY LOAD

1987



SALES

1. Pacific Gas and Electric Company	824,349	MWh
2. City of Vernon	768,155	MWh
3. Southern California Edison	396,824	MWh
4. Nevada Power Company	317,808	MWh
5. Metro. Water Dist. of So. California	109,342	MWh
6. Northern California Power Agency	69,426	MWh
7. City of Santa Clara	56,860	MWh
8. City of Anahiem	46,910	MWh
9. Salt River Project	24,517	MWh
10. City of Riverside	21,396	MWh
11. City of Azusa	12,186	MWh
12. Portland General Electric	4,800	MWh
13. City of Colton	4,360	MWh
14. City of Banning	1,361	MWh
15. Los Angeles Dept. of Water and Power	300	MWh

TOTAL: 7,872,794 MWh

Note: See Figure G for breakdown of Project Energy Loads.

SACRAMENTO-SAN JOAQUIN DELTA OPERATIONS

The State Water Project (SWP) operations in the Sacramento-San Joaquin Delta are greatly influenced by the classification of year type as prescribed by the Sate Water Resources Control Board (SWRCB) Water Right Decision 1485 (D-1485). Earlier forecasts of the Sacramento Valley unimpaired runoff for the four river basins, confirmed by the May 1 forecast, classified the 1986-87 water year as a "critical year," thus relaxing water quality standards under D-1485. Water quality conditions were good throughout 1987, and all D-1485 standards were met.

The Delta Outflow Index (DOI) is a calculated value that is a relative measure of the net westerly flow of fresh water at Chipps Island near Pittsburgh. The DOI averaged slightly over 12,000 cfs early in 1987, peaking at 36,892 cfs on March 17, then declining gradually through the spring and summer months. The index averaged about 8,800 cfs in March, 6,900 cfs in April, and then it was increased to about 7,200 cfs in May to help reduce the salinity at Emmaton. The index continued to decline through the summer, reaching a low of just under 1,900 cfs in August. Delta outflows generally increased during the fall, and the index average reached 8,400 cfs in December. At all times, Delta outflow remained above the minimum needed to meet D-1485 standards. Sacramento River flow at Rio Vista also remained above the required minimum D-1485 standards.

SWP export of Delta water is limited by (1) the physical capacity of the Banks Pumping Plant at 6,400 cfs, (2) SWRCB's D-1485 May through July export limitations, and (3) Fish Pump Agreement May and June pumping restrictions. The D-1485 pumping limitations allow a monthly mean daily pumping rate of 3,000 cfs or less during the period of May 6th through May 31, 3,000 cfs in June, and 2,900 cfs in July. Under the Fish Pump Agreement, May and June summed daily average exports cannot exceed 2,000 cfs, and the May 17-31 mean pump export rate cannot exceed 3,000 cfs for the period.

During 1987, 1,867,435 AF were exported from the Delta for the SWP. August was the month of greatest total export with 305,233 AF and November was the month of lowest total export with 81,555 AF. The amount of water exported from the Delta in 1987 was 273,206 AF less than in 1986. Throughout the year, and especially during the summer months, pumping rates are increased on the weekends to take advantage of less costly off-peak energy. This produces peaks in the export rate at about seven-day intervals.

Figure I on page 26 shows 1987 water quality data compared with their respective standards at three Delta stations: Emmaton, Jersey Point, and Contra Costa Canal Intake. Figure J on page 27 shows 1987 high-high tide at Antioch, the DOI, and Delta inflow.

DWR and USBR declared balanced water conditions[5/] in the Sacramento-San Joaquin Delta from April 6 through December 10. Flows in the Delta were controlled by coordinating releases from upstream reservoirs of the two agencies. The determination for apportioning each agency's share of responsibility for reservoir releases was based on the Coordinated Operation Agreement (COA) between the State and the U. S. Government that was signed on November 24, 1986. Figures K-1, K-2, and K-3 on pages 28, 29 and 30 show CVP-SWP coordinated operations for 1987. These figures show "lagged storage withdrawals." This term means that the storage withdrawals had been adjusted for the travel time, or "lag," (to the nearest whole day) for reservoir releases to reach the Delta so that water data at the Delta will then be referenced to the same time basis. For data comparisons and calculations at the Delta, storage withdrawals from Whiskeytown and Shasta Lakes are time lagged by five days, those from Lake Oroville are lagged by two days, and those from Folsom Lake are not lagged.

During the time when balanced water conditions were in effect, the State provided its share of storage releases to meet the in-basin use and D-1485 water quality requirements of the Federal-State COA.

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5 "Balanced water conditions" occur when it is agreed by USBR and DWR that the releases of water from upstream CVP and SWP reservoirs, plus other inflows, approximately equal the water supply needed to meet Sacramento Valley in-basin uses, including water quality objectives, plus exports.

Table 5 on page 31 tabulates by months the routing of water released to the Sacramento, Feather, and American Rivers from CVP-SWP upstream reservoirs. The water flowing to the ocean, represented by the DOI, provides a fresh water barrier to the more-saline water from the west, and thus maintains desired levels of Delta water quality. During the period of balanced water conditions, any water more than that needed for in-basin use (including Delta consumptive use and the DOI) is available for export from the Delta in agreement with the terms of D-1485.

To protect the striped bass fishery and avoid pumping very small fish from the Delta, D-1485 limits exports from the Delta to 3,000 cfs average monthly flow for both the CVP and the SWP during May and June, plus a limit of 4,600 cfs average monthly flow for each Project in July. In 1987, these limits were met with small margins by the SWP. Total exports (state and federal) for the year from the Delta by SWP facilities were about 5.10 million ac-ft. For a detailed description of federal pumping at Harvey O. Banks Delta Pumping Plant, see page 42.

Operation of the SWP and CVP either increases or reduces the mean DOI. The DOI was augmented by the operation of the SWP in May, June, and July, and reduced during the remainder of the year. The monthly mean rate of reduction during the year was about 3,600 cfs, and the monthly mean rate of augmentation was about 400 cfs. The DOI remained well above the level required by D-1485 throughout 1987. Table 6 on page 32 provides a tabulation of the daily computed total Delta outflow, which includes flows in the Sacramento River at Sacramento and in the San Joaquin River at Vernalis, plus Yolo Bypass flows from Fremont Weir and from Sacramento Weir. Starting on July 1, 1982, the flow measurements in the Sacramento River at Sacramento were shifted from the "I" Street Bridge to a more accurate measurement at Freeport.

During lower flow years, a rock barrier is installed across Old River at its confluence with the San Joaquin River to encourage the upstream migration of salmon and steelhead by increasing fall flows in the lower San Joaquin River. In 1987, the barrier was installed in early September and removed in late November.

For further information and data on 1987 Delta operations, see *DWR Bulletin 132-88, The California State Water Project; Appendix E, Water Operations in the Sacramento-San Joaquin Delta During 1987.*

FIGURE I: WATER QUALITY CONDITIONS AT SELECTED DELTA STATIONS 1987

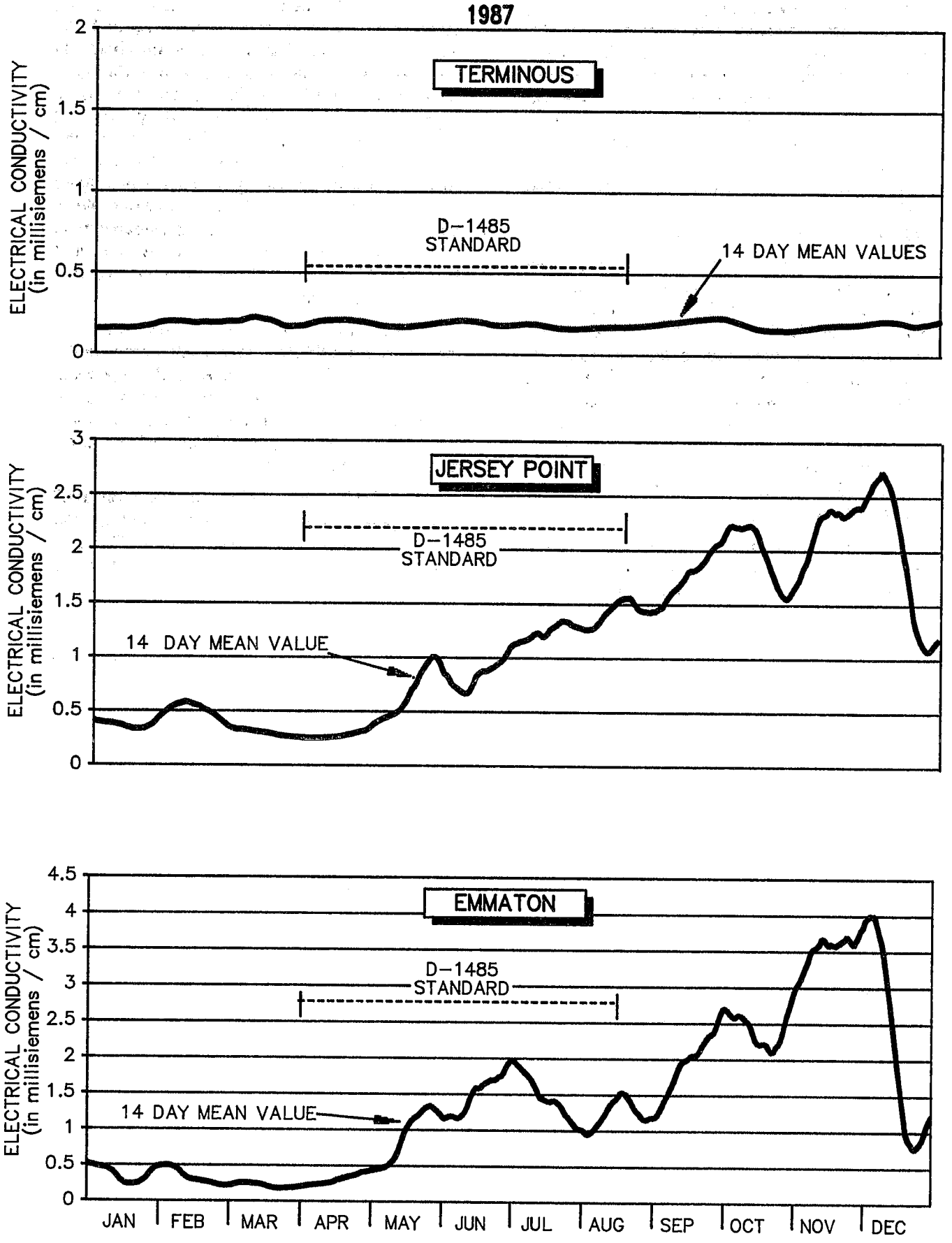


FIGURE J: DELTA TIDE, INFLOW, AND OUTFLOW INDEX
1987

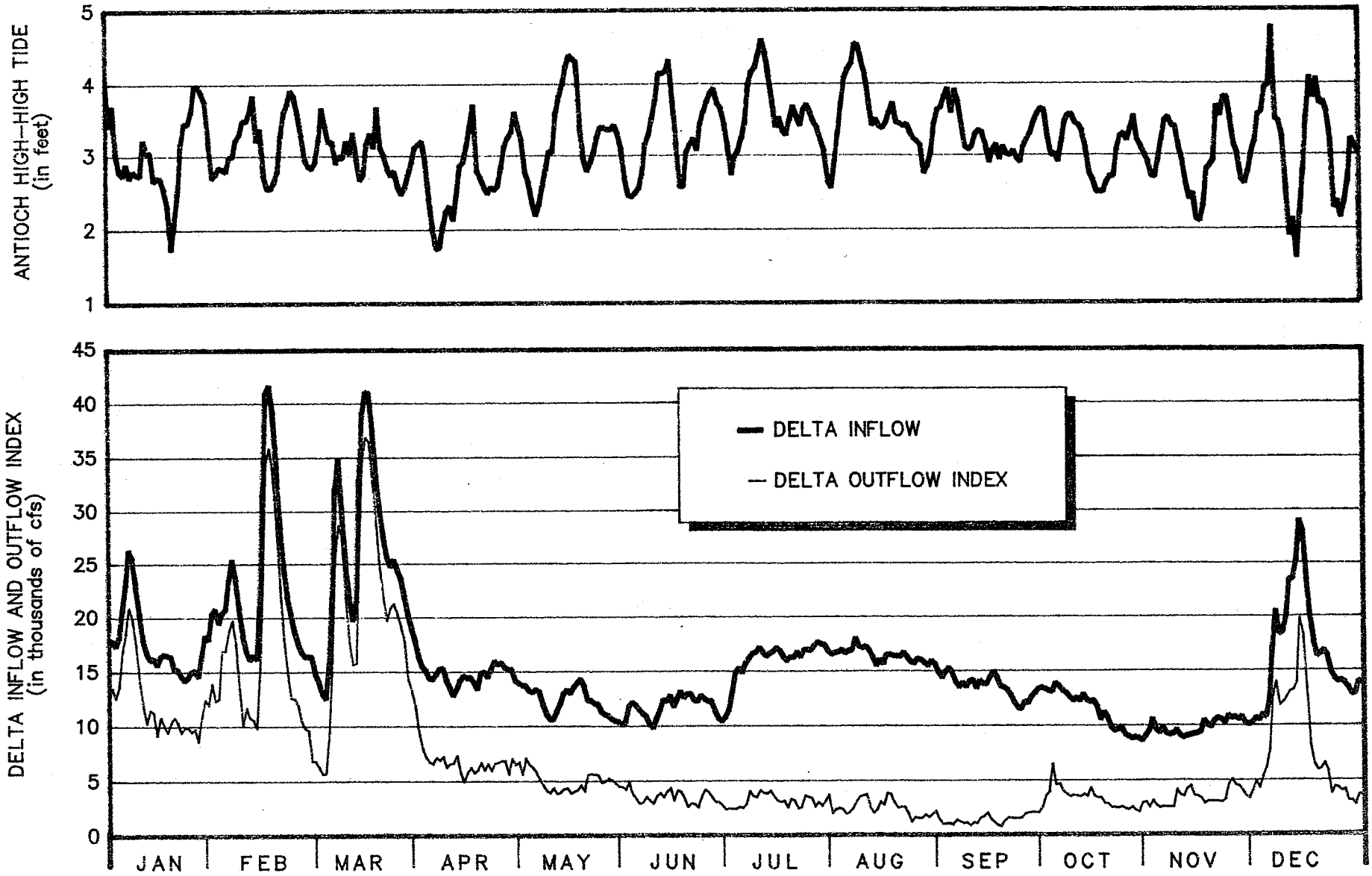
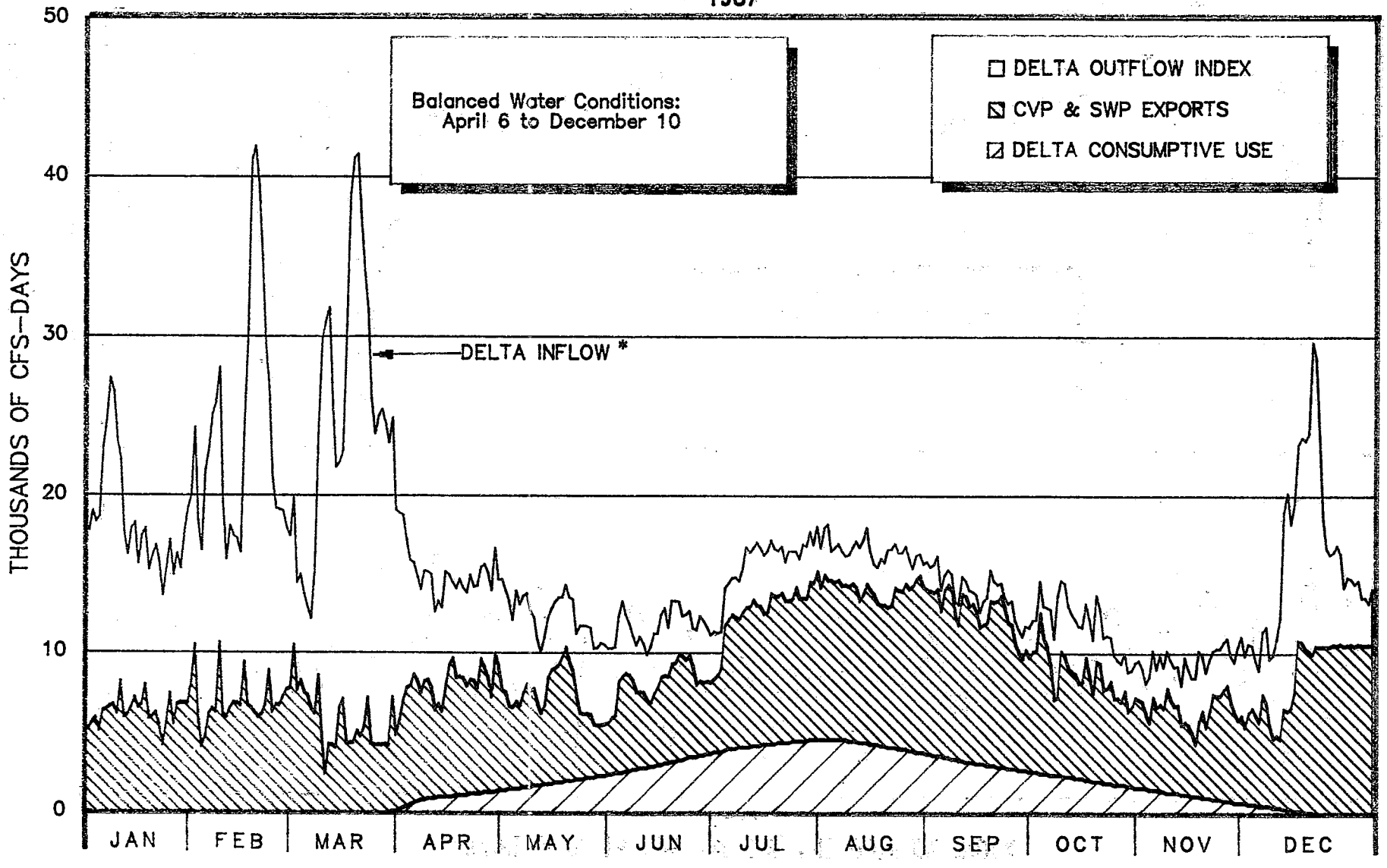


FIGURE K-1: COORDINATED DELTA OPERATIONS
1987



* Delta inflow = Exports + Outflow + Consumptive use.

FIGURE K-2: COORDINATED DELTA OPERATIONS
LAGGED STORAGE WITHDRAWALS
1987

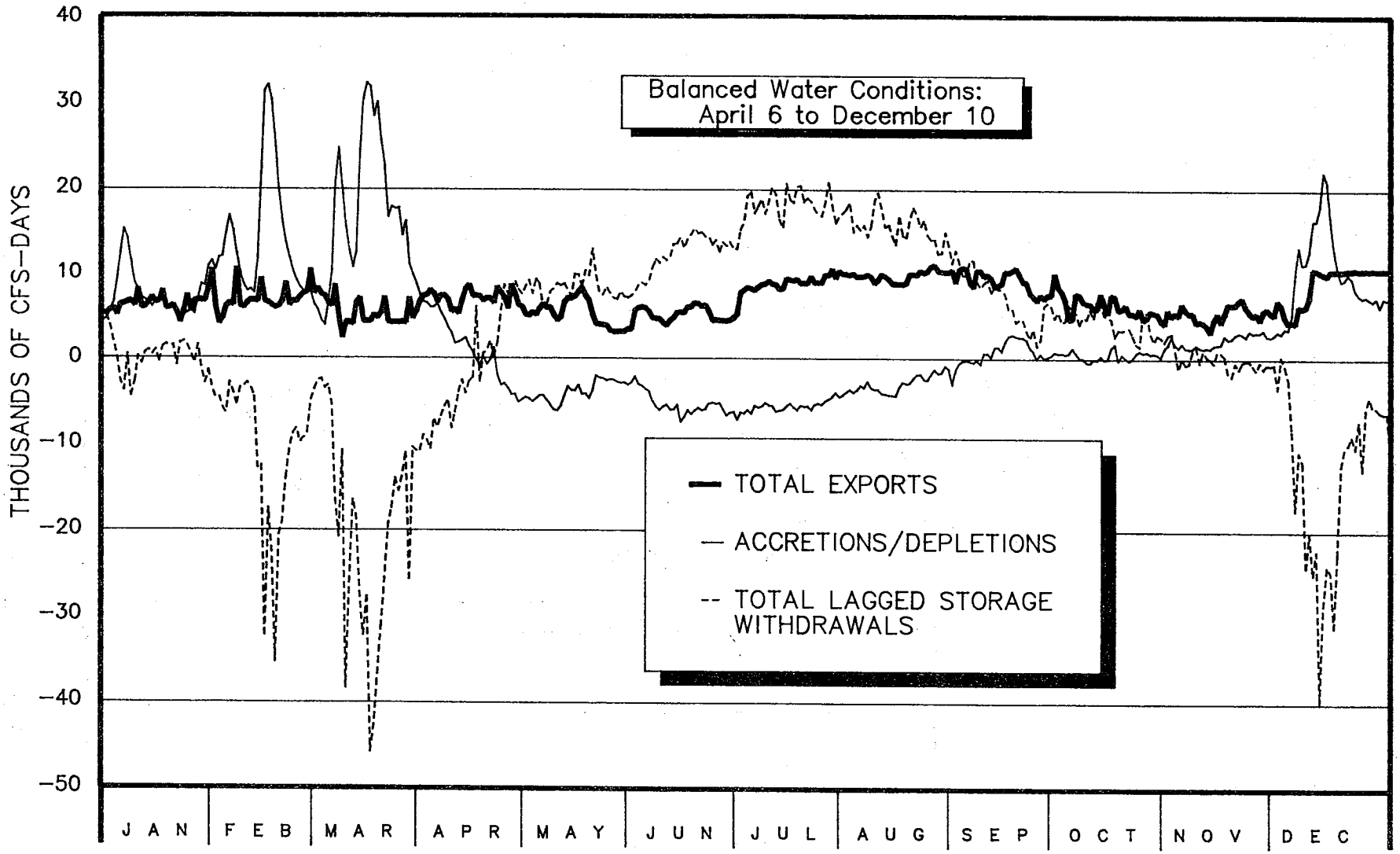
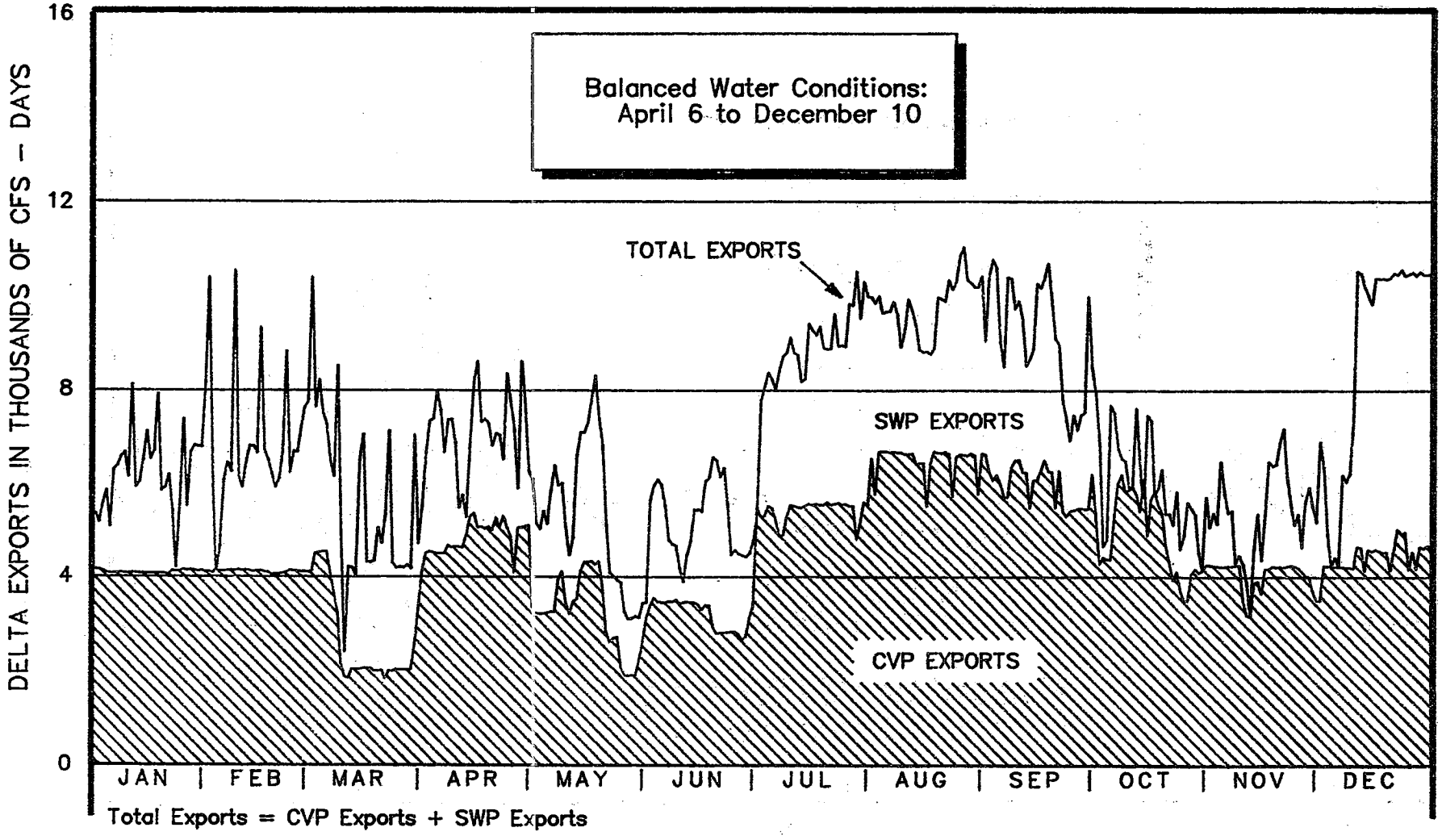


FIGURE K-3: COORDINATED DELTA OPERATIONS
DELTA EXPORTS
1987



Total Exports = CVP Exports + SWP Exports

TABLE 5: SACRAMENTO BASIN AND SACRAMENTO-SAN JOAQUIN DELTA OPERATIONS 1987

(in thousands of acre-feet except as noted)

MONTH	UPSTREAM RESERVOIR RELEASES TO RIVER			SACRAMENTO RIVER IN-BASIN USE	DELTA INFLOW			DELTA USES			DELTA EXPORTS		
	KESWICK 1/	OROVILLE 1/	NIMBUS	2/	SACRAMENTO RIVER AT SACRAMENTO 3/	SAN JOAQUIN RIVER AT VERNALIS 4/	TOTAL 5/	DELTA CONSUMPTIVE USE	DELTA OUTFLOW INDEX TOTAL	DELTA OUTFLOW INDEX AVERAGE CFS	TOTAL EXPORTS	EXPORTED BY DWR	EXPORTED BY USBR
JAN	283	105	66	457	924	159	1,090	-56	757	382	386	132	254
FEB	194	94	55	803	1,131	132	1,285	-37	942	475	381	151	230
MAR	200	105	62	1,026	1,331	198	1,543	-10	1,209	609	344	176	168
APR	536	141	67	69	703	153	873	63	393	198	420	131	289
MAY	674	110	62	-239	615	115	746	121	298	150	321	122	199
JUN	748	147	80	-328	599	92	700	191	200	101	312	119	193
JUL	889	225	164	-335	930	75	1,010	268	191	96	553	218	335
AUG	734	154	138	-174	888	94	1,001	252	146	74	601	200	401
SEP	399	99	126	52	692	95	803	174	89	45	540	185	355
OCT	307	100	140	34	583	78	683	118	201	101	361	60	301
NOV	217	71	67	134	484	94	588	55	208	105	323	82	241
DEC	207	74	62	629	977	84	1,056	2	502	253	554	280	274
TOTAL	5,388	1,425	1,089	2,128	9,857	1,369	11,378	1,141	5,136	---	5,096	1,856	3,240

1/ Time lagged values (Keswick: 5 days; Oroville: 2 days).
2/ Positive values are accretions; negative values are depletions.
3/ These values are a measured daily average taken from the Sacramento River at Freeport.
4/ These values are based on daily 6 a.m. readings. Columns 1, 2, 3, 12, and 13 are based on measured total daily flow.
5/ Includes Sacramento County regional Waste Treatment Plant.

TABLE 6: CALCULATED TOTAL DELTA OUTFLOW (INCLUDES YOLO BYPASS FLOWS)

1987

(in cfs-days except as noted)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	12,662	12,312	6,827	9,588	5,587	4,831	2,387	2,451	1,016	3,908	2,638	4,242
2	13,496	12,493	6,772	8,005	7,054	3,775	2,403	2,349	1,024	6,433	2,429	5,254
3	12,533	16,928	6,252	7,182	6,474	3,318	2,591	1,922	893	4,568	2,551	6,070
4	13,613	16,917	5,630	6,724	6,195	2,897	2,481	2,083	1,337	4,648	2,514	7,607
5	16,795	18,720	5,701	6,555	5,801	3,010	2,847	2,438	1,175	3,977	2,515	12,576
6	18,471	19,710	9,344	7,119	5,136	3,529	4,041	3,079	1,036	3,683	2,521	13,923
7	20,875	17,542	15,853	6,889	4,583	3,163	3,568	3,516	1,082	3,476	4,115	11,784
8	19,915	13,480	25,137	7,212	4,083	2,913	3,455	3,629	818	3,633	3,594	12,067
9	17,467	10,052	28,610	6,225	3,877	3,580	4,136	3,712	1,093	3,540	3,500	12,497
10	14,171	11,691	27,646	6,576	4,354	3,866	3,866	2,546	1,034	3,469	4,199	13,043
11	11,859	10,759	21,821	6,626	3,820	3,486	3,783	2,033	1,554	3,678	4,472	13,186
12	10,257	10,538	17,764	7,312	3,931	4,007	4,063	2,307	1,687	3,507	3,558	13,832
13	11,462	9,804	15,629	5,808	4,261	4,314	3,559	3,040	2,005	4,251	3,496	19,789
14	11,234	15,175	15,789	4,891	4,329	3,156	3,156	2,754	1,406	3,536	3,294	18,304
15	9,136	23,559	26,316	5,717	3,852	4,092	3,032	3,811	1,087	3,375	2,803	13,487
16	10,848	34,623	34,640	6,223	4,021	4,000	3,126	3,722	842	3,348	3,046	8,234
17	10,076	35,805	36,892	5,749	4,158	3,436	2,522	2,996	730	2,850	3,031	6,411
18	9,425	33,491	36,448	5,964	4,593	2,571	3,292	2,480	1,281	2,793	3,038	5,895
19	10,282	28,799	32,677	6,674	4,036	2,906	3,169	2,557	1,551	2,460	3,017	5,998
20	10,790	22,844	28,804	5,992	5,534	2,858	2,428	2,571	1,534	2,476	2,954	6,510
21	10,296	18,063	24,586	6,566	5,630	2,529	2,567	1,966	1,482	2,400	3,227	5,819
22	9,422	14,962	21,877	5,915	5,576	3,493	3,595	1,167	1,503	2,550	4,581	3,736
23	9,841	12,562	19,696	6,606	5,526	4,158	3,487	1,584	1,560	2,366	5,041	4,354
24	9,906	12,482	20,811	6,688	4,826	3,950	3,367	1,521	1,921	2,243	4,520	4,239
25	9,449	11,890	21,250	6,816	4,910	3,503	2,595	1,534	2,031	2,507	4,408	3,965
26	9,733	10,442	20,316	6,851	5,211	3,046	3,004	1,855	2,049	2,183	4,024	4,101
27	8,582	9,753	19,143	5,608	5,059	3,051	2,657	1,585	2,079	2,020	3,496	3,082
28	10,801	9,537	17,814	7,025	4,754	2,719	3,123	1,873	2,017	2,896	3,298	3,086
29	12,399		14,316	6,473	4,459	2,355	3,668	2,189	2,534	2,991	3,997	2,685
30	11,901		13,258	6,698	4,413	2,457	1,961	1,390	3,543	2,484	4,855	3,650
31	13,927		11,871		4,164		2,347	997		3,106		3,575
TOTAL	381,624	474,933	609,490	198,277	150,207	100,969	96,276	73,657	44,904	101,355	104,732	253,001
AVE.	12,310	16,962	19,661	6,609	4,845	3,366	3,106	2,376	1,497	3,270	3,491	8,161
MAX.	20,875	35,805	36,892	9,588	7,054	4,831	4,136	3,811	3,543	6,433	5,041	19,789
MIN.	8,582	9,537	5,630	4,891	3,820	2,355	1,961	997	730	2,020	2,429	2,685
TOTAL IN AF	756,951	942,030	1,208,923	393,282	297,936	200,272	190,963	146,099	89,067	201,038	207,736	501,827

Average daily value for the year = 7,094
Maximum daily value for the year = 36,892
Minimum daily value for the year = 730

Annual Total= 2,589,425 cfs days
or 5,136,124 acre-feet

PROJECT OPERATIONS BY FIELD DIVISION

OROVILLE FIELD DIVISION

Water Storage

The SWP's water storage facilities north of the Delta include Lake Oroville, Thermalito Forebay and Afterbay (Oroville-Thermalito Complex) and upper Feather River reservoirs of Lake Davis, Frenchman Lake, and Antelope Lake. The Lake Oroville operation stores winter and spring runoff for later SWP use.

None of the upper Feather River reservoirs filled and spilled in 1987. Before 1987 Antelope Lake had spilled every year since its original filling in 1965 except for 1977. Monthly operations for the three upper Feather River reservoirs are presented in Table 7 on page 35.

During 1987, inflow into Lake Oroville was insufficient to cause encroachment into the lake's flood control reservation. The lake was not operated for flood control, and no water spilled over Oroville Dam spillway in 1987.

The computed inflow to Lake Oroville during 1987 was 1,961,620 AF. The maximum daily inflow into the lake was 43,660 AF on March 13, and the maximum daily release to the Feather River from the lake was 8,058 ac-ft on July 15. The minimum daily inflow into the lake was estimated at 0 AF on July 17.

Detailed information on Lake Oroville and the Oroville-Thermalito complex water operations is presented on pages 42 through 47.

The following table presents the 1987 range of storages in the Oroville Field Division reservoirs:

Reservoir	Operational Capacity(ac-ft)	Start of 1987 (ac-ft)	End of 1987 (ac-ft)	Maximum (ac-ft)	Date	Minimum (ac-ft)	Date
Antelope Lake	22,566	15,680	14,231	19,328	5/10	14,202	11/30
Frenchman Lake	55,477	39,660	30,667	42,118	4/21	30,342	12/05
Lake Davis	84,371	67,293	54,884	70,325	4/11	54,504	11/30
Lake Oroville	3,537,577	2,388,007	2,564,058	3,139,394	4/13	1,967,234	10/23

Water Deliveries

Water stored in Lake Oroville is released into the Thermalito diversion Pool, from which specified quantities are released into both the Feather River and the Thermalito Power Canal. The Power Canal supplies water first to the Thermalito Forebay and then to Thermalito Afterbay. From the Thermalito Afterbay, water is released to the Feather River and several local distribution systems for use in the Feather River Service Area (FRSA). Lake Oroville is operated for power generation, flood control, recreation, and fish and wildlife enhancement in addition to water supply. All the water delivered to SWP contractors in the Oroville Field Division was for municipal and industrial purposes. Table 2 on page 12 shows water deliveries by year with totals to date for individual agencies.

In addition to Feather River releases, water is released from the Oroville-Thermalito complex to water rights holders predating the SWP construction. These deliveries are collectively called diversions to the FRSA and flow through the Sutter-Butte, Western, Richvale, P.G.& E. lateral, and Palermo outlets. FRSA diversions are not considered SWP benefits as they pre-dated and would have occurred in the absence of the SWP to the limit of available natural river flows. Nearly all FRSA diversions are for agricultural uses.

A total of 836,720 AF was diverted from the Feather River to the FRSA during 1987. The highest rates of diversion were from April through July with mean diversion rates above 2,400 cfs. About 15 to 25 percent of the total FRSA amount diverted eventually returns to the Feather River.

Deliveries during 1987 in the Oroville Field Division are shown in the table on the right:

Agency	Amount (ac-ft)
State Water Project (SWP) Contractors:	
County of Butte	459
Plumas County	452
Yuba City	88
Local Supply (under special contracts):	
Last Chance Water District	9,444
Thermalito Irrigation District	2,338
Prior Water Rights Entitlement:	
Upper Feather Lakes	2,203
Palermo Canal	8,612
Thermalito Afterbay Deliveries:	
Sutter-Butte Canal	496,171
PGandE Lateral	3,746
Richvale Canal	86,248
Western Canal	239,740
Total	849,501

Outages and Limitations

Major outages affecting or influencing operations in the Oroville Field Division in 1987 were:

* The 13.8 KV line at Thermalito was out of service from June 25 through June 26 to check the line CT's ratio.
* Power circiut breaker #562 at Thermalito was out of service from October 20 through October 23 to be replaced with a new circuit breaker.
* The #2 intake and Units 4, 5, and 6 at Hyatt were out of service from January 22 through January 26 to repair the raw water header valve on Unit #6.
* Power circuit breaker #962 at Hyatt was out of service from September 3 through September 4 to repair a gas leak and to add and balance SF6 gas.

The following units at the two power plants in the Oroville Field Division were out of service for the times and reasons noted:

Unit	Outage Beginning	Outage Ending	Reason
Edward Hyatt Powerplant:			
1	02/17/87	02/27/87	Annual maintenance.
2	01/01/87	01/15/87	Rectify stator ground.
3	02/02/87	02/13/87	Annual maintenance and repair broken bolts on TSV trunion seal.
5	04/27/87	05/08/87	Annual maintenance.
	05/13/87	07/29/87	Repair faulty vent valve.
6	03/02/87	03/18/87	Annual maintenance and trunion bearing repair.
Thermalito powerplant:			
1	09/28/87	10/24/87	Annual maintenance.
2	01/02/87	01/14/87	Annual maintenance.
	10/16/87	11/06/87	Routine maintenance.
3	04/01/87	04/22/87	Annual maintenance.
4	01/16/87	01/30/87	Annual maintenance.
	12/07/87	12/14/87	Annual maintenance.

TABLE 7: UPPER FEATHER AREA LAKES MONTHLY OPERATION
1987

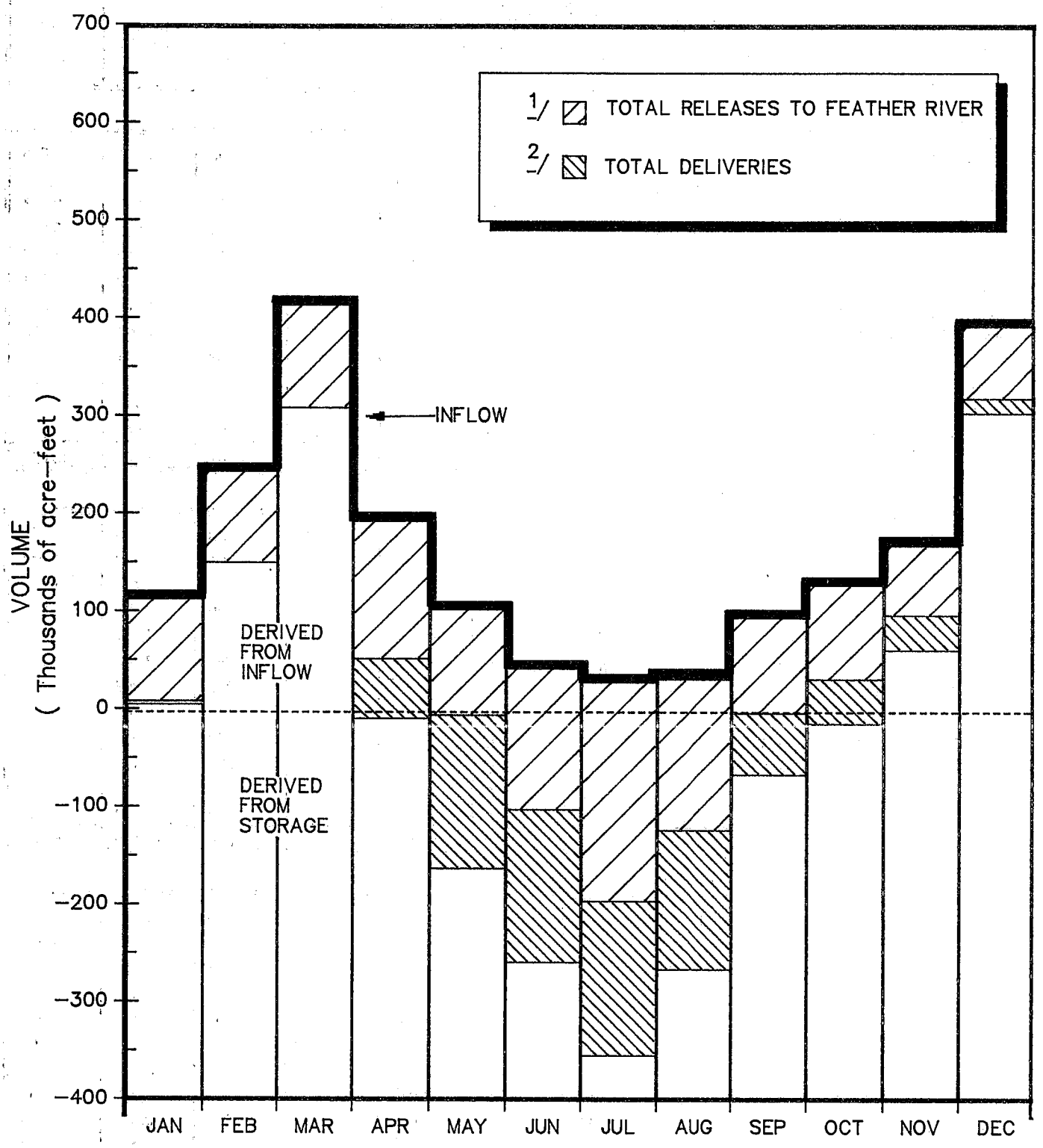
(in acre-feet except as noted)

MONT	LAKE STORAGE			OUTFLOW							INFLOW
				REGULATED RELEASE							
	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	TREAMFLOW MANT.	WATER SUPPLY CONTRACTS	PRIOR WATER RIGHT	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
ANTELOPE LAKE			Capacity 22,566 acre-feet								
JAN	4,993.00	15,074	-616	1,230	0	0	1,230	0	52	1,282	666
FEB	4,993.09	15,140	66	1,111	0	0	1,111	0	88	1,199	1,265
MAR	4,994.97	16,561	1,421	625	0	0	625	0	91	716	2,137
APR	4,998.10	19,098	2,537	595	0	0	595	0	163	758	3,295
MAY	4,998.32	19,285	187	615	0	0	615	0	348	963	1,150
JUN	4,997.42	18,529	-756	595	0	0	595	0	512	1,107	351
JUL	4,996.17	17,508	-1,021	615	0	0	615	0	611	1,226	205
AUG	4,994.80	16,429	-1,079	615	0	0	615	0	476	1,091	12
SEP	4,933.66	15,562	-867	555	0	0	555	0	386	941	74
OCT	4,992.61	14,789	-773	615	0	0	615	0	248	863	90
NOV	4,991.79	14,202	-587	595	0	0	595	0	114	709	122
DEC	4,991.83	14,231	29	615	0	0	615	0	78	693	722
TOTAL	---	---	-1,459	8,381	0	0	8,381	0	3,167	11,548	10,089
FRENCHMAN LAKE			Capacity 55,477 acre-feet								
JAN	5,577.32	40,150	490	116	0	0	116	0	90	206	696
FEB	5,577.97	40,997	847	126	0	0	126	0	91	217	1,064
MAR	5,578.51	41,710	713	57	0	258	315	0	158	473	1,186
APR	5,578.66	41,909	199	63	322	88	473	0	266	739	938
MAY	5,577.12	39,892	-2,017	0	2,218	0	2,218	0	533	2,751	734
JUN	5,574.59	36,712	-3,180	0	2,715	0	2,715	0	789	3,504	324
JUL	5,572.40	34,094	-2,618	0	1,861	0	1,861	0	897	2,758	140
AUG	5,570.40	31,813	-2,281	0	1,626	0	1,626	0	717	2,343	62
SEP	5,569.52	30,842	-971	3	505	0	508	0	552	1,060	89
OCT	5,569.18	30,472	-370	75	105	0	180	0	304	484	114
NOV	5,569.09	30,374	-98	58	92	0	150	0	173	323	225
DEC	5,569.36	30,667	293	123	0	0	123	0	119	242	535
TOTAL	---	---	-8,993	621	9,444	346	10,411	0	4,689	15,100	6,107
LAKE DAVIS			Capacity 84,371 acre-feet								
JAN	5,770.37	66,830	-463	1,230	3	0	1,233	0	250	1,483	1,020
FEB	5,770.61	67,686	856	837	1	0	838	0	250	1,088	1,944
MAR	5,771.19	69,778	2,092	922	0	0	922	0	434	1,356	3,448
APR	5,771.20	69,815	37	857	26	36	919	0	729	1,648	1,685
MAY	5,770.72	68,080	-1,735	553	67	369	989	0	1,192	2,181	446
JUN	5,770.05	65,699	-2,381	536	78	357	971	0	1,777	2,748	367
JUL	5,769.17	62,642	-3,057	553	67	369	989	0	2,221	3,210	153
AUG	5,768.29	59,668	-2,974	553	96	369	1,018	0	1,992	3,010	36
SEP	5,767.59	57,361	-2,307	536	80	357	973	0	1,383	2,356	49
OCT	5,767.59	55,713	-1,648	922	14	0	936	0	839	1,775	127
NOV	5,766.70	54,504	-1,209	879	8	0	887	0	507	1,394	185
DEC	5,766.82	54,884	380	922	12	0	934	0	350	1,284	1,664
TOTAL	---	---	-12,409	9,300	452	1,857	11,609	0	11,924	23,533	11,124

* At end of month.

FIGURE L : OROVILLE-THERMALITO COMPLEX
1987

INFLOW, RELEASES AND DIVERSIONS



1/ Total of Fish Barrier Dam, Fish Hatchery, and Thermalito Afterbay River Outlet releases.

2/ Total of Palermo Canal, Butte Co., Thermalito Irrigation District, Western Canal, Richvale Canal, P.G.& E. Lateral, and Sutter Butte diversions.

TABLE 8: LAKE OROVILLE MONTHLY OPERATION

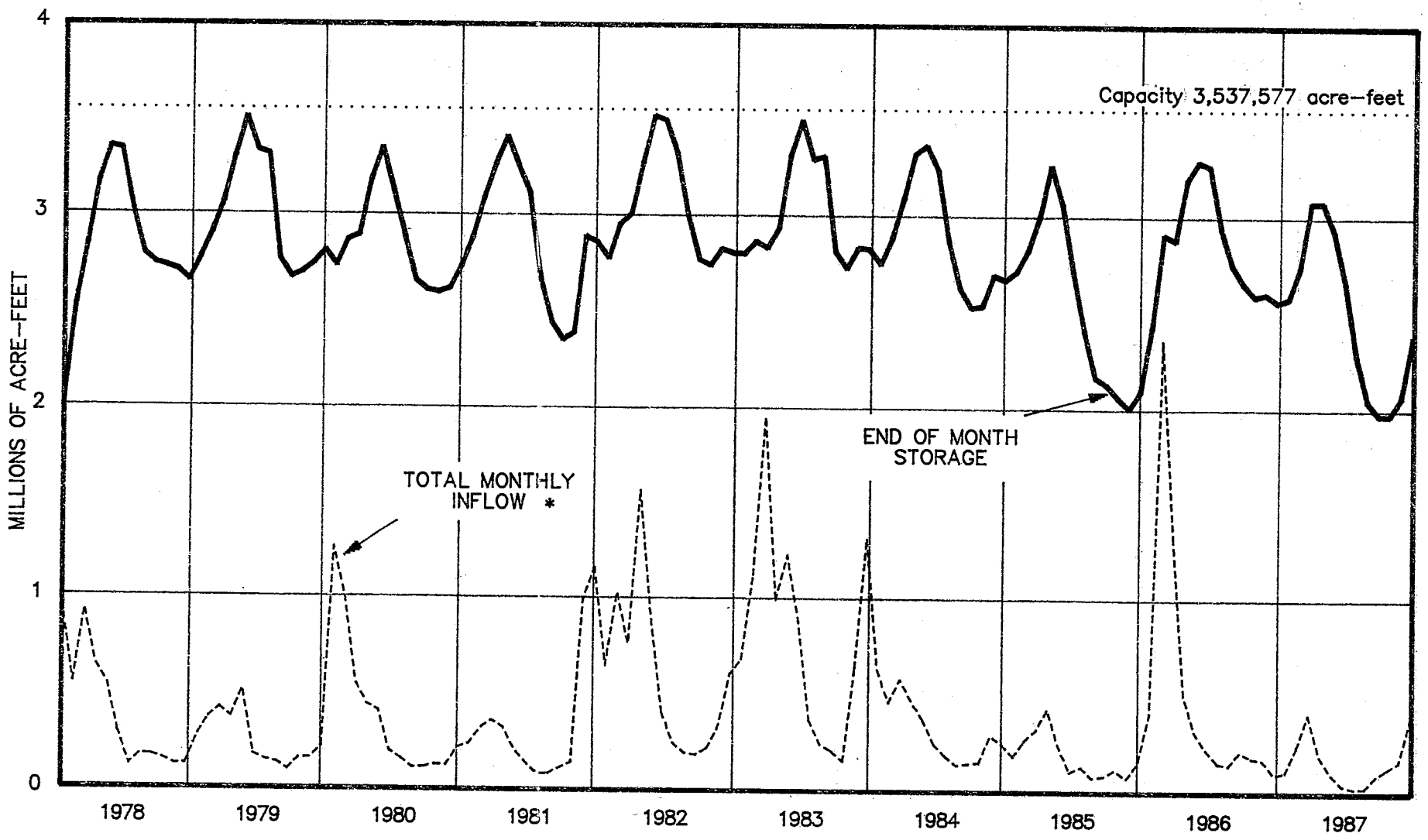
(in acre-feet except as noted)

Capacity 3,537,577 acre-feet

MONTH	YEAR	WATER SURFACE ELEVATION	STORAGE	STORAGE* CHANGE	OUTFLOW						PUMPBACK	TOTAL INFLOW (excluding pumpback)
					POWER	PALERMO CANAL	SPILLWAY LEAKEAGE	EVAP-ORATION	SPILL	TOTAL OUTFLOW		
JAN	1987	832.80	2,584,139	20,081	139,321	258	0	961	0	140,540	47,726	112,895
	1986	820.31	2,429,331	331,457	78,928	142	14	793	0	79,877	0	411,334
FEB	1987	845.14	2,743,689	159,550	88,564	237	0	1,558	0	90,359	4,768	245,141
	1986	857.55	2,910,906	481,575	469,646	122	14	1,098	1,409,685	1,880,565	1,059	2,361,081
MAR	1987	869.46	3,078,012	334,323	95,147	276	165	2,620	0	98,208	18,400	414,131
	1986	855.32	2,880,344	-30,562	849,503	143	133	2,594	509,920	1,362,293	0	1,331,731
APR	1987	869.45	3,077,869	-143	187,218	658	305	5,437	0	193,618	545	192,930
	1986	877.41	3,193,260	312,916	228,520	342	555	3,768	0	233,185	31,367	514,734
MAY	1987	858.82	2,928,412	-149,457	258,753	1,152	228	7,101	0	267,234	12,605	105,172
	1986	883.76	3,287,497	94,237	259,171	1,039	1,180	6,821	0	268,211	45,693	316,755
JUN	1987	838.88	2,661,938	-266,474	305,985	1,190	60	8,716	0	315,951	4,862	44,615
	1986	881.91	3,259,837	-27,660	254,424	1,256	1,289	9,476	0	266,445	12,093	226,692
JUL	1987	808.59	2,290,153	-371,785	392,948	1,230	0	8,416	0	402,594	1,930	28,879
	1986	860.05	2,945,438	-314,399	482,228	1,244	752	10,424	0	494,648	22,570	157,679
AUG	1987	787.37	2,052,510	-237,643	281,463	1,230	0	8,127	0	290,820	21,966	31,211
	1986	846.15	2,757,039	-188,399	352,977	1,218	204	10,121	0	364,520	29,757	146,364
SEP	1987	780.41	1,978,538	-73,972	181,611	1,125	0	5,737	0	188,473	19,150	95,351
	1986	838.80	2,660,904	-96,135	323,198	952	8	5,556	0	329,714	17,081	216,498
OCT	1987	780.26	1,976,965	-1,573	135,185	902	0	4,394	0	140,481	8,092	130,816
	1986	833.56	2,593,776	-67,128	250,632	851	0	4,588	0	256,071	5,225	183,718
NOV	1987	788.99	2,069,358	92,393	125,809	254	0	1,144	0	127,207	51,564	168,036
	1986	834.63	2,607,386	13,610	163,310	403	0	3,069	0	166,782	7,347	173,045
DEC	1987	816.88	2,388,007	318,649	120,417	100	0	741	0	121,258	46,690	393,217
	1986	831.21	2,564,058	-43,328	148,134	258	0	858	0	149,250	7,271	98,651
TOTAL	1987	- - -	- - -	-176,051	2,312,421	8,612	758	54,952	0	2,376,743	238,298	1,962,394
	1986	- - -	- - -	466,184	3,860,671	7,970	4,149	59,166	1,919,605	5,851,561	179,463	6,138,282

*At end of month

FIGURE M: LAKE OROVILLE OPERATION



* Excludes pumpback.

FIGURE N: OPERATION OF LAKE OROVILLE FOR FLOOD CONTROL
1986-87

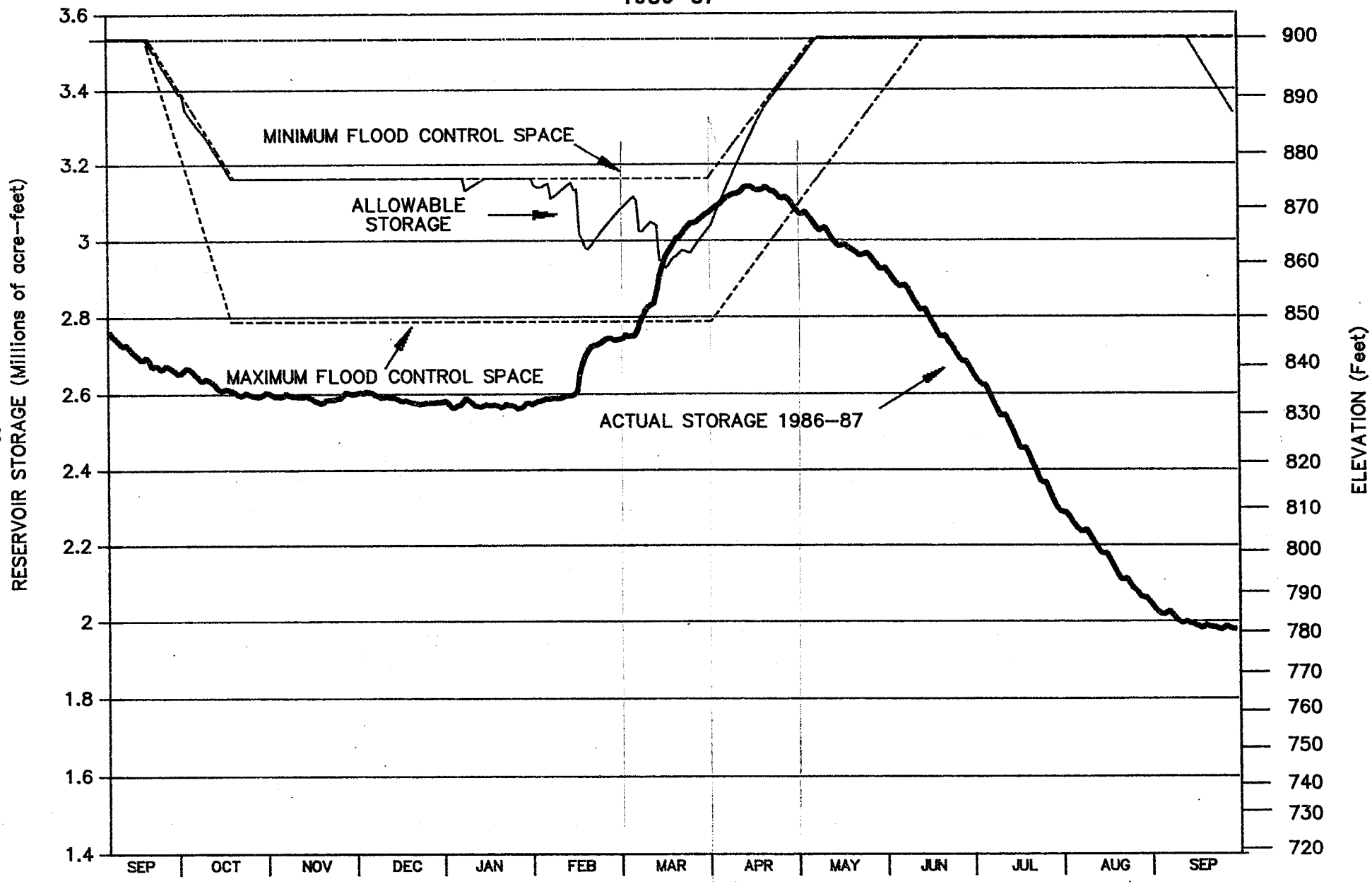


FIGURE O: LAKE OROVILLE TEMPERATURES
1987
(isotherms in degrees Fahrenheit)

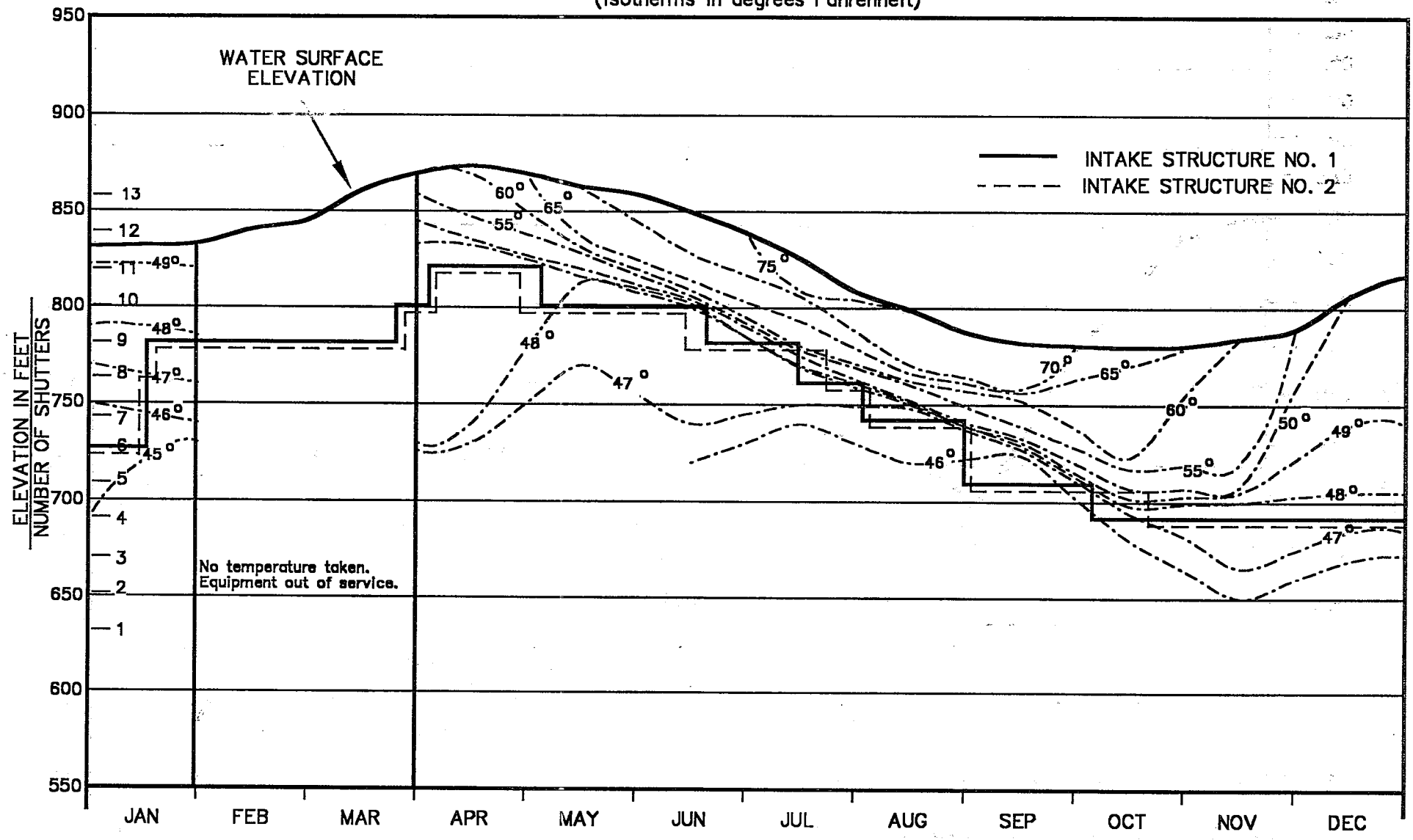


TABLE 9: OROVILLE-THERMALITO COMPLEX MONTHLY STORAGE

(elevation in feet, storage in acre-feet)

MONTH	YEAR	THERMALITO DIVERSION DAM POOL		THERMALITO FOREBAY		THERMALITO AFTERBAY	
		ELEVATION	STORAGE*	ELEVATION	STORAGE*	ELEVATION	STORAGE*
JAN	1987	223.08	12,739	223.14	10,619	130.14	32,618
	1986	223.70	12,936	224.00	11,144	127.91	25,562
FEB	1987	224.25	13,111	224.00	11,144	130.79	34,827
	1986	224.58	13,217	221.48	9,630	131.64	37,818
MAR	1987	223.44	12,853	223.30	10,716	129.09	29,194
	1986	223.73	12,945	223.38	10,764	125.92	19,959
APR	1987	223.93	12,692	222.88	10,462	130.04	32,285
	1986	222.23	12,472	222.02	9,948	129.39	30,154
MAY	1987	222.34	12,507	222.30	10,114	127.96	25,711
	1986	221.83	12,348	221.88	9,865	129.58	30,770
JUN	1987	223.62	12,910	224.02	11,157	130.28	33,088
	1986	223.41	12,844	223.26	10,692	127.31	23,803
JUL	1987	223.60	12,904	223.94	11,107	135.68	53,557
	1986	222.31	12,497	222.58	10,281	134.22	47,592
AUG	1987	223.62	12,910	223.96	11,120	130.97	35,451
	1986	223.51	12,875	223.48	10,825	127.49	24,324
SEP	1987	223.30	12,809	223.42	10,789	134.54	48,872
	1986	223.55	12,888	223.68	10,948	125.66	19,273
OCT	1987	223.33	12,818	223.28	10,704	133.38	44,298
	1986	222.86	12,670	222.76	10,389	128.77	28,187
NOV	1987	223.59	12,901	223.66	10,935	128.79	28,249
	1986	222.97	12,704	222.94	10,498	131.48	37,247
DEC	1987	222.50	12,557	222.90	10,474	129.30	29,865
	1986	223.37	12,831	223.58	10,887	130.90	35,208

* At end of month.

DELTA FIELD DIVISION

Water Storage

The maximum storage in Lake Del Valle of 41,273 AF was reached on May 15, exceeding the operational storage capacity of the lake (a permit discussed on page 9 allowed for exceeding the normal operational storage capacity). Storage above 39,000 AF is flood reservation between November 1 and March 31, and storage above 40,000 AF is flood reservation between April 1 and October 31. The minimum storage of 24,386 AF was reached on November 2, about 61 percent of the operational storage capacity. Table 10 on page 44 and Figure P on page 45 present reservoir operations for Lake Del Valle in 1987. Table 11 on page 46 presents Clifton Court Forebay's monthly operations in 1987.

Water Deliveries

Comparisons of the 1987 water deliveries to the three areas the Delta Field Division serves and their percent differences from 1986 deliveries are shown in the following table:

Area	Water Deliveries (in ac-ft)	Difference from 1986 (in percent)
California Aqueduct	6,390	+19
North Bay Aqueduct	9,243	+163
South Bay Aqueduct	146,958	+8

Of the total entitlement water delivered in the Delta Field Division, 115,224 AF was for municipal and industrial purposes.

In addition to the SWP deliveries, 491 AF of Central Valley Project (CVP) water was wheeled through the Governor Edmund G. Brown California Aqueduct (California Aqueduct) to Tracy Golf and Country Club, and 19 AF of CVP water was wheeled to Musco Olive Products Inc.

Also, a total of 137 AF of SWP water was delivered from Lake Del Valle for use at public recreation facilities administered by the East Bay Regional Park District.

Table 2 on page 12 presents water deliveries by year with totals to date for individual agencies.

Pumping Plants

Pumping at Harvey O. Banks Delta Pumping Plant (Banks Pumping Plant) for 1987 totaled 2,194,783 AF, 11 percent less than that pumped during 1986. Of that total, 337,069 AF was pumped for USBR.

In complying with D-1485 limitations on Delta diversions described on page 29, the USBR foregoes up to 193,590 AF of its May-June diversion capacity at its Tracy Pumping Plant. This foregone capacity is then replaced by pumping CVP water at Banks Pumping Plant to the extent needed. 193,590 AF of CVP water was pumped at Banks Pumping Plant in 1987 to replace capacity foregone in May and June because of CVP export reductions. Pumping at South Bay Pumping Plant totaled 145,923 AF for 1987, 28 percent more than the amount pumped in 1986, while pumping at Del Valle Pumping Plant was only 13,995 AF for the year. Pumping at Cordelia Pumping Plant totaled 7,693 AF for the year.

Outages and Limitations

Banks Pumping Plant KYA transformer, discharge line No. 1, and units Nos. 1, 2 and 3 were out of service from April 22 through May 17 to replace the breaker lifting devices on a 13.2 kilovolt breaker, replace upstream and downstream "O" rings on No. 3 discharge valve, and for annual maintenance on all three units.

The units at the pumping plants in the Delta Field Division presented in the table on the right were out of service for the times and reasons noted. If no date is given in the "Outage Ending" column, the unit remained out of service at the end of 1987.

Unit	Outage Beginning	Outage Ending	Reason
Banks Pumping Plant:			
2	07/27/87	08/06/87	Unit relay and motor maintenance.
	09/14/87	10/01/87	Replace melted brush holder.
3	04/27/87	05/19/87	Annual maintenance.
4	05/26/87	06/08/87	Annual maintenance.
5	04/06/87	04/27/87	Annual maintenance.
6	10/05/87	10/20/87	Annual maintenance.
7	03/05/87	03/09/87	Repair field break opening.
8	03/09/87	03/30/87	Repair upstream DV seats.
	06/15/87	06/19/87	Routine maintenance.
	10/25/87	11/18/87	Annual maintenance.
South Bay Pumping Plant:			
1	10/05/87	----	Annual maintenance and stator winding & testing.
2	10/13/87	10/16/87	Annual maintenance.
3	10/18/87	10/23/87	Annual maintenance.
4	10/26/87	11/02/87	Annual maintenance.
5	11/02/87	11/05/87	Annual maintenance.
7	01/26/87	01/30/87	Annual maintenance.
	08/26/87	10/27/87	Repair packing blowout and motor windings.
	10/30/87	12/31/87	Repairs to rectify excessive vibration.
8	02/06/87	04/16/87	Annual maintenance.
9	02/02/87	02/06/87	Annual maintenance.

TABLE 10: LAKE DEL VALLE MONTHLY OPERATION

1987

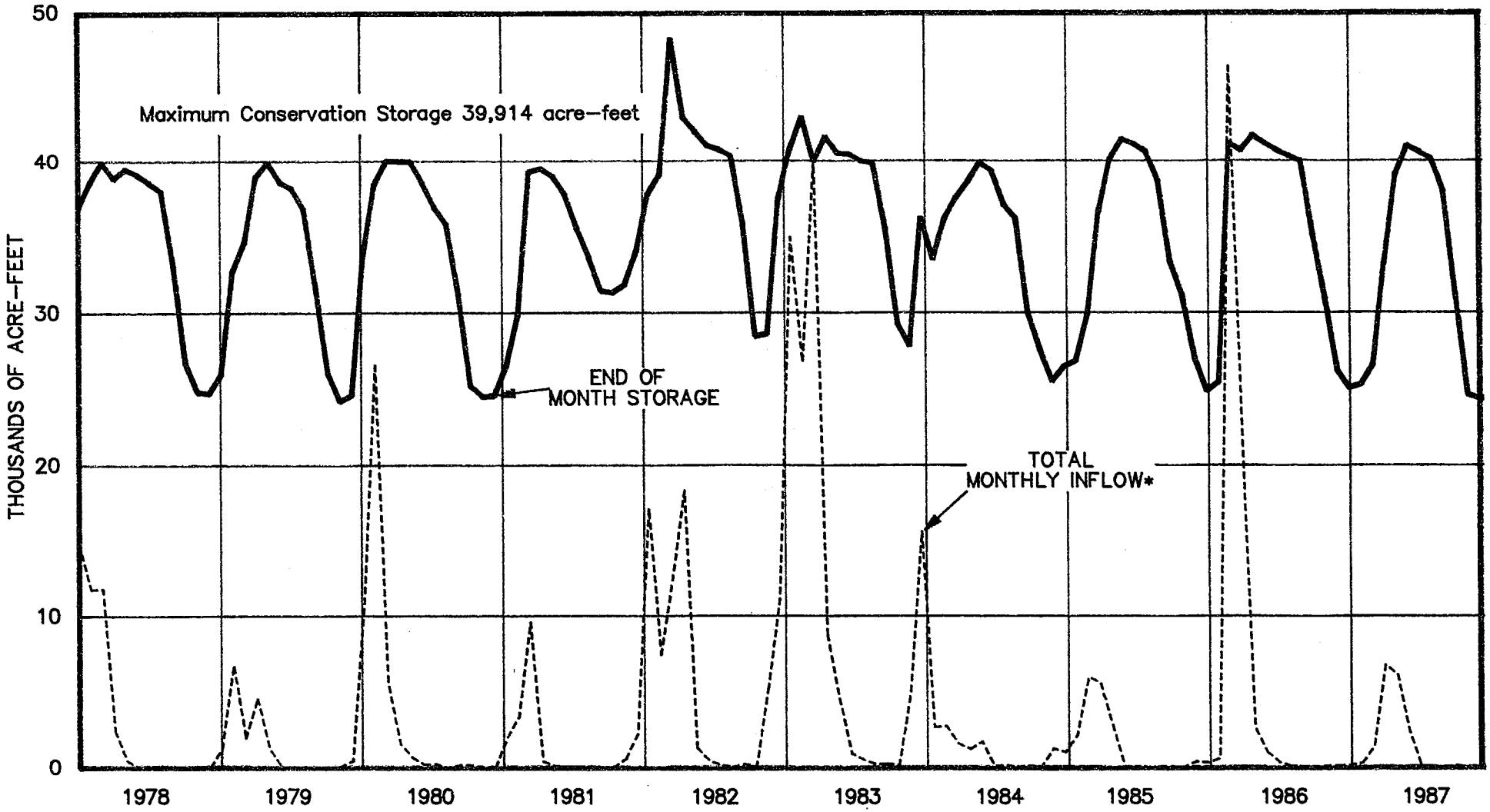
(in acre-feet except as noted)

MONTH	WATER* SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	INFLOW		OUTFLOW					PRECIPITATION (inches)
				NATURAL	SOUTH BAY AQUEDUCT	SOUTH BAY AQUEDUCT	RECREATION 1/	ARROYO VALLE	EVAPORATION	TOTAL	
JAN	679.07	25,311	261	309	0	0	3	0	45	48	2.04
FEB	681.54	26,585	1,274	1,357	0	0	4	18	61	83	3.35
MAR	693.02	33,243	6,658	1,083	5,679	0	4	0	100	104	2.48
APR	701.82	39,085	5,842	327	5,752	0	9	0	228	237	0.28
MAY	704.59	41,049	1,964	-211	2,564	57	21	0	311	389	0.06
JUN	704.01	40,633	-416	-37	0	0	19	0	360	379	0.00
JUL	703.32	40,141	-492	-109	0	0	16	0	367	383	0.00
AUG	700.20	37,964	-2,177	64	0	1,814	22	0	405	2,241	0.00
SEP	689.70	31,201	-6,763	139	0	6,561	20	0	319	6,900	0.00
OCT	677.70	24,630	-6,571	-58	0	6,313	14	0	185	6,512	1.28
NOV	677.14	24,357	-273	38	0	248	3	0	61	312	1.07
DEC	677.31	24,440	83	148	0	0	2	13	50	65	2.51
TOTAL	—	—	-871	3,050	13,995	14,993	137	31	2,492	17,653	13.07

*At end of month.

1/ To East Bay Regional Park District.

FIGURE P: LAKE DEL VALLE OPERATION



* Natural and pumped inflows.

TABLE 11: CLIFTON COURT FOREBAY MONTHLY OPERATION

(elevation in feet, storage in acre-feet)

MONTH	YEAR	WATER SURFACE ELEVATION*	STORAGE*	STORAGE CHANGE	INFLOW
JAN	1987	1.36	21,196	1,598	130,759
	1986	1.88	22,319	3,625	310,129
FEB	1987	0.94	20,289	-907	150,327
	1986	3.00	24,742	2,423	114,465
MAR	1987	1.06	20,548	259	189,905
	1986	2.64	23,963	-779	43,402
APR	1987	-1.19	15,704	-4,844	153,357
	1986	-0.94	16,241	-7,722	110,833
MAY	1987	1.06	20,548	4,844	134,270
	1986	1.43	21,347	5,106	195,672
JUN	1987	-0.53	17,122	-3,426	122,307
	1986	0.40	19,125	-2,222	182,136
JUL	1987	-1.68	14,652	-2,470	269,106
	1986	1.19	20,829	1,704	247,103
AUG	1987	-0.78	16,585	1,933	312,007
	1986	0.21	18,715	-2,114	333,425
SEP	1987	-1.15	15,790	15,790	274,578
	1986	-0.15	17,940	-775	377,110
OCT	1987	-0.05	18,155	215	107,969
	1986	1.43	21,347	3,407	212,169
NOV	1987	0.01	18,285	130	81,917
	1986	0.90	20,203	-1,144	179,676
DEC	1987	-0.55	17,079	-1,206	296,809
	1986	2.10	22,794	2,591	190,724
TOTAL	1987	—	—	11,916	2,223,311
	1986	—	—	4,100	2,496,844

*At end of month.

SAN LUIS FIELD DIVISION

Water Storage

San Luis Reservoir total storage reached its maximum of the year, 2,026,819 AF on March 12. Maximum operating storage capacity is 2,027,835 AF. Drawdown to the minimum total storage for the year, 529,199 AF, occurred on August 27. The State's share of San Luis Reservoir storage reached the maximum of 1,063,226 AF on February 13, while the minimum of 404,325 AF was reached on October 20. Table 12 on page 49 and Figure Q on page 50 present San Luis Reservoir operations during 1987. Table 13 on page 51 presents the monthly operation of O'Neill Forebay during 1987.

Water Deliveries

SWP water deliveries in the San Luis Field Division during 1987 consisted of 590 AF delivered to 830 acres of wildlife mitigation lands located below O'Neill Forebay at the Pilibos Wildlife Area for the Department of Fish and Game, and 8 AF of recreation water delivered to the Department of Parks and Recreation.

CVP water delivered in the San Luis Field Division during 1987 totaled 1,461,714 AF, a 6 percent decrease from 1986 totals. The SWP has no water service contractors who take delivery in the San Luis Field Division. The following tabulation details the components of these CVP water deliveries made in the San Luis Field Division:

Component	Amount (ac-ft)
Delivered from the Joint-Use facilities.	1,461,714
Delivered to the Grass Lands for the Department of Fish and Game.	9,335
Delivered from O'Neill Forebay to Department of Fish and Game.	406
Delivered to Mendota Waterfowl Habitat area for the Department of Fish and Game.	184
Delivered from O'Neill Forebay to the Department of Parks and recreation.	8

Table 14 on page 52 presents a monthly operations summary of the State-Federal San Luis Joint-Use facilities.

Pumping Plants

Total pumping in 1987 at William R. Gianelli Pumping-Generating Plant was 977,000 AF, a 10 percent increase from the amount pumped in 1986. Total water released from San Luis Reservoir to O'Neill Forebay for generation was 1,538,679 AF, a 22 percent increase over the 1986 amount.

Total pumping at Dos Amigos Pumping Plant in 1987 was 3,669,946 AF, an eleven percent increase over the amount pumped in 1986.

Outages and Limitations

The No. 1 penstock and units Nos. 1 and 2 at William R. Gianelli Pumping-Generating Plantwere out of service from April 26 through May 31 for biannual maintenance. The No. 4 penstock and units Nos. 7 and 8 were out of service from October 23 through November 27 for a two-year inspection.

The following individual power circuit breakers (PCB) at the William R. Gianelli Pumping-Generating Plant were out of service for the times and reasons noted:

PCB	Outage Beginning	Outage Ending	Reason
1282	07/22/87	07/24/87	Annual and 5 year preventive maintenance.
2282	08/17/87	08/19/87	Annual maintenance.
	10/15/87	10/23/87	Relay maintenance.
2382	04/04/87	04/17/87	Dry interrupter heads.
	08/10/87	08/12/87	Annual and 5 year preventive maintenance.
2682	08/05/87	08/07/87	Annual and f year preventive maintenance.
	10/27/87	11/20/87	Routine maintenance.
2786	07/28/87	07/30/87	Annual and 5 year preventive maintenance.
	09/15/87	09/17/87	Repair relief valve.
	10/05/87	10/13/87	Relay maintenance.
3482	07/31/87	08/04/87	Annual and 5 year preventive maintenance.
5682	08/13/87	08/17/87	Annual and 5 year preventive maintenance.
7882	08/20/87	08/24/87	Annual and 5 year preventive maintenance.

The following units at the two pumping plants in the San Luis Field Division were out of service for the times and reasons noted. If no date is given in the "Outage Ending" column, the unit remained out of service at the end of 1987:

Unit	Outage Beginning	Outage Ending	Reason
William R. Gianelli Pumping-Generating Plant:			
1	03/18/87	03/20/87	Test & calibrate relays.
	09/28/87	10/02/87	Repair field pole.
2	01/01/87	06/15/87	Annual maintenance.
	10/14/87	11/05/87	Inspect straps, brakes and jacks.
	12/18/87	----	Inspect amortisseur straps.
3	10/20/87	10/26/87	Inspect amortisseur straps.
	12/02/87	12/15/87	Repair field pole amortisseur straps
4	07/03/87	07/06/87	Caulk upstream side of unit #8.
	10/08/87	12/03/87	Inspect headgate.
5	12/17/87	----	Repair amortisseur straps.
6	03/03/87	03/06/87	Bench test unit relays.
	09/14/87	09/22/87	Replace one field pole.
7	03/09/87	03/13/87	Routine maintenance.
	07/03/87	07/06/87	Caulk upstream side of unit #8.
	09/01/87	09/10/87	Replace field poles.
	10/08/87	12/03/87	Inspect headgate.
8	07/03/87	07/06/87	Caulk upstream side.
	10/06/87	----	Annual maintenance.
Dos Amigos Pumping Plant:			
1	11/26/87	11/30/87	Clean and replace oil filters.
2	08/03/87	----	Annual maintenance and rewind unit.
3	09/16/87	09/23/87	Relay testing.
	07/27/87	07/30/87	Reset motor guide bearing clearances.
	08/31/87	09/10/87	Repair dresser coupling.
4	09/10/87	09/21/87	Repack leaking dresser coupling in discharge line.

TABLE 12: SAN LUIS RESERVOIR MONTHLY OPERATION

(in acre-feet except as noted)

MONTH	YEAR	RESERVOIR STORAGE*			INFLOW	OUTFLOW			GAIN (+) LOSS (-)	EVAPORATION	PRECIPITATION (In inches)
		WATER SURFACE ELEVATION (In feet)	STORAGE	MONTHLY STORAGE CHANGE	GIANELLI P-G PLANT PUMPING	GIANELLI P-G PLANT GENERATION	PACHECO TUNNEL	SPILL			
JAN	1987	540.52	1,996,408	79,937	82,697	0	0	0	-2,760	1,490	1.15
	1986	530.30	1,868,710	272,751	272,310	0	0	0	441	942	1.23
FEB	1987	542.47	2,021,105	24,697	25,929	1,392	0	0	160	2,519	2.46
	1986	538.77	1,974,334	105,624	94,870	0	0	0	10,754	1,918	3.94
MAR	1987	542.80	2,025,295	4,190	5,260	0	133	0	-937	4,235	1.89
	1986	542.76	2,024,787	50,453	88,630	43,026	0	0	4,849	3,535	2.75
APR	1987	534.00	1,914,602	-110,693	1,551	109,030	43	0	-3,171	8,950	0.17
	1986	542.84	2,025,803	1,016	63,097	54,645	0	0	-7,436	6,788	0.11
MAY	1987	506.58	1,583,809	-330,793	2,383	329,380	206	0	-3,590	10,610	0.32
	1986	539.02	1,977,482	-48,321	20,596	61,312	0	0	-7,605	11,227	0.00
JUN	1987	460.45	1,077,695	-506,114	0	503,200	3,142	0	228	11,161	0.00
	1986	516.79	1,704,450	-273,032	0	267,688	0	0	-5,344	12,333	0.00
JUL	1987	422.74	715,058	-362,637	0	354,466	7,096	0	-1,075	9,923	0.00
	1986	489.59	1,389,871	-314,579	0	307,062	0	0	-7,517	12,240	0.00
AUG	1987	402.60	543,727	-171,331	17,107	177,566	7,878	0	-2,994	8,487	0.00
	1986	476.74	1,248,961	-140,910	19,297	152,895	0	0	-7,312	10,830	0.00
SEP	1987	419.70	688,082	144,355	170,610	13,149	5,739	0	-7,367	6,252	0.00
	1986	497.69	1,481,259	232,298	247,457	2,968	0	0	-12,191	7,303	0.59
OCT	1987	427.05	753,936	65,854	115,636	39,771	7,355	0	-2,656	4,054	1.11
	1986	510.35	1,628,001	146,742	157,851	0	0	0	-11,109	5,248	0.02
NOV	1987	446.81	940,812	186,876	207,077	10,725	5,117	0	-4,359	1,525	0.37
	1986	520.83	1,753,022	125,021	133,989	0	77	0	-8,891	3,268	0.02
DEC	1987	478.49	1,267,855	327,043	348,750	0	7,394	0	-14,313	1,392	1.99
	1986	534.15	1,916,471	163,449	168,155	0	0	0	-4,706	930	0.93
TOTAL	1987	—	—	-648,616	977,000	1,538,679	44,103	0	-42,834	70,598	9.46
	1986	—	—	320,512	1,266,252	889,596	77	0	-56,067	76,562	9.59

* At end of month.

FIGURE Q: SAN LUIS RESERVOIR OPERATION

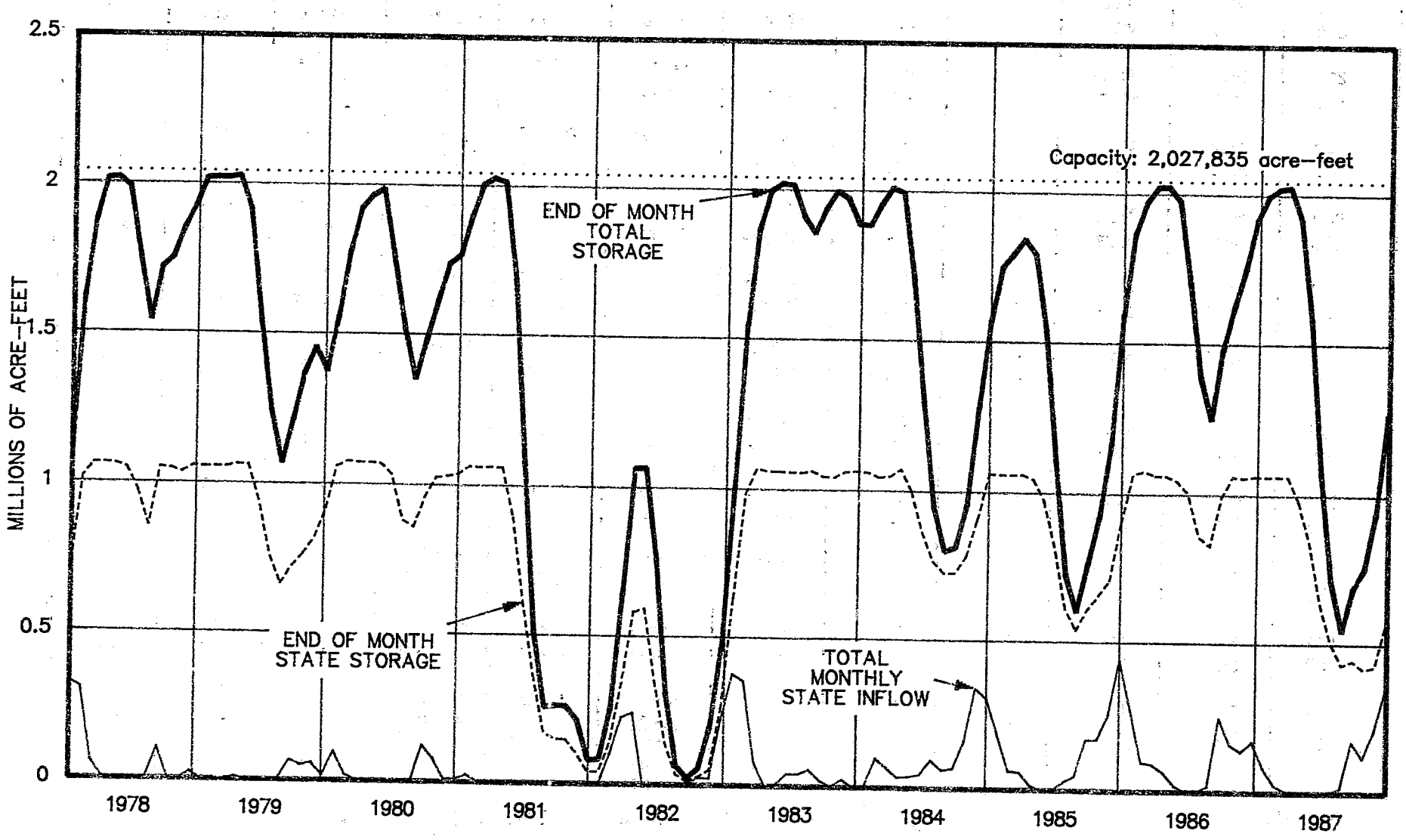


TABLE 13: O'NEILL FOREBAY MONTHLY OPERATION

(in acre-feet except as noted)

MONTH	YEAR	RESERVOIR STORAGE*			INFLOW			OUTFLOW				GAIN (+) LOSS (-)
		WATER SURFACE ELEVATION (in feet)	STORAGE	MONTHLY STORAGE CHANGE	O'NEILL P-G PLANT PUMPING	GIANELLI P-G PLANT GENERATION	CALIFORNIA AQUEDUCT CHECK 12	O'NEILL P-G PLANT GENERATION	GIANELLI P-G PLANT PUMPING	DOS AMIGOS PUMPING	DELIVERIES	
JAN	1987	221.35	46,679	-5,222	208,002	0	120,970	0	82,697	241,987	271	-9,239
	1986	222.01	48,411	129	209,812	0	299,002	0	272,310	227,788	140	-8,447
FEB	1987	219.00	40,584	-6,095	160,614	1,392	141,551	0	25,929	279,612	665	-3,446
	1986	219.81	42,660	-5,751	200,277	0	105,804	0	94,870	206,950	514	-9,498
MAR	1987	219.37	41,528	944	69,874	0	173,598	0	5,260	233,554	1,879	-1,835
	1986	220.97	45,682	3,022	144,526	43,026	41,126	42	88,630	133,662	707	-2,615
APR	1987	222.50	49,713	8,185	84,611	109,030	136,260	0	1,551	312,153	3,715	-4,297
	1986	223.69	52,893	7,211	118,177	54,645	110,463	0	63,097	205,744	1,976	-5,257
MAY	1987	220.23	43,749	-5,964	6,148	329,380	104,154	36,107	2,383	402,422	3,233	-1,501
	1986	220.72	45,027	-7,866	103,601	61,312	171,422	0	20,596	311,525	2,834	-9,246
JUN	1987	221.27	46,469	2,720	0	503,200	99,577	64,740	0	526,209	4,490	-4,618
	1986	220.72	45,027	0	46,973	267,688	162,539	33,669	0	427,483	3,756	-12,292
JUL	1987	222.19	48,889	2,420	5,996	354,466	245,858	5,856	0	584,279	5,155	-8,610
	1986	221.64	47,441	2,414	3,359	307,062	220,987	6,111	0	509,572	4,456	-8,855
AUG	1987	220.24	43,775	-5,114	42,296	177,566	289,306	1,741	17,107	483,528	4,540	-7,366
	1986	221.92	48,176	735	25,728	152,895	312,525	1,271	19,297	459,965	5,404	-4,476
SEP	1987	221.45	46,941	3,166	110,857	13,149	264,121	0	170,610	210,161	2,132	-2,058
	1986	221.58	47,283	-893	107,628	2,968	364,300	0	247,457	223,922	1,711	-2,699
OCT	1987	220.75	45,106	-1,835	117,548	39,771	97,235	1,171	115,636	137,390	1,485	-707
	1986	221.92	48,176	893	124,208	0	201,568	0	157,851	165,816	417	-799
NOV	1987	219.33	41,426	-3,680	208,305	10,725	73,863	0	207,077	81,497	293	-7,706
	1986	221.78	47,809	-367	163,002	0	175,691	0	133,989	203,298	164	-1,609
DEC	1987	222.62	50,033	8,607	244,338	0	292,318	0	348,750	177,154	105	-2,040
	1986	223.32	51,901	4,092	227,171	0	177,828	0	168,155	224,447	178	-8,127
TOTAL	1987	—	—	-1,868	1,258,589	1,538,679	2,038,811	109,615	977,000	3,669,946	27,963	-53,423
	1986	—	—	3,619	1,474,462	889,596	2,343,255	41,093	1,266,252	3,300,172	22,257	-73,920

* At end of month.

TABLE 14: MONTHLY OPERATIONS SUMMARY, STATE-FEDERAL SAN LUIS JOINT-USE FACILITIES
1987

(in acre-feet except as noted)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
Check 12													
State	120,970	141,551	160,397	114,188	104,154	99,577	198,893	184,361	176,878	53,261	73,863	273,649	1,701,742
Federal	0	0	13,201	22,072	0	0	46,965	104,945	87,243	43,974	0	18,669	337,069
Total	120,970	141,551	173,598	136,260	104,154	99,577	245,858	289,306	264,121	97,235	73,863	292,318	2,038,811
O'Neill P-G Plant Amount Pumped													
State	0	0	0	0	0	0	0	0	0	0	0	0	0
Federal	208,002	160,614	69,874	84,611	6,148	0	5,996	42,296	110,857	117,548	208,305	244,338	1,258,589
Total	208,002	160,614	69,874	84,611	6,148	0	5,996	42,296	110,857	117,548	208,305	244,338	1,258,589
Released for Generation													
Federal	0	0	0	0	36,107	64,740	5,856	1,741	0	1,171	0	0	109,615
O'Neill Forebay Storage*													
State	22,800	16,277	19,402	24,300	16,974	12,534	12,212	14,167	27,664	23,090	24,703	26,934	
Federal	23,879	24,307	22,126	25,413	26,775	33,935	36,677	29,608	19,277	22,016	16,723	23,099	
Total	46,679	40,584	41,528	49,713	43,749	46,469	48,889	43,775	46,941	45,106	41,426	50,033	
San Luis Reservoir Storage*													
State	1,061,213	1,062,094	1,061,583	981,311	844,506	643,296	509,182	430,221	444,890	417,020	425,456	569,765	
Federal	935,195	959,011	963,712	933,291	739,303	434,399	205,876	113,506	243,192	336,916	515,356	698,090	
Total	1,996,408	2,021,105	2,025,295	1,914,602	1,583,809	1,077,695	715,058	543,727	688,082	753,936	940,812	1,267,855	
Gianelli Pumping													
State	141	731	4	-16	2,383	0	0	237	31,870	13,362	21,558	152,181	222,451
Federal	82,556	25,198	5,256	1,567	0	0	0	16,870	138,740	102,274	185,519	196,569	754,549
Total	82,697	25,929	5,260	1,551	2,383	0	0	17,107	170,610	115,636	207,077	348,750	977,000
Released for Generation													
State	0	-62	0	78,512	137,214	201,335	133,523	77,551	13,149	39,771	10,725	0	691,718
Federal	0	1,454	0	30,518	192,166	301,865	220,943	100,015	0	0	0	0	846,961
Total	0	1,392	0	109,030	329,380	503,200	354,466	177,566	13,149	39,771	10,725	0	1,538,679
San Felipe Pumping	0	0	133	43	206	3,142	7,096	7,878	5,739	7,355	5,117	7,394	44,103
Dos Amigos Pumping													
State	113,964	145,386	156,259	185,455	245,485	271,812	311,002	274,669	160,528	96,089	57,179	118,734	2,136,562
Federal	128,023	134,226	77,295	126,698	156,937	254,397	273,277	208,859	49,633	41,301	24,318	58,420	1,533,384
Total	241,987	279,612	233,554	312,153	402,422	526,209	584,279	483,528	210,161	137,390	81,497	177,154	3,669,946

* At end of month.

SAN JOAQUIN FIELD DIVISION

Water Deliveries

Of the 1,248,998 AF total SWP water delivered to SWP water service contractors in the San Joaquin Field Division during 1987, about 90 percent was entitlement water, 9 percent was unscheduled water, and one percent was divided between 1982 exchange water, and SWP banking. The largest delivery (1,028,124 AF) was to the Kern County Water Agency (KCWA), which represented 82 percent of the total SWP water delivered within the Division.

Of the total entitlement water delivered in the San Joaquin Field Division, only 117,174 AF was for municipal and industrial purposes. In addition to SWP deliveries, 137,289 AF of CVP water was wheeled through SWP facilities to KCWA's Cross Valley Canal to be delivered to Cross Valley Canal contractors. Table 2 on page 12 presents water deliveries by year with totals to date for individual agencies.

Pumping plants

The table on the right presents the total pumping at the six pumping plants in the San Joaquin Field Division during 1987 and their percent differences from 1986 totals. For more details, see Table 20, pages 74 and 75.

Pumping Plant	1987 Total (ac-ft)	Difference from 1986 (percent)
California Aqueduct:		
Buena Vista	1,042,362	-12
Wheeler Ridge	919,910	-13
Ira J. Chrisman	868,332	-14
A. D. Edmonston	852,317	-13
Coastal Branch:		
Las Perillas	142,455	+3
Badger Hill	142,250	+4

Outages and Limitations

California Aqueduct:

The tables on the right and below present the units at the various pumping plants of the California Aqueduct which were out of service for the times and reasons noted. If no date is given in the "Outage Ending" column, the unit remained out of service at the end of 1987.

Unit	Outage Beginning	Outage Ending	Reason
Buena Vista			
1	09/08/87	10/13/87	Annual maintenance and impellor repair.
4	01/01/87	08/27/87	Annual maintenance and repair impellor and discharge line.
5	04/08/87	04/20/87	Annual relay maintenance.
6	03/16/87	03/20/87	Differential relay repair.
	03/30/87	04/03/87	Routine relay testing.
8	03/20/87	03/23/87	Repair peizometer leak.
	04/17/87	04/20/87	Repair breaker contacts.
Wheeler Ridge			
1	07/09/87	07/24/87	Routine relay maintenance.
3	06/08/87	06/10/87	Annual maintenance.
	06/30/87	07/02/87	Routine relay maintenance.
4	05/28/87	06/04/87	Bench test relays.
5	01/16/87	08/24/87	Annual maintenance and rebuild discharge valve.
7	01/16/87	08/24/87	Annual maintenance and rebuild discharge valve.
8	03/17/87	03/25/87	Annual relay maintenance.
	09/01/87	------	Annual maintenance and rebuild discharge valve.

Unit	Outage Beginning	Outage Ending	Reason
Ira J. Chrisman			
1	09/04/87	09/22/87	Annual relay maintenance.
2	10/01/87	10/14/87	Annual relay maintenance.
3	04/07/87	04/10/87	Repack pump.
	10/14/87	11/10/87	Repair commutator and repair shaft deflection.
4	03/12/87	03/30/87	Repair loose nose cone.
	06/22/87	07/28/87	Discharge line out of service.
	10/20/87	10/29/87	Annual relay maintenance.
5	11/02/87	11/10/87	Annual relay maintenance.
6	03/23/87	03/27/87	Repair suction elbow and impellor nose cone.
	10/13/87	10/30/87	Repack discharge line.
	11/16/87	11/25/87	Annual relay maintenance.
	12/21/87	------	Annual relay maintenance.
7	09/21/87	11/02/87	Repair discharge valve and repack discharge line.
8	02/18/87	06/04/87	Repair nose cone.
	06/15/87	06/18/87	Inspect noise in balance line.
	11/06/87	11/13/87	Repair discharge valve.
	12/10/87	12/18/87	Annual electrical maintenance and routine relay maintenance.
9	11/06/87	11/13/87	Repair discharge valve.
A. D. Edmonston			
1	03/02/87	03/06/87	Annual maintenance.
6	02/25/87	06/17/87	Repair thrust bearing.
7	02/12/87	02/23/87	Repair PCB.
	09/24/87	12/22/87	Repair thrust bearing.
8	06/08/87	06/23/87	Annual maintenance.
9	03/09/87	03/20/87	Vacuum trash racks.
12	02/18/87	02/20/87	Repack heat exchangers and repair oil leak.
	05/04/87	05/08/87	Replace RTDs in thrust bearing oil tub.
13	03/16/87	03/20/87	Maintenance for breaker 1312
	08/17/87	08/19/87	Testing; inspection.
14	05/07/87	05/11/87	Replace thrust bearing RTDs.

Coastal Branch:

The table on the right presents the units at the two pumping plants in the Coastal Branch of the California Aqueduct in the San Joaquin Field Division that were out of service for the times and reasons noted. If no date is given in the "Outage Ending" column, the unit remained out of service at the end of 1987:

Unit	Outage Beginning	Outage Ending	Reason
Las Perillas Pumping Plant			
2	10/28/87	10/30/87	Elective maintenance.
3	11/04/87	11/06/87	Elective maintenance.
5	01/08/87	01/22/87	Annual maintenance.
	09/29/87	09/30/87	Annual maintenance on electrical switch gear.
6	01/21/87	01/29/87	Mechanical annual maintenance.
	10/01/87	10/02/87	Electrical annual maintenance.
Badger Hill Pumping Plant			
1	10/14/87	10/26/87	Mechanical annual maintenance.
2	10/26/87	11/13/87	Mechanical annual maintenance.
3	11/12/87	11/24/87	Mechanical annual maintenance.
4	09/24/87	09/25/87	Electrical annual maintenance.
5	11/24/87	------	Check amortisseur straps.
6	02/18/87	03/20/87	Inspect windings and impellor.
	12/03/87	------	Check amortisseur straps.

SOUTHERN FIELD DIVISION

Water Storage

At the start of 1987, total combined reservoir storage in the Southern Field Division's five reservoirs (Pyramid Lake, Elderberry Forebay, Castaic Lake, Silverwood Lake, and Lake Perris) was 678,789 AF, or 95 percent of the combined capacity (717,251 AF). Combined storage at the end of the year was 654,043 AF, or 91 percent of the combined capacity. In addition, 7,186 AF of natural flow was released through the Project's southern reservoirs in 1987. Summaries of operations for those reservoirs are in pages 72 through 79.

A table of reservoir storages for the Southern Field Division follows:

Reservoir	Operational capacity (ac-ft)	Start of 1987 (ac-ft)	End of 1987 (ac-ft)	Maximum (ac-ft)	Date	Minimum (ac-ft)	Date
Pyramid Lake	169,901	165,955	160,548	167,921	4/5	155,037	3/27
Elderberry Forebay	28,230	18,739	26,037	28,912	10/2	18,739	1/1
Castaic Lake	319,247	298,123	286,608	321,491	3/27	217,648	11/1
Silverwood Lake	73,032	71,939	68,354	73,784	10/22	67,033	12/24
Lake Perris	126,841	124,033	112,496	125,880	4/16	104,066	10/10

Water Deliveries

The total SWP water delivered to SWP water service contractors in the Southern Field Division was 858,583 AF, a 49 percent increase over the amount delivered in 1986. This total includes 6,937 AF of SWP recreation water. Of the total entitlement water delivered within the division, 723,222 AF was for municipal and industrial purposes.

SWP recreation water delivered in 1987 consisted of 4,203 AF to the California Department of Parks and Recreation (121 AF at Silverwood Lake, 1,118 AF at Lake Perris, 29 AF at Pyramid Lake, and 2,935 AF released to maintain a trout fishery in Piru Creek). An additional 2,734 AF was delivered to Los Angeles County Recreation Department at Castaic Lake. Table 2 on page 12 presents water deliveries by year with totals to date for individual agencies.

Outages and Limitations

East Branch:

Units Nos. 1, 2 and 3 transformer at Pearblossom Pumping Plant was out of service from January 4 to 8 to replace a bad current transformer on the "B" phase.

The following individual units were out of service for the times and reasons noted. If no date is given in the "Outage Ending" column, the unit remained out of service at the end of 1987:

Unit	Outage Beginning	Outage Ending	Reason
Pearblossom Pumping Plant:			
1	01/05/87	02/10/87	Annual maintenance.
2	03/09/87	03/12/87	Service discharge valve.
3	02/25/87	04/10/87	Annual maintenance.
	04/16/87	11/06/87	Correct excessive vibration.
4	10/06/87	10/07/87	Recalibrate devise 38.
5	11/17/87	--------	Annual maintenance.
Devil Canyon Powerplant:			
1	12/07/87	12/22/87	Annual maintenance.

West Branch:

The stand-by emergency generator at the Oso Pumping Plant was out of service from October 22 through the end of the year to repair an oil leak.

Oso Pumping Plant's No. 3 discharge line and units Nos. 3,4,5 and 6 were out of service from November 14 to 27 to inspect and repair leaking joints along the pipeline. The No. 5 discharge line and Unit No. 8 were out of service from December 17 to 21 for inspection.

Unit No. 2 transformer at William E. Warne Powerplant was out of service from December 11 to 20 for electrical preventive maintenance.

The following individual units were out of service for the times and reasons noted. If no date is given in the "Outage Ending" column, the unit remained out of service at the end of 1987:

Unit	Outage Beginning	Outage Ending	Reason
Oso Pumping Plant:			
2	07/14/87	07/16/87	Calibrate all unit relays.
	07/27/87	07/30/87	Calibrate relay devises.
	09/28/87	10/28/87	Routine maintenance and bearing testing.
4	08/31/87	09/17/87	Annual maintenance.
5	03/23/87	06/04/87	Annual maintenance and replace impellor.
7	08/18/87	09/03/87	Annual maintenance and repair discharge valve.
William E. Warne Powerplant:			
1	05/04/87	05/19/87	Annual maintenance.
2	06/01/87	07/07/87	Annual maintenance.
	10/19/87	10/29/87	Repair turbine nozzle valve restoring mechanism.

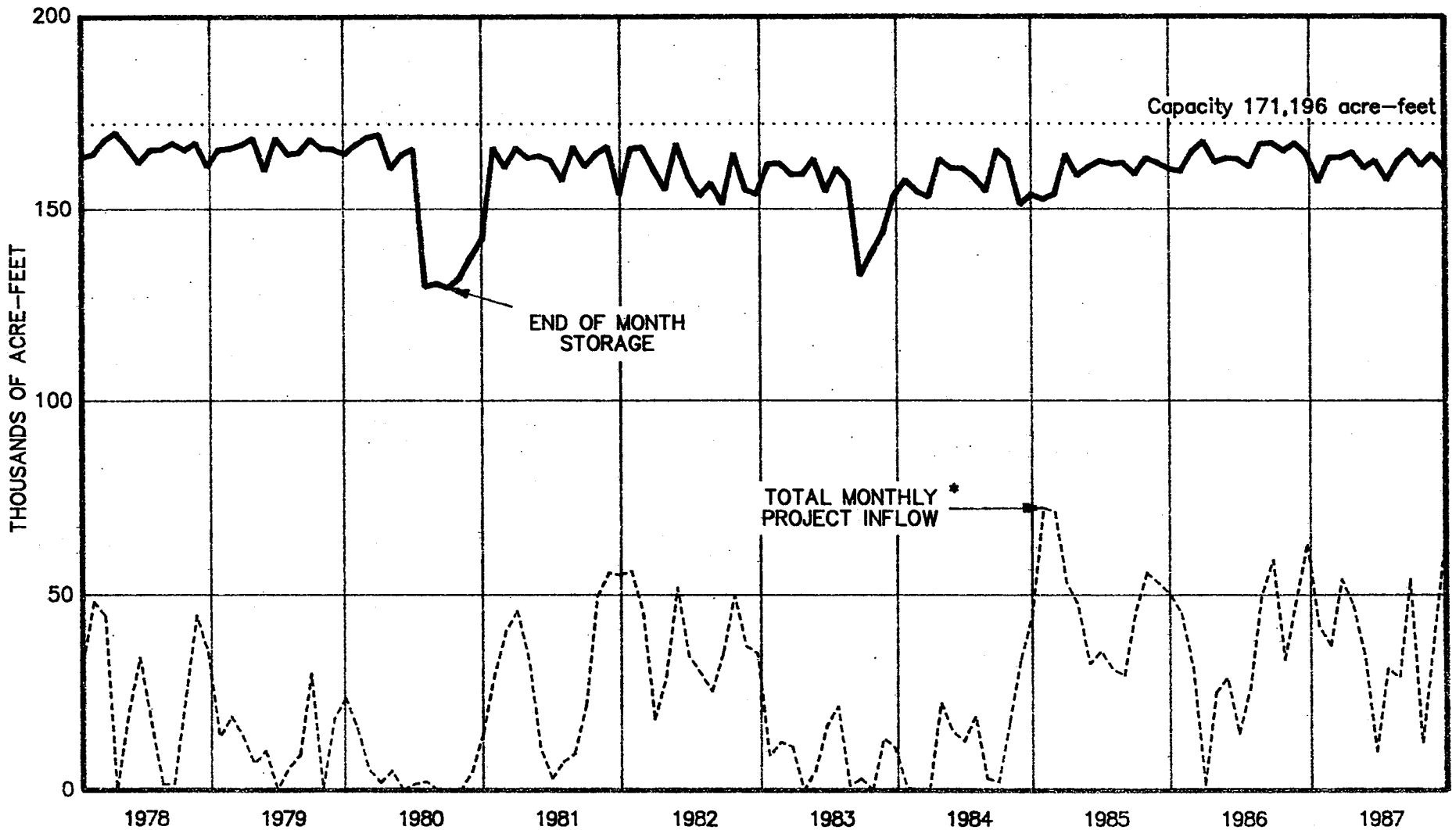
TABLE 15: PYRAMID LAKE MONTHLY OPERATION
1987

(in acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	TOTAL STORAGE	NATURAL INFLOW STORAGE SHARES	STORAGE CHANGE	INFLOW			OUTFLOW				COMPUTED LOSSES (-) GAINS (+)
						PROJECT			TO PIRU CREEK			
					NATURAL	WARNE POWER-PLANT	PUMPBACK 1/	ANGELES TUNNEL	NATURAL INFLOW RELEASE 2/	RECREATION (METERED WATER)	PROJECT WATER FOR FISH ENHANCEMENT	
JAN	2567.68	156,918	344	-7,062	714	41,846	0	46,387	611	0	0	-2,624
FEB	2572.67	163,111	411	6,193	629	36,898	215	28,732	562	0	0	-2,255
MAR	2572.69	163,136	690	25	1,467	54,015	2,471	54,325	1,188	0	0	-2,415
APR	2573.63	164,447	254	1,311	556	47,212	1,215	44,419	992	6	0	-2,255
MAY	2570.56	160,473	36	-3,974	480	34,021	8,714	43,612	698	4	0	-2,875
JUN	2572.01	162,283	0	1,810	210	9,972	20,831	27,111	246	5	544	-1,297
JUL	2568.07	157,396	0	-4,887	151	31,098	27,882	61,470	151	4	612	-1,781
AUG	2572.02	162,296	0	4,900	126	28,705	22,974	44,561	126	5	714	-1,499
SEP	2574.17	165,004	0	2,708	199	54,107	2,046	50,289	199	4	614	-2,538
OCT	2571.05	161,083	0	-3,921	294	11,983	12,374	26,451	294	1	451	-1,375
NOV	2573.35	163,967	340	2,884	1,009	37,523	9,196	43,850	669	0	0	-325
DEC	2570.65	160,585	857	-3,382	971	62,403	5,670	71,807	454	0	0	-165
TOTAL	—	—	—	-3,395	6,806	449,783	113,588	543,014	6,190	29	2,935	-21,404

1/ Pumpback by Los Angeles Department of Water and Power (LADWP) from Elderberry Forebay thru Castaic powerplant.
2/ Portion of these amounts used to satisfy fishery enhancement agreement.

FIGURE R: PYRAMID LAKE OPERATION



* Excludes pumpback by LADWP through Castaic Powerplant.

TABLE 16: ELDERBERRY FOREBAY MONTHLY OPERATION
1987

(in acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	TOTAL STORAGE*	STORAGE CHANGE	INFLOW		OUTFLOW			COMPUTED LOSSES (-) GAINS (+)
				CASTAIC P.P. GENERATION	NATURAL	TO CASTAIC LAKE		PUMPBACK TO PYRAMID LAKE 1/	
						NATURAL	PROJECT		
JAN	1,526.01	26,113	7,374	46,387	42	42	38,885	0	-128
FEB	1,516.99	22,258	-3,855	28,732	35	35	32,768	215	396
MAR	1,521.32	24,066	1,808	54,325	71	71	50,641	2,471	595
APR	1,516.13	21,908	-2,158	44,419	17	17	45,526	1,215	164
MAY	1,527.59	26,825	4,917	43,612	0	0	30,455	8,714	474
JUN	1,520.57	23,748	-3,077	27,111	0	0	9,472	20,831	115
JUL	1,526.40	26,288	2,540	61,470	0	0	30,884	27,882	-164
AUG	1,518.86	23,029	-3,259	44,561	0	0	24,685	22,974	-161
SEP	1,515.91	21,818	-1,211	50,289	0	0	49,477	2,046	23
OCT	1,524.67	25,519	3,701	26,451	0	0	10,330	12,374	-46
NOV	1,517.90	22,632	-2,887	43,850	14	14	37,099	9,196	-442
DEC	1,525.84	26,037	3,405	71,807	46	46	66,947	5,670	4,215
TOTAL	—	—	7,298	543,014	225	225	427,169	113,588	5,041

* At end of month.

1/ Pumpback by Los Angeles Department of Water and Power (LADWP) thru Castaic Power Plant.

TABLE 17: CASTAIC LAKE MONTHLY OPERATION

1987

(in acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	TOTAL STORAGE	NATURAL INFLOW STORAGE SHARES	STORAGE CHANGE	INFLOW			OUTFLOW			DISPOSITION OF NATURAL INFLOW		COMPUTED LOSSES (-) GAINS (+)
					NATURAL	FROM ELDERBERRY FOREBAY		DELIVERIES		RELEASED TO CASTAIC LAGOON	RELEASED FROM CASTAIC AFTERBAY		
						NATURAL	PROJECT	1/ ENTITLE-MENT	RECREA-TION		SURFACE	SUBSURFACE	
JAN	1506.93	305,956	-42	6,660	146	42	38,885	32,744	14	0	0	146	345
FEB	1506.23	304,444	-52	-1,512	116	35	32,768	35,335	14	196	0	141	1,114
MAR	1511.98	316,990	-185	12,546	163	71	50,641	38,078	26	82	0	101	-143
APR	1511.21	315,293	0	-1,697	80	17	45,526	47,165	610	282	0	282	737
MAY	1503.68	298,976	0	-16,317	26	0	30,455	46,849	359	26	0	26	436
JUN	1487.76	266,139	0	-32,837	3	0	9,472	42,033	311	3	0	3	35
JUL	1484.61	259,891	0	-6,248	0	0	30,884	36,645	332	0	0	0	-155
AUG	1475.37	242,030	0	-17,861	0	0	24,685	41,946	471	0	0	0	-129
SEP	1478.44	247,888	0	5,858	0	0	49,477	42,864	537	0	0	0	-218
OCT	1462.79	218,799	0	-29,089	38	0	10,330	40,496	60	0	0	38	1,099
NOV	1473.64	238,762	-21	19,963	219	14	37,099	16,849	0	0	0	212	-520
DEC	1497.79	286,567	-172	47,805	226	46	66,947	12,448	0	234	0	121	-6,732
TOTAL	---	---	---	-12,729	1,017	225	427,169	433,452	2,734	823	0	1,070	-4,131

1/ Includes 16,167 ac-ft to C.L.W.A. and 417,285 ac-ft to M.W.D.

FIGURE S: CASTAIC LAKE OPERATION

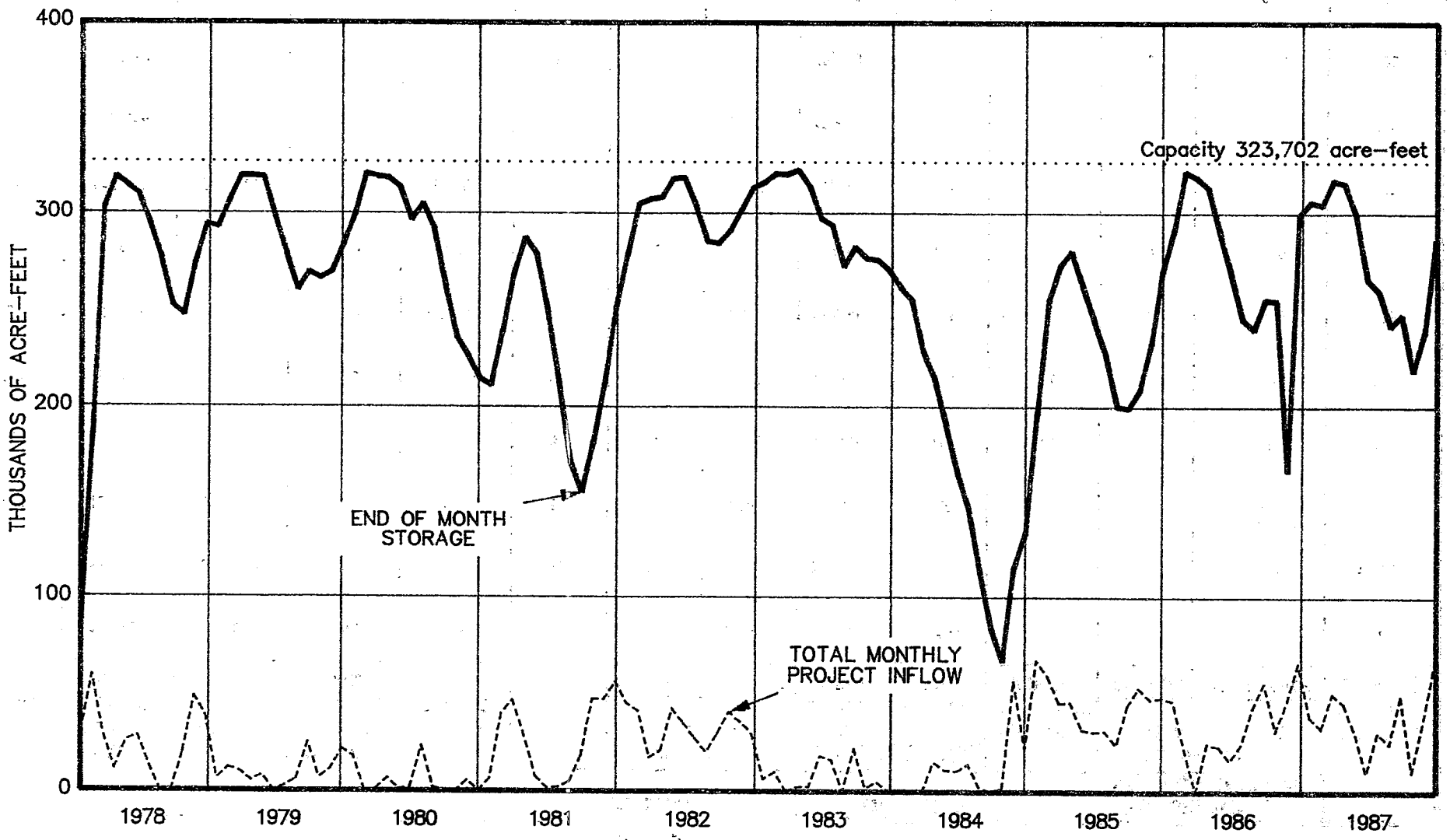


TABLE 18: SILVERWOOD LAKE MONTHLY OPERATION
1987
(in acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE	STORAGE CHANGE	NATURAL INFLOW STORAGE SHARES	INFLOW		OUTFLOW			1/ LOS FLORES RANCH EXCHANGE	COMPUTED LOSSES (-) GAINS (+)
					PROJECT	NATURAL STREAM FLOW	PROJECT (CLAWA) TURNOUT	PROJECT SAN BERNARDINO TUNNEL	NATURAL TO MOJAVE RIVER		
JAN	3351.02	71,140	-1,086	-338	13,980	682	140	16,154	19	488	565
FEB	3351.12	71,235	95	273	30,130	221	120	31,777	13	273	1,654
MAR	3352.18	72,245	1,010	840	15,810	768	118	17,099	12	189	1,661
APR	3352.45	72,503	258	923	42,790	419	117	43,058	13	323	237
MAY	3351.92	71,997	-506	690	61,010	113	161	62,560	14	352	1,106
JUN	3352.10	72,168	171	428	34,890	15	190	35,222	13	264	691
JUL	3351.30	71,406	-762	239	33,520	0	231	32,665	13	176	-1,373
AUG	3351.06	71,178	-228	199	46,610	0	261	45,272	13	27	-1,292
SEP	3351.84	71,920	742	186	36,410	0	214	34,543	13	0	-898
OCT	3352.38	72,628	708	216	26,900	44	172	25,645	14	0	-405
NOV	3351.74	71,825	-803	382	6,125	762	124	6,308	21	575	-1,237
DEC	3348.10	68,400	-3,425	272	9,520	396	122	12,854	15	491	-350
TOTAL	—		-3,826	—	357,695	3,420	1,970	363,157	173	3,158	359

1/ Project water delivered from Mojave Siphon in exchange for like amount of natural streamflow into lake.

FIGURE T: SILVERWOOD LAKE OPERATION

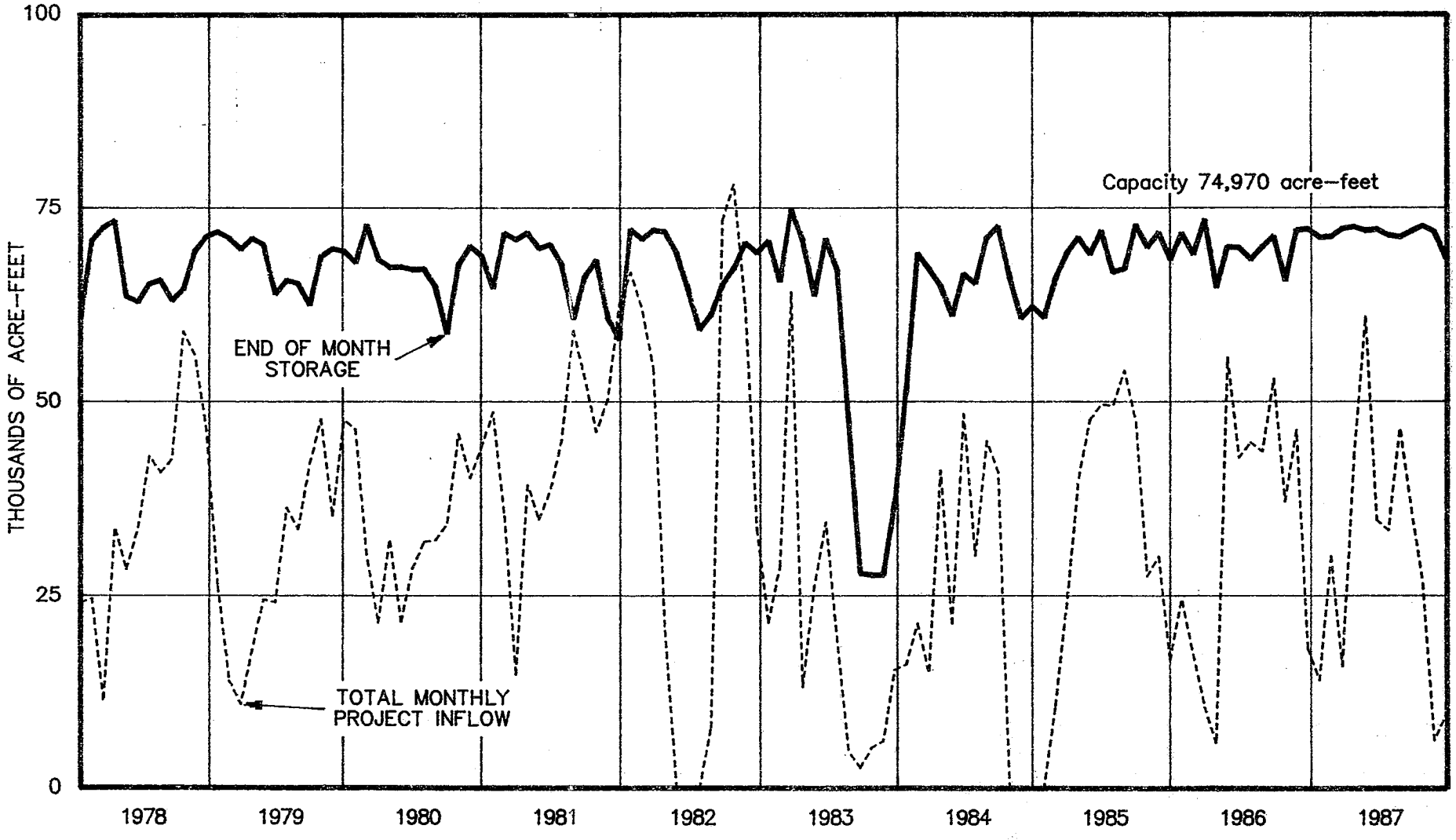


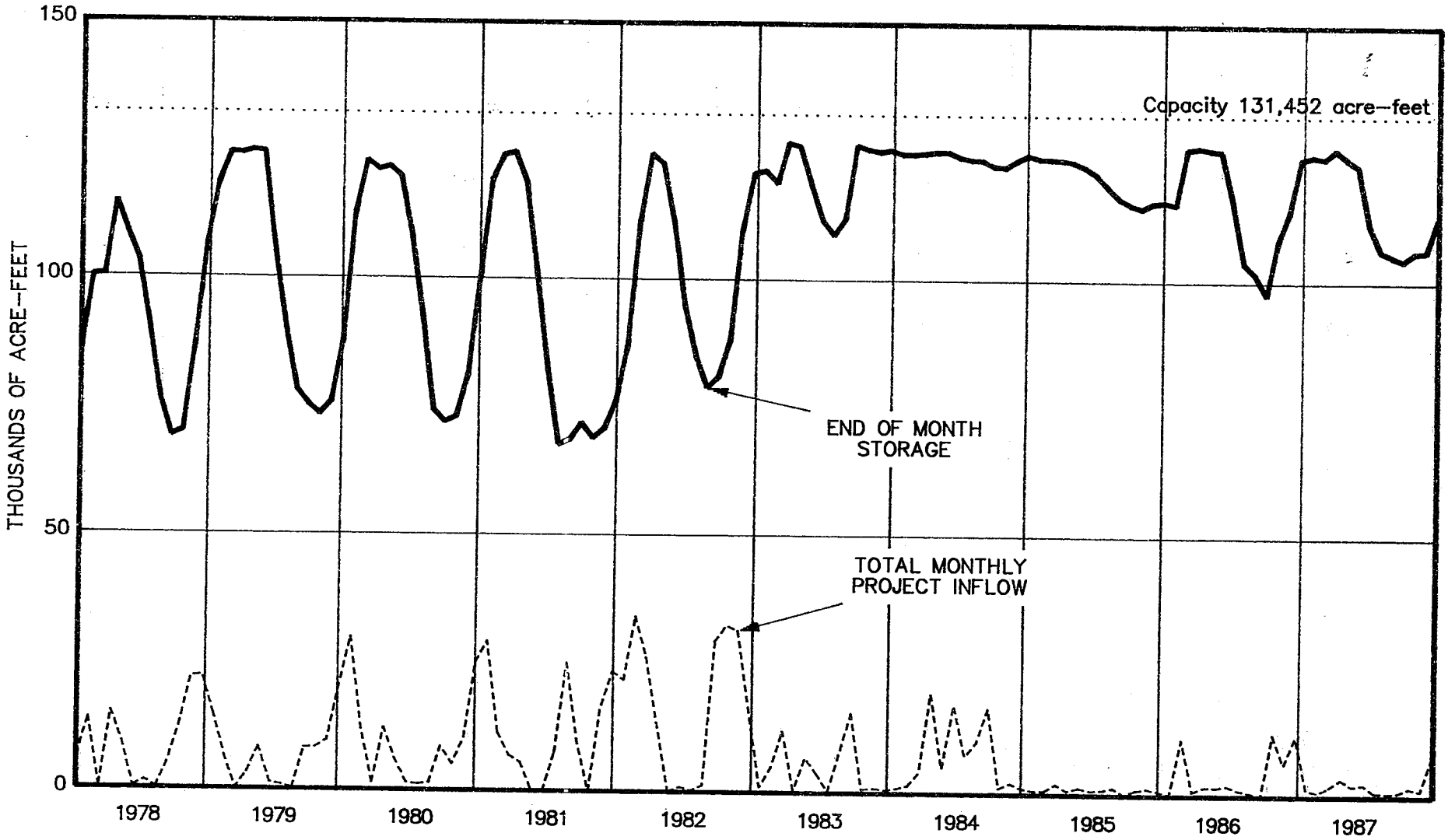
TABLE 19: LAKE PERRIS MONTHLY OPERATION

1987

(in acre-feet except as noted)

MONTH	WATER SURFACE ELEVATION (in feet)	TOTAL STORAGE	STORAGE CHANGE	INFLOW	OUTFLOW	COMPUTED LOSSES (-) GAINS (+)
JAN	1,596.95	124,442	591	1,409	421	-397
FEB	1,586.77	124,033	-409	820	392	-837
MAR	1,587.50	125,697	1,664	1,994	438	108
APR	1,586.72	123,919	-1,778	3,498	2,877	-2,399
MAY	1,586.09	122,491	-1,428	2,149	3,337	-240
JUN	1,581.12	111,446	-11,045	2,504	12,657	-892
JUL	1,578.76	106,332	-5,114	817	5,412	-519
AUG	1,578.28	105,304	-1,028	695	536	-1,187
SEP	1,577.89	104,471	-833	883	510	-1,206
OCT	1,578.62	106,032	1,561	1,816	433	178
NOV	1,578.71	106,225	193	1,279	369	-717
DEC	1,581.60	112,496	6,271	7,710	371	-1,068
TOTAL	---	---	-11,355	25,574	27,753	-9,176

FIGURE U: LAKE PERRIS OPERATION



APPENDICES

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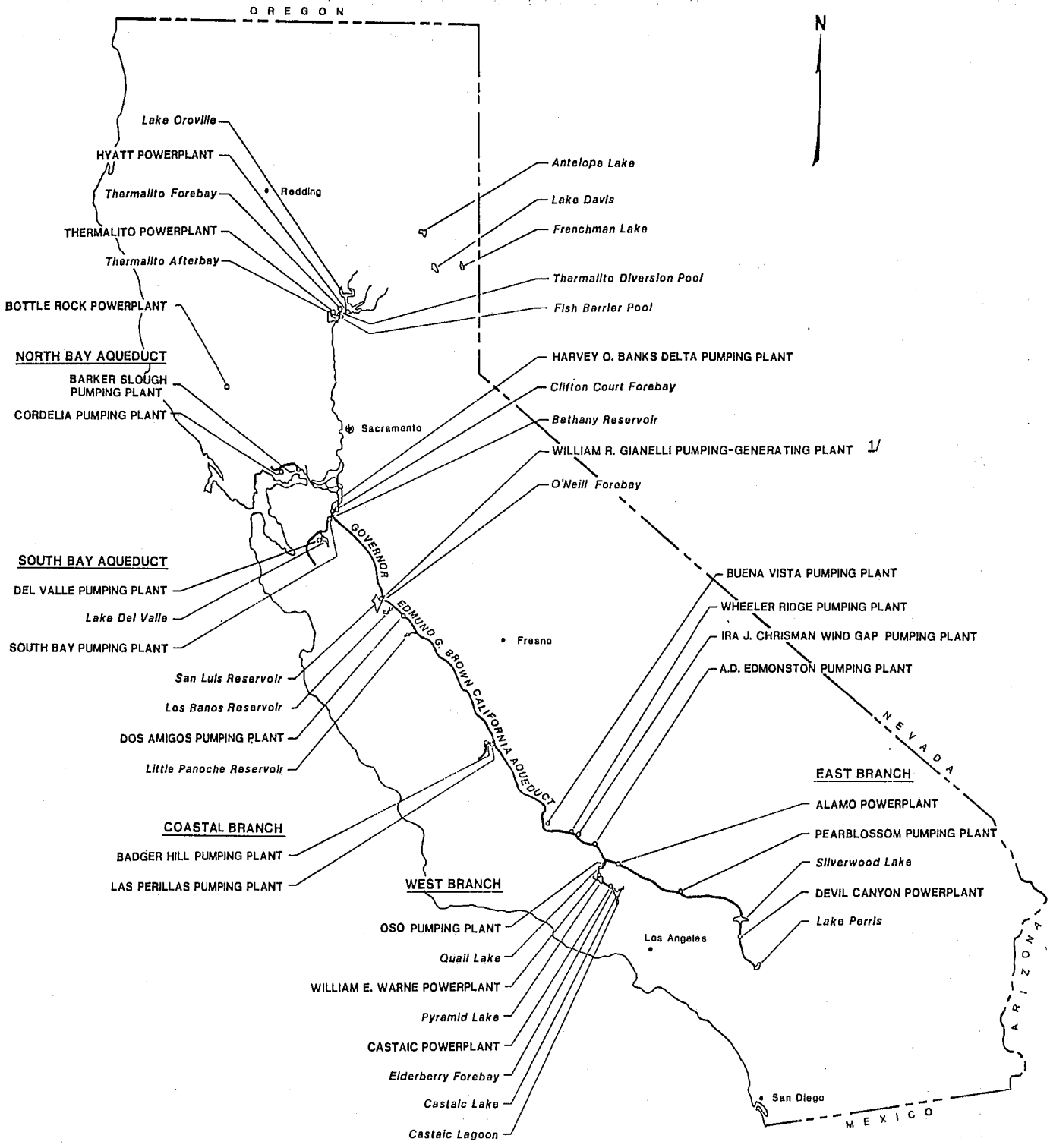
SUMMARY OF

AQUEDUCT OPERATIONS

APPENDIX I

MAP 3
PROJECT FACILITIES



1/ William R. Gianelli Pumping-Generating Plant, previously known as San Luis Pumping-Generating Plant, will be the name designating this facility throughout this report.

TABLE 20: SUMMARY OF GOVERNOR EDMUND
1987
(in acre-feet)

DESCRIPTION	JAN	FEB	MAR	APR	MAY	JUN
DELTA FIELD DIVISION						
		Note: North Bay Aqueduct, South Bay Aqueduct, and Lake Del Valle they are shown here				
North Bay Aqueduct						
Pumped at Cordelia Interim Pumping Plant	322	125	162	450	681	848
Delivered to Contracting Agencies	322	130	163	448	681	848
Change in Storage	0	-5	-1	2	0	0
Computed Losses (-), Gains (+)	0	0	0	0	0	0
California Aqueduct						
Pumped at Harvey O. Banks Delta Pumping Plant	132,326	151,234	189,646	153,282	122,880	118,977
Pumped at South Bay Pumping Plant	11,496	9,221	15,907	15,879	16,946	16,675
Delivered to Contracting Agencies	160	295	179	926	893	1,272
Outflow at Check 12	120,970	141,551	173,598	136,260	104,154	99,577
Change in Storage	199	-189	-23	226	-420	158
Computed Losses (-), Gains (+)	499	-356	15	9	-1,307	-1,295
South Bay Aqueduct						
Pumped at South Bay Pumping Plant	11,496	9,221	15,907	15,879	16,946	16,675
Inflow from Lake Del Valle	0	18	0	0	57	0
Outflow (Pumped into Lake Del Valle)	0	0	5,679	5,752	2,564	0
Delivered to Contracting Agencies Project Water Only	11,177	7,872	9,135	9,783	14,429	16,665
Del Valle Natural Inflow Exchanged and Released from Aqueduct	309	1,339	1,083	327	0	0
Del Valle Natural Inflow Released from Aqueduct	0	18	0	0	0	0
Del Valle Stored Water Released	0	0	0	0	0	0
Del Valle Stored Exchange and Released from Aqueduct	0	0	0	0	0	0
Change in Storage	0	0	0	0	0	0
Computed Losses (-), Gains (+)	-10	-10	-10	-17	-10	-10
Lake Del Valle Operation:						
End-of-Month Storage (State)	25,311	26,585	33,243	39,085	41,049	40,633
Change in Storage	261	1,274	6,658	5,842	1,964	-416
SAN LUIS FIELD DIVISION						
O'Neill Forebay Operation						
End-of-Month Storage	46,679	40,584	41,528	49,713	43,749	46,469
Inflow, California Aqueduct	120,970	141,551	173,598	136,260	104,154	99,577
Inflow, O'Neill P.- G. Plant	208,002	160,614	69,874	84,611	6,148	0
Inflow, Gianelli P.- G. Plant	0	1,392	0	109,030	329,380	503,200
Delivered to Federal Customers	268	649	1,790	3,665	3,221	4,466
Delivered to Dept. of Parks and Rec. (State)	0	1	0	1	1	1
Delivered to Dept. of Fish and Game (State)	3	15	89	49	11	23
Outflow, O'Neill P.- G. Plant	0	0	0	0	36,107	64,740
Outflow, Gianelli P.- G. Plant	82,697	25,929	5,260	1,551	2,383	0
Outflow, Dos Amigos P.P.	241,987	279,612	233,554	312,153	402,422	526,209
Change in Storage	-5,222	-6,095	944	8,185	-5,964	2,720
Computed Losses (-), Gains (+)	-9,239	-3,446	-1,835	-4,297	-1,501	-4,618
San Luis Reservoir Operation						
State End-of-Month Storage	1,061,213	1,062,094	1,061,583	981,311	844,506	643,296
Total End-of-Month Storage	1,996,408	2,021,105	2,025,295	1,914,602	1,583,809	1,077,695
Inflow, Gianelli P.- G. Plant	82,697	25,929	5,260	1,551	2,383	0
Outflow, Gianelli P.- G. Plant	0	1,392	0	109,030	329,380	503,200
Pacheco Tunnel Diversion	0	0	133	43	206	3,142
Change in Storage (Total)	79,937	24,697	4,190	-110,693	-330,793	-506,114
Computed Losses (-), Gains (+)	-2,760	160	-937	-3,171	-3,590	228

G. BROWN CALIFORNIA AQUEDUCT OPERATION
1987
(in acre-feet)

JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	DESCRIPTION
							DELTA FIELD DIVISION
are not within the Edmond G. Brown California Aqueduct, for simplicity.							North Bay Aqueduct
926	913	903	816	760	787	7,693	Pumped at Cordelia Interim Pumping Plant
923	922	893	823	754	786	7,693	Delivered to Contracting Agencies
3	-9	10	-7	6	1	0	Change in Storage
0	0	0	0	0	0	0	Computed Losses (-), Gains (+)
							California Aqueduct
265,122	305,233	272,233	104,091	81,555	298,204	2,194,783	Pumped at Harvey O. Banks Delta Pumping Plant
16,779	14,258	7,312	6,729	8,359	6,362	145,923	Pumped at South Bay Pumping Plant
1,408	760	346	105	8	38	6,390	Delivered to Contracting Agencies
245,858	289,306	264,121	97,235	73,863	292,318	2,038,811	Outflow at Check 12
369	-2	-142	401	-128	-206	243	Change in Storage
-708	-911	-596	379	547	308	-3,416	Computed Losses (-), Gains (+)
							South Bay Aqueduct
16,779	14,258	7,312	6,729	8,359	6,362	145,923	Pumped at South Bay Pumping Plant
0	1,814	6,563	6,314	247	13	15,026	Inflow from Lake Del Valle
0	0	0	0	0	0	13,995	Outflow (Pumped into Lake Del Valle)
16,769	16,062	13,865	13,033	8,596	6,359	143,745	Delivered to Contracting Agencies Project Water Only
0	0	0	0	0	0	3,058	Del Valle Natural Inflow Exchanged and Released from Aqueduct
0	0	0	0	0	13	31	Del Valle Natural Inflow Released from Aqueduct
0	0	0	0	0	0	0	Del Valle Stored Water Released
0	0	0	0	0	0	0	Del Valle Stored Exchange and Released from Aqueduct
0	0	0	0	0	0	0	Change in Storage
-10	-10	-10	-10	-10	-3	-120	Computed Losses (-), Gains (+)
							Lake Del Valle Operation:
40,141	37,964	31,201	24,630	24,357	24,440	---	End-of-Month Storage (State)
-492	-2,177	-6,763	-6,571	-273	83	-610	Change in Storage
							SAN LUIS FIELD DIVISION
							O'Neill Forebay Operation
48,889	43,775	46,941	45,106	41,426	50,033	---	End-of-Month Storage
245,858	289,306	264,121	97,235	73,863	292,318	2,038,811	Inflow, California Aqueduct
5,996	42,296	110,857	117,548	208,305	244,338	1,258,589	Inflow, O'Neill P.- G. Plant
354,466	177,566	13,149	39,771	10,725	0	1,538,679	Inflow, Gianelli P.- G. Plant
5,107	4,502	2,081	1,428	267	105	27,549	Delivered to Federal Customers
1	1	1	0	1	0	8	Delivered to Dept. of Parks and Rec. (State)
47	37	50	57	25	0	406	Delivered to Dept. of Fish and Game (State)
5,856	1,741	0	1,171	0	0	109,615	Outflow, O'Neill P.- G. Plant
0	17,107	170,610	115,636	207,077	348,750	977,000	Outflow, Gianelli P.- G. Plant
584,279	483,528	210,161	137,390	81,497	177,154	3,669,946	Outflow, Dos Amigos P.P.
2,420	-5,114	3,166	-1,835	-3,680	8,607	-1,868	Change in Storage
-8,610	-7,366	-2,058	-707	-7,706	-2,040	-53,423	Computed Losses (-), Gains (+)
							San Luis Reservoir Operation
509,182	430,221	444,890	417,020	425,456	569,765	---	State End-of-Month Storage
715,058	543,727	688,082	753,936	940,812	1,267,855	---	Total End-of-Month Storage
0	17,107	170,610	115,636	207,077	348,750	977,000	Inflow, Gianelli P.- G. Plant
354,466	177,566	13,149	39,771	10,725	0	1,538,679	Outflow, Gianelli P.- G. Plant
7,096	7,878	5,739	7,355	5,117	7,394	44,103	Pacheco Tunnel Diversion
-362,637	-171,331	144,355	65,854	186,876	327,043	-648,616	Change in Storage (Total)
-1,075	-2,994	-7,367	-2,656	-4,359	-14,313	-42,834	Computed Losses (-), Gains (+)

TABLE 20: SUMMARY OF GOVERNOR EDMUND 1987

(in acre-feet)

DESCRIPTION	JAN	FEB	MAR	APR	MAY	JUN
SAN LUIS FIELD DIVISION (Cont.)						
California Aqueduct (Pools 14 thru 21)						
Inflow, Dos Amigos P.P.(State)	113,964	145,386	156,259	185,455	245,485	271,813
Inflow, Dos Amigos P.P.(Federal)	128,023	134,226	77,295	126,698	156,937	254,396
Inflow, Floodwater	0	0	0	0	0	0
Delivered to Dept. of Fish and Game (State)	13	25	22	11	4	18
Delivered to Federal Customers	127,950	134,312	67,212	107,959	147,256	243,555
Outflow, Check 21 (State)	113,601	151,414	160,676	188,869	251,379	275,564
Outflow, Check 21 (Federal)	0	4,542	13,287	22,211	13,888	14,458
Evaporation	282	331	551	1,166	1,436	1,688
Change in Storage	289	-342	-474	843	-969	914
Computed Losses (-), Gains (+)	148	10,670	7,720	8,906	10,572	9,988
SAN JOAQUIN FIELD DIVISION						
California Aqueduct, Check 21 to Buena Vista Pumping Plant						
Inflow, Check 21 (state)	113,601	151,414	160,676	188,869	251,379	275,564
Inflow, Check 21 (Federal)	0	4,542	13,287	22,211	13,888	14,458
Inflow, Kern River Intertie (State)	0	0	0	0	0	0
Kern Water - Bank-A	3,788	3,713	0	0	0	0
Delivered to Contracting State Agencies	41,688	54,080	55,965	58,519	101,478	160,704
Delivered to Federal Customers	0	4,542	13,287	22,211	13,851	14,333
Delivered for Repayment of Pre-consolidation Water	0	0	0	0	0	0
Outflow, Buena Vista P.P.	59,266	81,934	92,796	108,997	122,554	83,665
Coastal Br. Diversion	6,005	6,168	7,762	14,291	20,290	23,860
Change in Storage	-233	-218	182	31	568	-654
Computed Losses (-), Gains (+)	-3,087	-5,737	-3,971	-7,031	-6,526	-8,114
California Aqueduct, Buena Vista P.P. to Wheeler Ridge P.P.						
Inflow, Buena Vista P.P.	59,266	81,934	92,796	108,997	122,554	83,665
Delivered to Contracting State Agencies	2,510	10,664	16,261	9,025	13,424	23,434
Outflow, Wheeler Ridge P.P.	57,721	72,505	78,538	101,738	111,245	62,196
Change in Storage	-41	-207	268	133	-25	32
Computed Losses (-), Gains (+)	924	1,028	2,271	1,899	2,090	1,997
California Aqueduct, Wheeler Ridge to Ira J. Chrisman Wind Gap P.P.						
Inflow, Wheeler Ridge P.P.	57,721	72,505	78,538	101,738	111,245	62,196
Delivered to Contracting State Agencies	178	1,144	2,717	3,796	6,258	5,504
Outflow, Ira J. Chrisman Wind Gap P.P.	57,740	70,796	74,183	96,655	103,140	55,114
Change in Storage	61	-4	10	-77	58	-27
Computed Losses (-), Gains (+)	258	-569	-1,628	-1,364	-1,789	-1,605
California Aqueduct, Ira J. Chrisman Wind Gap P.P. to A.D. Edmunston P.P.						
Inflow, Ira J. Chrisman Wind Gap P.P.	57,740	70,796	74,183	96,655	103,140	55,114
Delivered to Contracting State Agencies	11	242	792	1,210	1,817	1,963
Outflow, A.D. Edmunston P.P.	56,949	70,221	72,719	94,589	100,379	52,455
Change in Storage	-54	-21	-66	-45	38	79
Computed Losses (-), Gains (+)	-834	-354	-738	-901	-906	-617
Coastal Branch, California Aqueduct						
Inflow, Las Perillas P.P.	6,005	6,168	7,762	14,291	20,290	23,860
Delivered to Contracting State Agencies	5,670	5,682	7,194	13,140	18,711	21,130
Delivered to Federal Customers	0	0	0	0	37	125
Change in Storage	-3	-2	12	-16	28	-10
Computed Losses (-), Gains (+)	-338	-488	-556	-1,167	-1,514	-2,615

G. BROWN CALIFORNIA AQUEDUCT OPERATION
1987
(in acre-feet)

JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	DESCRIPTION
							SAN LUIS FIELD DIVISION (Cont.)
							California Aqueduct (Pools 14 thru 21)
311,002	274,669	160,528	96,089	57,179	118,734	2,136,563	Inflow, Dos Amigos P.P.(State)
273,277	208,859	49,633	41,301	24,318	58,420	1,533,383	Inflow, Dos Amigos P.P.(Federal)
0	0	0	0	0	0	0	Inflow, Floodwater
16	16	15	16	15	13	184	Delivered to Dept. of Fish and Game (State)
262,553	192,412	40,833	35,034	21,963	53,697	1,434,736	Delivered to Federal Customers
317,270	286,733	163,030	97,103	60,582	117,732	2,183,953	Outflow, Check 21 (State)
15,973	25,931	10,435	7,044	3,622	5,898	137,289	Outflow, Check 21 (Federal)
1,696	1,664	1,214	758	268	224	11,278	Evaporation
167	-454	-486	-45	-1,835	2,455	63	Change in Storage
13,396	22,774	4,880	2,520	3,118	2,865	97,557	Computed Losses (-), Gains (+)
							SAN JOAQUIN FIELD DIVISION
							California Aqueduct, Check 21 to Buena Vista Pumping Plant
317,270	286,733	163,030	97,103	60,582	117,732	2,183,953	Inflow, Check 21 (state)
15,973	25,931	10,435	7,044	3,622	5,898	137,289	Inflow, Check 21 (Federal)
0	0	0	0	0	0	0	Inflow, Kern River Intertie (State)
0	0	0	0	0	0	7,501	Kern Water - Bank-A
176,776	142,220	47,258	36,899	12,600	38,238	926,425	Delivered to Contracting State Agencies
15,789	25,836	10,435	7,044	3,582	5,898	136,808	Delivered to Federal Customers
0	0	0	0	0	0	0	Delivered for Repayment of Pre-consolidation Water
108,932	112,874	103,477	48,663	44,143	75,060	1,042,361	Outflow, Buena Vista P.P.
26,312	18,786	8,878	8,252	907	944	142,455	Coastal Br. Diversion
-134	394	-162	398	-454	102	-180	Change in Storage
-5,568	-12,554	-3,579	-2,891	-3,426	-3,388	-65,872	Computed Losses (-), Gains (+)
							California Aqueduct, Buena Vista P.P. to Wheeler Ridge P.P.
108,932	112,874	103,477	48,663	44,143	75,060	1,042,361	Inflow, Buena Vista P.P.
30,058	25,107	5,198	3,211	268	612	139,772	Delivered to Contracting State Agencies
81,450	89,483	100,078	46,280	43,888	74,798	919,920	Outflow, Wheeler Ridge P.P.
-140	228	-143	55	154	-18	296	Change in Storage
2,436	1,944	1,656	883	167	332	17,627	Computed Losses (-), Gains (+)
							California Aqueduct, Wheeler Ridge to Ira J. Chrisman Wind Gap P.P.
81,450	89,483	100,078	46,280	43,888	74,798	919,920	Inflow, Wheeler Ridge P.P.
6,549	3,646	2,652	2,723	305	1,486	36,958	Delivered to Contracting State Agencies
73,296	84,023	95,998	42,226	42,966	72,697	868,834	Outflow, Ira J. Chrisman Wind Gap P.P.
12	3	5	-18	26	14	63	Change in Storage
-1,593	-1,811	-1,423	-1,349	-591	-601	-14,065	Computed Losses (-), Gains (+)
							California Aqueduct, Ira J. Chrisman Wind Gap P.P. to A.D. Edmunston P.P.
73,296	84,023	95,998	42,226	42,966	72,697	868,834	Inflow, Ira J. Chrisman Wind Gap P.P.
2,385	1,627	1,423	748	5	177	12,400	Delivered to Contracting State Agencies
70,527	82,505	94,304	41,883	43,198	72,588	852,317	Outflow, A.D. Edmunston P.P.
-21	-22	-31	129	-10	-36	-60	Change in Storage
-405	87	-302	534	227	32	-4,177	Computed Losses (-), Gains (+)
							Coastal Branch, California Aqueduct
26,312	18,786	8,878	8,252	907	944	142,455	Inflow, Las Perillas P.P.
23,843	17,528	8,438	7,789	654	874	130,653	Delivered to Contracting State Agencies
184	95	0	0	0	0	441	Delivered to Federal Customers
-11	-7	11	-44	39	-7	-10	Change in Storage
-2,296	-1,170	-429	-507	-214	-77	-11,371	Computed Losses (-), Gains (+)

TABLE 20: SUMMARY OF GOVERNOR E
1987

(in acre-feet)

DESCRIPTION	JAN	FEB	MAR	APR	MAY	JUN
SOUTHERN FIELD DIVISION						
California Aqueduct, A.D. Edmonston P.P. to Junction of West Branch						
Inflow, A.D. Edmonston P.P.	56,949	70,221	72,719	94,589	100,379	52,455
Change in Storage	-16	9	-2	-8	13	-11
Computed Losses (-), Gains (+)	12	19	7	34	47	14
Outflow, West Branch	41,214	36,644	53,105	46,742	34,670	9,865
Outflow, East Branch	15,763	33,587	19,623	47,889	65,743	42,615
California Aqueduct, Junction of West Branch to Pearblossom P.P.						
Inflow (Aqueduct)	15,763	33,587	19,623	47,889	65,743	42,615
Change in Storage	-215	123	-153	687	-32	-1
Delivered to Contracting Agencies	1,134	1,313	2,262	3,721	4,211	5,494
Computed Losses (-), Gains (+)	900	1,405	528	2,545	3,489	1,028
Outflow, Pearblossom P.P.	15,744	33,556	18,042	46,026	65,053	38,150
California Aqueduct, Pearblossom P.P. to Silverwood Lake						
Inflow, Pearblossom P.P.	15,744	33,556	18,042	46,026	65,053	38,150
Change in Storage	-54	68	-42	27	18	-30
Deliveries (Exchange of Natural Inflow)	488	273	189	323	352	264
Computed Losses (-), Gains (+)	-1,330	-3,085	-2,085	-2,886	-3,673	-3,026
Outflow to Silverwood Lake	13,980	30,130	15,810	42,790	61,010	34,890
Silverwood Lake Operation						
Inflow, Project	13,980	30,130	15,810	42,790	61,010	34,890
Inflow, Natural	682	221	768	419	113	15
Change in storage	-1,086	95	1,010	258	-506	171
Delivered to Contracting Agencies	140	120	118	117	161	190
Outflow, Natural Inflow Released	19	13	12	13	14	13
Computed Losses (-), Gains (+)	565	1,654	1,661	237	1,106	691
Outflow, Project Water at San Bernardino Tunnel	16,154	31,777	17,099	43,058	62,560	35,222
California Aqueduct, Silverwood Lake to Lake Perris						
Inflow, San Bernardino Tunnel	16,154	31,777	17,099	43,058	62,560	35,222
Change in Storage	-3	1	-1	0	1	-1
Delivered to Contracting Agencies	14,747	30,955	15,104	39,558	60,407	32,716
Operational Losses (-), Gains (+)	-1	-1	-2	-2	-3	-3
Outflow to Lake Perris	1,409	820	1,994	3,498	2,149	2,504
Lake Perris Operation						
Inflow	1,409	820	1,994	3,498	2,149	2,504
Change in Storage	591	-409	1,664	-1,778	-1,428	-11,045
Delivered to Contracting Agencies	421	392	438	2,877	3,337	12,657
Computed Losses (-), Gains (+)	-397	-837	108	-2,399	-240	-892
Outflow	0	0	0	0	0	0

MUND G. BROWN CALIFORNIA AQUEDUCT OPERATION (Continued)
1987
(in acre-feet)

JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	DESCRIPTION
							SOUTHERN FIELD DIVISION
							California Aqueduct, A.D. Edmonston P.P. to Junction of West Branch
70,527	82,505	94,304	41,883	43,198	72,588	852,317	Inflow, A.D. Edmonston P.P.
6	-3	-1	-3	7	-8	-17	Change in Storage
-1	32	23	25	2	18	232	Computed Losses (-), Gains (+)
30,912	28,752	54,046	12,724	36,175	62,213	447,062	Outflow, West Branch
39,608	53,788	40,282	29,187	7,018	10,401	405,504	Outflow, East Branch
							California Aqueduct, Junction of West Branch to Pearblossom P.P.
39,608	53,788	40,282	29,187	7,018	10,401	405,504	Inflow (Aqueduct)
-405	1,018	-389	149	15	425	1,222	Change in Storage
5,945	6,825	4,692	3,466	832	661	40,556	Delivered to Contracting Agencies
-59	2,386	1,674	1,886	177	1,367	17,326	Computed Losses (-), Gains (+)
34,009	48,331	37,653	27,458	6,348	10,682	381,052	Outflow, Pearblossom P.P.
							California Aqueduct, Pearblossom P.P. to Silverwood Lake
34,009	48,331	37,653	27,458	6,348	10,682	381,052	Inflow, Pearblossom P.P.
12	110	0	12	0	108	229	Change in Storage
176	27	0	0	575	491	3,158	Deliveries (Exchange of Natural Inflow)
-301	-1,584	-1,243	-546	352	-563	-19,970	Computed Losses (-), Gains (+)
33,520	46,610	36,410	26,900	6,125	9,520	357,695	Outflow to Silverwood Lake
							Silverwood Lake Operation
33,520	46,610	36,410	26,900	6,125	9,520	357,695	Inflow, Project
0	0	0	44	762	396	3,420	Inflow, Natural
-762	-228	742	708	-803	-3,425	-3,826	Change in storage
231	261	214	172	124	122	1,970	Delivered to Contracting Agencies
13	13	13	14	21	15	173	Outflow, Natural Inflow Released
-1,373	-1,292	-898	-405	-1,237	-350	359	Computed Losses (-), Gains (+)
32,665	45,272	34,543	25,645	6,308	12,854	363,157	Outflow, Project Water at San Bernardino Tunnel
							California Aqueduct, Silverwood Lake to Lake Perris
32,665	45,272	34,543	25,645	6,308	12,854	363,157	Inflow, San Bernardino Tunnel
1	2	-5	6	4	-1	4	Change in Storage
31,844	44,572	33,663	23,821	5,024	5,144	337,555	Delivered to Contracting Agencies
-3	-3	-2	-2	-1	-1	-24	Operational Losses (-), Gains (+)
817	695	883	1,816	1,279	7,710	25,574	Outflow to Lake Perris
							Lake Perris Operation
817	695	883	1,816	1,279	7,710	25,574	Inflow
-5,114	-1,028	-833	1,561	193	6,271	-11,355	Change in Storage
5,412	536	510	433	369	371	27,753	Delivered to Contracting Agencies
-519	-1,187	-1,206	178	-717	-1,068	-9,176	Computed Losses (-), Gains (+)
0	0	0	0	0	0	0	Outflow

TABLE 20: SUMMARY OF GOVERNOR EDMUND 1987

(in acre-feet)

DESCRIPTION	JAN	FEB	MAR	APR	MAY	JUN
SOUTHERN FIELD DIVISION (Cont.)						
West Branch California Aqueduct Tehachapi Afterbay to Oso P.P.						
Inflow	41,214	36,644	53,105	46,742	34,670	9,865
Change in Storage	-48	27	-5	-23	40	-34
Computed Losses (-), Gains (+)	37	58	22	105	146	43
Outflow, Oso Pumping Plant	41,299	36,675	53,132	46,870	34,776	9,942
West Branch California Aqueduct Oso P.P. to Pyramid Lake						
Inflow, Oso P.P.	41,299	36,675	53,132	46,870	34,776	9,942
Change in Storage	-279	14	123	-190	786	-319
Operational Losses (-), Gains (+)	268	237	1,006	152	31	-289
Outflow through William E. Warne P.P. to Pyramid Lake	41,846	36,898	54,015	47,212	34,021	9,972
Pyramid Lake Operation						
Inflow, Project	41,846	36,898	54,015	47,212	34,021	9,972
Inflow, Natural	714	629	1,467	556	480	210
Inflow, Pumpback from Elderberry Forebay	0	215	2,471	1,215	8,714	20,831
Delivered to Dept. of Parks and Rec. (State)	0	0	0	6	4	5
Change in Storage	-7,062	6,193	25	1,311	-3,974	2,354
Computed Losses (-), Gains (+)	-2,624	-2,255	-2,415	-2,255	-2,875	-1,297
Outflow, Pyramid Diversion	611	562	1,188	992	698	246
Outflow, Angeles Tunnel	46,387	28,732	54,325	44,419	43,612	27,111
Elderberry Forebay Operation						
Inflow, Project through Castaic P-G Plant	46,387	28,732	54,325	44,419	43,612	27,111
Inflow, Natural	42	35	71	17	0	0
Change in Storage	7,374	-3,855	1,808	-2,158	4,917	-3,077
Computed Losses (-), Gains (+)	-128	396	595	164	474	115
Outflow, Pumpback to Pyramid Lake	0	215	2,471	1,215	8,714	20,831
Outflow, Project Water Released to Castaic Lake	38,885	32,768	50,641	45,526	30,455	9,472
Outflow, Natural	42	35	71	17	0	0
Castaic Lake Operation						
Inflow, Project	38,885	32,768	50,641	45,526	30,455	9,472
Inflow, Natural	146	116	163	80	26	3
Inflow, Natural Outflow from Elderberry	42	35	71	17	0	0
Change in Storage	6,660	-1,512	12,546	-1,697	-16,317	-32,837
Delivered to Contracting Agencies	32,758	35,349	38,104	47,735	47,176	42,344
Computed Losses (-), Gains (+)	345	1,114	-143	697	404	35
Outflow, Castaic Afterbay	0	196	82	282	26	3
Castaic Lagoon Operation						
Inflow (Includes recreation inflow)	0	196	82	817	321	264
Change in Storage	-173	19	-76	307	-12	-63
Operational Losses (-), Gains (+)	-27	-36	-57	-228	-307	-324
Outflow	146	141	101	282	26	3

G. BROWN CALIFORNIA AQUEDUCT OPERATION (Continued)
1987
(in acre-feet)

JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	DESCRIPTION
							SOUTHERN FIELD DIVISION (Cont.)
							West Branch California Aqueduct Tehachapi Afterbay to Oso P.P.
30,912	28,752	54,046	12,724	36,175	62,213	447,062	Inflow
20	-10	-2	-8	23	-25	-45	Change in Storage
-2	98	69	78	7	56	717	Computed Losses (-), Gains (+)
30,890	28,860	54,117	12,810	36,159	62,294	447,824	Outflow, Oso Pumping Plant
							West Branch California Aqueduct Oso P.P. to Pyramid Lake
30,890	28,860	54,117	12,810	36,159	62,294	447,824	Inflow, Oso P.P.
-154	132	13	1,054	-1,372	166	-26	Change in Storage
54	-23	3	227	-8	275	1,933	Operational Losses (-), Gains (+)
31,098	28,705	54,107	11,983	37,523	62,403	449,783	Outflow through William E. Warne P.P. to Pyramid Lake
							Pyramid Lake Operation
31,098	28,705	54,107	11,983	37,523	62,403	449,783	Inflow, Project
151	126	199	294	1,009	971	6,806	Inflow, Natural
27,882	22,974	2,046	12,374	9,196	5,670	113,588	Inflow, Pumpback from Elderberry Forebay
4	5	3	1	0	0	28	Delivered to Dept. of Parks and Rec. (State)
-4,275	5,614	3,323	-3,470	2,884	-3,382	-459	Change in Storage
-1,781	-1,499	-2,538	-1,375	-325	-165	-21,404	Computed Losses (-), Gains (+)
151	126	199	294	669	454	6,190	Outflow, Pyramid Diversion
61,470	44,561	50,289	26,451	43,850	71,807	543,014	Outflow, Angeles Tunnel
							Elderberry Forebay Operation
61,470	44,561	50,289	26,451	43,850	71,807	543,014	Inflow, Project through Castaic P-G Plant
0	0	0	0	14	46	225	Inflow, Natural
2,540	-3,259	-1,211	3,701	-2,887	3,405	7,298	Change in Storage
-164	-161	23	-46	-442	4,215	5,041	Computed Losses (-), Gains (+)
27,882	22,974	2,046	12,374	9,196	5,670	113,588	Outflow, Pumpback to Pyramid Lake
30,884	24,685	49,477	10,330	37,099	66,947	427,169	Outflow, Project Water Released to Castaic Lake
0	0	0	0	14	46	225	Outflow, Natural
							Castaic Lake Operation
30,884	24,685	49,477	10,330	37,099	66,947	427,169	Inflow, Project
0	0	0	38	219	226	1,017	Inflow, Natural
0	0	0	0	14	46	225	Inflow, Natural Outflow from Elderberry
-6,248	-17,861	5,858	-29,089	19,963	47,805	-12,729	Change in Storage
36,977	42,417	43,401	40,556	16,849	12,448	436,114	Delivered to Contracting Agencies
-155	-129	-218	1,099	-520	-6,732	-4,203	Computed Losses (-), Gains (+)
0	0	0	0	0	234	823	Outflow, Castaic Afterbay
							Castaic Lagoon Operation
293	407	442	0	0	234	3,056	Inflow (Includes recreation inflow)
-72	112	124	-228	-280	23	-319	Change in Storage
-365	-295	-318	-190	-68	-90	-2,305	Operational Losses (-), Gains (+)
0	0	0	38	212	121	1,070	Outflow

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WATER QUALITY

APPENDIX II

MAP 4
WATER QUALITY MONITORING STATIONS

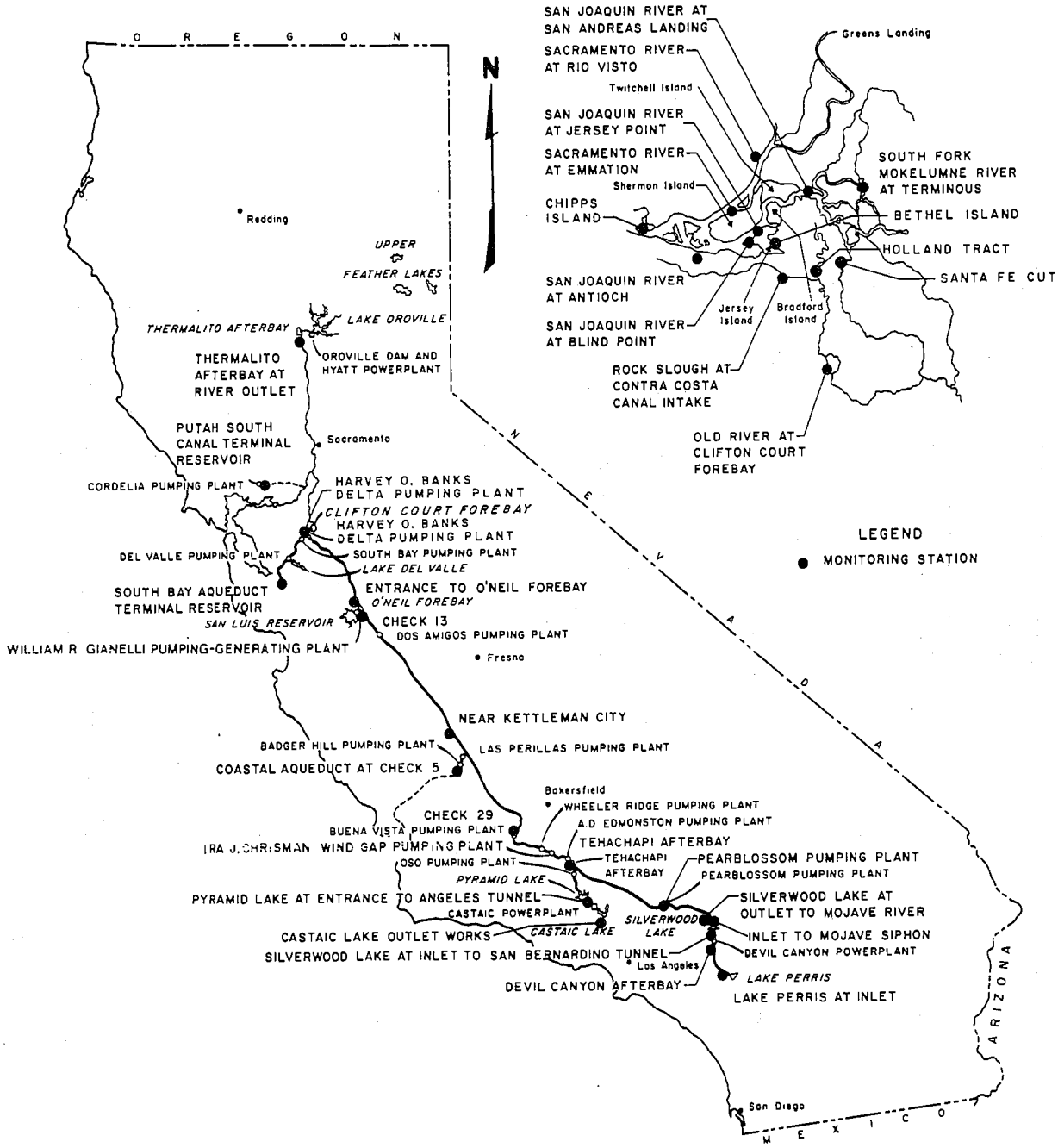

TABLE 21: THERMALITO AFTERBAY AT FEATHER RIVER OUTLET*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	66	55	53	53	53	50	58	56	56	62	62	53	56
Total Hardness	37	32	36	34	36	37	39	36	36	39	39	36	36
Chlorides	1	1	1	1	1	<1	<1	<1	1	<1	1	1	1
Sulfates	1	3	2	2	3	2	2	2	3	3	3	3	2
Sodium	4	3	3	3	2	3	3	3	2	3	6	3	3
Percent Sodium	18	16	15	16	11	15	14	15	11	14	24	15	15
Electrical Conductivity	86	82	79	76	77	82	84	84	87	87	91	87	84
pH	7.3	8.0	8.5	8.4	8.0	7.9		7.9	8.0	8.5	8.3	8.3	8.2
Boron	0.0	0.0	0.0	0.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoride													
Lead													
Selenium													
Hexavalent Chromium													
Arsenic													
Iron													
Manganese													
Magnesium	4	3	4	4	4	4	4	4	4	4	4	4	4
Copper													
Calcium	8	8	8	7	8	8	9	8	8	9	9	8	8
Zinc													
Phenol													
Color (units)													
Sampling Date	01/21	02/18	03/18	04/15	05/20	06/17	07/15	08/19	09/16	10/21	11/18	12/15	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

<X.X = none detected at stated detection level

TABLE 22: INFLOW TO NORTH BAY AQUEDUCT*
(AT CORDELIA INTERIM PLANT ON PUTAH SOUTH CANAL)
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	182	161	183	181	180	173	176	175	180	180	212	173	180
Total Hardness	149	131	158	151	154	155	155	153	160	160	155	163	154
Chlorides	6	8	7	6	7	6	5	5	5	5	13	11	7
Sulfates	23	23	23	21	20	19	20	19	20	21	20	24	21
Sodium	9	12	11	10	11	9	9	9	9	10	14	16	11
Percent Sodium	12	17	13	13	14	11	11	11	11	12	16	18	13
Electrical Conductivity	317	287	323	316	311	311	307	310	309	312	335	345	315
pH	8.6	8.0	8.4	8.4	8.6	8.4	8.7	8.6	8.6	8.6	8.5	8.4	8.5
Boron	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Fluoride													
Lead													
Selenium													
Hexavalent Chromium													
Arsenic													
Iron													
Manganese													
Magnesium	27	22	28	27	27	28	28	28	29	29	28	28	27
Copper													
Calcium	15	16	17	16	17	16	16	15	16	16	16	19	16
Zinc													
Phenol													
Color (units)													
Sampling Date	01/20	02/17	03/17	04/14	05/19	06/16	07/14	08/18	09/15	10/20	11/17	12/15	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

TABLE 23: CALIFORNIA AQUEDUCT AT HARVEY O. BANKS DELTA PUMPING PLANT*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	187	219	296	229	217	253	264	304	353	444	415	412	299
Total Hardness**	81	91	115	94	90	101	105	117	132	160	151	150	115
Chlorides**	38	52	88	57	52	68	73	92	114	156	142	141	90
Sulfates**	31	39	59	42	39	48	51	61	73	97	89	88	60
Sodium**	31	40	61	42	39	49	52	63	76	101	93	92	62
Percent Sodium**	46	49	54	50	49	51	52	54	56	58	57	57	53
Electrical Conductivity***	319	375	515	394	373	437	457	529	616	781	728	722	521
Electrical Conductivity	314	413	533	416	340	462	478	604	670	795	737	715	540
pH	8.2	8.0	8.1	8.2	8.2	8.3	8.1	8.1	8.3	8.3	8.1	8.0	8.2
Boron	0.1	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Fluoride	0.1	0.3	0.2	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.1
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005
Selenium	0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium		0.005							<0.005				<0.005
Arsenic	0.001	0.002	0.002	0.002	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002
Iron	0.035	0.324	0.115	0.014	0.015	0.006	0.021	<0.005	0.013	0.098	0.026	0.021	0.057
Manganese	0.015	0.070	0.057	0.040	0.013	0.013	0.036	0.009	0.014	0.036	0.018	0.008	0.027
Magnesium	10	12	15	12	11	14	14	16	18	22	20	20	15
Copper	0.010	0.006	0.018	0.008	<0.005	0.010	0.012	<0.005	0.009	0.017	0.007	0.007	0.009
Calcium	17	21	27	21	17	20	18	17	17	21	22	20	20
Zinc	0.012	0.009	0.027	0.018	<0.005	0.010	0.013	0.013	0.048	0.022	0.023	0.016	0.018
Phenol		0.000							0.002				0.001
Color (units)	15	25	25	15	10	10	20	15		5	5	20	15
Sampling Date	01/21	02/18	03/18	04/15	05/20	06/17	07/15	08/19	09/16	10/21	11/18	12/16	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

<X.XXX = none detected at stated detection level

TABLE 24: SOUTH BAY AQUEDUCT TERMINAL RESERVOIR*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	184	222	256	215	235	260	284	307	330	375	438	430	295
Total Hardness**	82	95	106	92	99	107	115	122	129	144	164	162	118
Chlorides**	33	48	62	45	53	63	73	83	92	110	136	133	78
Sulfates**	30	41	51	39	45	52	59	65	72	85	103	101	62
Sodium**	28	38	46	36	41	47	53	59	64	76	91	90	56
Percent Sodium**	43	46	49	46	47	49	50	51	52	54	55	55	50
Electrical Conductivity***	310	379	441	366	403	448	492	534	576	658	773	759	512
Electrical Conductivity	340	410	477	437	355	469	461	621	531	658	704	869	528
pH	8.4	8.0	8.2	8.3	8.4	8.3	8.2	8.2	8.4	8.4	8.2	7.9	8.3
Boron	0.1	0.2	0.3	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2
Fluoride	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.3	0.1
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium	0.000	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium		0.005							<0.005				<0.005
Arsenic	0.000	0.002	0.002	0.002	0.003	0.002	0.003	0.002	0.003	0.002	0.002	0.002	0.002
Iron	0.015	0.090	0.085	0.008	0.020	0.034	0.024	0.030	0.015	0.007	0.012	0.012	0.029
Manganese	0.026	0.050	0.015	0.010	0.008	0.012	0.006	0.007	<0.005	0.005	0.007	0.013	0.013
Magnesium	10	13	14	12	12	14	13	16	20	22	19	24	16
Copper	0.010	0.005	0.011	0.006	0.008	0.012	0.007	0.020	0.008	<0.005	<0.005	0.006	0.008
Calcium	17	21	25	20	19	21	19	16	26	26	21	22	21
Zinc	0.015	0.013	0.009	0.014	0.017	0.015	0.009	0.091	0.016	0.008	0.017	0.019	0.020
Phenol		0.001							0.003				0.002
Color (units)	0	20	30	10	15	10	10	15	10	0	5	20	12
Sampling Date	01/20	02/17	03/17	04/14	05/19	06/16	07/14	08/18	09/15	10/20	11/17	12/15	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

<X.XXX = none detected at stated detection level

TABLE 25: CALIFORNIA AQUEDUCT ENTRANCE TO O'NEILL FOREBAY*
1987

Constituents	JAN	FEB	MAR 1/	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	181	217	287	309	222	258	268	301	349	435	442	398	306
Total Hardness**	81	93	118	126	95	108	111	123	140	170	173	157	125
Chlorides**	34	46	57	86	48	63	67	83	107	156	161	134	87
Sulfates**	30	41	59	70	43	54	57	67	82	109	111	97	68
Sodium**	29	38	49	63	40	49	52	61	73	96	98	87	61
Percent Sodium**	44	47	47	52	48	50	51	52	53	55	55	55	51
Electrical Conductivity***	307	370	468	534	380	444	461	520	605	757	769	692	526
Electrical Conductivity	322	389	468	437	370	441	456	632	665	782	708	847	543
pH	8.3	8.0	8.2	8.3	8.3	8.3	8.2	8.1	8.2	8.4	8.1	8.0	8.2
Boron	0.1	0.2	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2
Fluoride	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.2	0.0	0.1	0.1
Lead	<0.005	0.016	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium	0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium		0.005							<0.005				<0.005
Arsenic	0.001	0.001	0.002	0.002	0.002	0.002	0.004	0.004	0.003	0.002	0.002	0.002	0.002
Iron	0.050	0.173	0.151	0.007	0.007	<0.005	0.038	0.028	0.009	0.058	0.008	0.010	0.045
Manganese	0.006	0.044	0.029	0.011	<0.005	<0.005	0.009	0.006	<0.005	0.006	<0.005	<0.005	0.010
Magnesium	10	12	14	12	12	13	13	17	17	22	19	23	15
Copper	0.011	0.037	0.012	0.011	0.008	0.008	0.009	0.014	0.009	0.009	0.008	0.010	0.012
Calcium	16	20	24	21	20	19	18	16	16	21	21	22	20
Zinc	0.012	0.027	0.015	0.011	0.007	0.008	0.011	0.060	0.009	0.011	0.017	0.015	0.017
Phenol		0.001							0.004				0.003
Color (units)	20	20	25	15	10	10	15	10	10	0	5	20	13
Sampling Date	01/21	02/18	03/18	04/15	05/20	06/17	07/15	08/19	09/16	10/21	11/18	12/16	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

<X.XXX = none detected at stated detection level

1/ This month's data are all lab values.

TABLE 26: CALIFORNIA AQUEDUCT AT CHECK 13*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	250	294	261	285	250	263	281	313	361	414	436	449	321
Total Hardness**	98	110	101	108	98	102	107	115	128	142	148	151	117
Chlorides**	59	78	64	74	59	65	73	86	106	128	137	143	89
Sulfates**	48	60	51	57	48	51	56	65	78	93	99	103	67
Sodium**	45	56	48	54	45	49	53	61	73	86	92	95	63
Percent Sodium**	50	53	51	52	50	51	52	54	56	57	58	58	54
Electrical Conductivity***	430	510	450	494	430	453	487	545	631	727	767	792	560
Electrical Conductivity	439	510	463	498	435	474	472	528	658	800	757	833	572
pH	8.2	7.9	8.2	8.3	8.5	8.3	8.1	8.1	8.4	8.1	7.9	8.1	8.2
Boron	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Fluoride	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium	0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium		0.005							<0.005				<0.005
Arsenic	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002
Iron	0.060	0.167	0.203	0.084	0.045	0.013	0.039	0.020	0.038	0.027	0.034	0.050	0.065
Manganese	0.022	0.020	0.030	0.007	<0.005	0.009	0.007	0.013	<0.005	0.020	0.015	<0.005	0.013
Magnesium	12	14	13	13	13	13	14	15	17	21	20	22	16
Copper	0.007	0.012	0.005	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	21	25	22	22	20	21	20	20	19	22	24	24	22
Zinc	0.007	0.013	0.005	0.011	0.006	0.011	0.006	<0.005	<0.005	0.006	<0.005	<0.005	0.006
Phenol		0.005							0.004				0.005
Color (units)	15	20	20	10	5	5	5	10	20	0	5	20	11
Sampling Date	01/21	02/18	03/18	04/15	05/20	06/17	07/15	08/19	09/16	10/21	11/18	12/16	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

<X.XXX = none detected at stated detection level

TABLE 27: CALIFORNIA AQUEDUCT NEAR KETTLEMAN CITY*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	236	300	294	327	256	263	285	292	375	430	438	486	332
Total Hardness**	94	111	109	118	99	101	107	109	130	144	146	158	119
Chlorides**	54	76	74	86	61	63	71	74	102	121	124	140	87
Sulfates**	45	59	58	65	49	51	56	57	76	88	90	101	66
Sodium**	43	56	55	62	47	48	53	55	72	83	85	95	63
Percent Sodium**	50	53	52	53	51	51	52	52	55	56	56	57	53
Electrical Conductivity***	405	510	500	554	437	449	485	497	632	723	736	814	562
Electrical Conductivity	409	498	505	555	442	502	478	524	604	691	776	835	568
pH	8.2	7.9	8.0	8.3	8.8	8.0	8.0	8.0	8.4	7.9	8.2	8.1	8.2
Boron	0.2	0.3	0.3	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2
Fluoride	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium	0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium		<0.005							<0.005				<0.005
Arsenic	0.001	0.002	0.002	0.002	0.002	0.002	0.004	0.002	0.002	0.005	0.002	0.002	0.002
Iron	0.054	0.152	0.175	0.068	0.032	0.015	0.057	0.024	0.043	0.031	0.026	0.032	0.059
Manganese	0.015	0.013	0.010	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.006
Magnesium	11	14	14	15	13	13	14	14	16	18	21	23	16
Copper	<0.005	0.005	<0.005	<0.005	0.016	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005
Calcium	20	24	25	26	20	21	20	17	19	21	24	28	22
Zinc	0.005	<0.005	0.035	0.009	0.014	0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	0.008
Phenol		0.003							0.005				0.004
Color (units)	10	10	20	15	5	5	5	5	15	0	5	5	8
Sampling Date	01/21	02/18	03/18	04/15	05/20	06/17	07/15	08/19	09/16	10/21	11/18	12/16	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

<X.XXX = none detected at stated detection level

TABLE 28: COASTAL BRANCH AT CHECK 5*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	234	261	267	298	237	247	257	282	326	351	395	439	299
Total Hardness**	94	101	103	112	94	97	100	107	119	126	138	151	112
Chlorides**	53	64	66	80	54	58	62	73	91	101	120	138	80
Sulfates**	43	51	52	61	44	47	50	57	69	75	88	100	61
Sodium**	42	49	51	59	43	46	48	55	66	73	84	96	59
Percent Sodium**	50	52	52	54	50	51	51	53	55	56	57	58	53
Electrical Conductivity***	400	450	461	519	405	424	442	489	570	615	697	778	521
Electrical Conductivity	442	485	501	633	406	470	473	493	583	664	734	716	550
pH	7.9	7.8	7.9	8.0	7.9	8.2	8.0	8.0	7.9	8.7	8.5	8.9	8.3
Boron	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2
Fluoride	0.2	0.3	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium		0.00							0.00				0.00
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.06	0.09	0.08	0.12	0.02	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.04
Manganese	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Magnesium	14	15	16	16	16	13	13	13	16	18	18	19	16
Copper	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
Calcium	24	24	24	29	14	21	20	22	17	23	24	24	22
Zinc	0.02	0.04	0.02	0.04	0.04	0.04	0.06	0.04	0.03	0.04	0.03	0.01	0.03
Phenol		0.000							0.007				0.004
Color (units)													
Sampling Date	01/20	02/17	03/17	04/14	05/19	06/16	07/14	08/19	09/15	10/20	11/17	12/15	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

TABLE 29: CALIFORNIA AQUEDUCT AT CHECK 29*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	227	285	314	365	263	275	282	320	379	436	427	479	338
Total Hardness**	92	113	123	141	105	109	111	125	146	166	163	181	131
Chlorides**	49	74	87	109	65	70	73	89	115	140	136	158	97
Sulfates**	40	57	65	80	51	54	56	67	84	100	97	112	72
Sodium**	40	56	64	78	50	53	55	65	81	97	95	109	70
Percent Sodium**	49	52	53	55	51	52	52	53	55	56	56	57	53
Electrical Conductivity***	383	494	550	646	452	475	488	560	673	781	765	863	594
Electrical Conductivity	376	465	527	702	428	449	473	473	588	671	704	764	552
pH	7.8	7.9	7.9	8.1	8.0	8.1	8.0	8.2	8.0	8.2	7.8	8.0	8.0
Boron	0.1	0.2	0.3	0.4	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Fluoride	0.1	0.3	0.2	0.2	0.1	0.2	0.1	0.1		0.2	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium		0.00							0.00				0.00
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.05	0.06	0.07	0.06	0.02	0.00	0.02	0.01	0.02	0.01	0.00	0.04	0.03
Manganese	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00
Magnesium	11	14	18	17	12	13	14	13	16	17	18	20	15
Copper	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.01
Calcium	20	24	27	31	20	21	20	21	19	24	24	25	23
Zinc	0.01	0.01	0.02	0.04	0.03	0.02	0.03	0.02	0.02	0.02	0.04	0.03	0.02
Phenol		0.000							0.006				0.003
Color (units)	5	20	8	6	5	5	8		5	5	4	4	7
Sampling Date	01/20	02/17	03/17	04/14	05/19	06/16	07/14	08/19	09/15	10/20	11/17	12/15	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

TABLE 30: CALIFORNIA AQUEDUCT AT TEHACHAPI AFTERBAY*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE 1/	JULY 1/	AUG 1/	SEP 1/	OCT 1/	NOV 1/	DEC 1/	Annual Average
Total Dissolved Solids**	165	226	326	304	265	310	277	264	315	379	353	495	307
Total Hardness**	76	92	119	113	103	102	105	104	109	126	125	156	111
Chlorides**	26	51	94	85	68	66	72	76	118	140	130	169	91
Sulfates**	24	43	74	67	55	42	40	38	35	38	42	72	47
Sodium**	25	41	68	62	52	48	52	55	76	90	84	110	64
Percent Sodium**	42	50	56	55	53	49	51	52	59	60	58	59	54
Electrical Conductivity***	279	390	574	534	463	444	478	470	595	647	634	814	527
Electrical Conductivity	346	464	536	601	433	444	478	470	595	647	634	814	539
pH	7.9	7.9	8.2	8.1	8.1	8.0	7.8	8.0	7.9	8.1	8.1	7.9	8.0
Boron	0.2	0.2	0.2	0.4	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.3	0.2
Fluoride	0.2	0.1	0.3	0.3	0.1	0.2	0.2	0.1	0.2	0.3	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.01	0.00	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Manganese	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.01
Magnesium	12	14	14	17	12	12	14	13	15	18	17	21	15
Copper	0.00	0.02	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Calcium	17	22	26	32	21	21	19	20	19	21	22	28	22
Zinc	0.00	0.02	0.00	0.00	0.03	0.01	0.09	0.02	0.02	0.06	0.01	0.14	0.03
Phenol													
Color (units)	2	7	5	5	4	5	5	7	5	5	3	5	5
Sampling Date	01/21	02/18	03/18	04/15	05/20	06/17	07/15	08/19	09/16	10/21	11/18	12/23	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

1/ This month's data are all lab values.

TABLE 31: PYRAMID LAKE AT ENTRANCE TO ANGELES TUNNEL*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	219	240	263	270	285	304	290	279	309	292	312	335	283
Total Hardness	95	96	114	118	119	120	118	117	118	110	118	124	114
Chlorides	45	47	59	61	64	62	65	70	80	90	94	106	70
Sulfates	37	40	54	61	63	59	55	48	47	43	46	47	50
Sodium	36	37	45	50	54	52	53	54	60	64	66	72	54
Percent Sodium	44	45	46	47	48	47	49	49	52	55	54	55	49
Electrical Conductivity	375	378	440	457	508	491	482	484	524	527	523	565	480
pH	8.1	7.9	8.0	8.1	7.9	8.2	8.3	9.0	8.0	8.0	8.1	8.1	8.3
Boron	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Fluoride	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.01
Manganese	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Magnesium	11	10	13	14	15	14	14	14	14	14	14	16	14
Copper	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Calcium	20	22	24	24	23	25	24	24	24	21	24	23	23
Zinc	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.00	0.00
Phenol													
Color (units)	5	5	6	11	9	4	12	4	5	3	4	4	6
Sampling Date	01/23	02/18	03/16	04/14	05/21	06/18	07/16	08/18	09/17	10/20	11/20	12/15	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

TABLE 32: CASTAIC LAKE AT OUTLET WORKS*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	288	292	292	249	273	257	309	270	294	284	290	280	282
Total Hardness	125	131	126	124	118	125	122	122	128	128	124	128	125
Chlorides	64	63	62	59	58	57	56	57	59	59	61	66	60
Sulfates	61	58	59	57	59	60	63	61	67	64	64	62	61
Sodium	51	47	48	46	46	45	46	47	50	48	50	52	48
Percent Sodium	46	43	44	44	45	43	44	45	45	44	46	46	45
Electrical Conductivity	492	486	470	445	467	446	473	465	482	473	461	475	470
pH	8.0	8.1	8.4	8.3	8.2	8.7	8.8	8.9	8.3	8.0	8.1	8.1	8.4
Boron	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.3	0.2	0.2
Fluoride	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manganese	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00
Magnesium	14	16	15	13	13	14	14	14	14	13	16	14	14
Copper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Calcium	27	26	26	28	26	27	26	26	28	30	23	28	27
Zinc	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.00	0.01
Phenol													
Color (units)	4	2	3	5	2	5	5	4	5	5	5	5	4
Sampling Date	01/22	02/17	03/17	04/13	05/18	06/17	07/15	08/17	09/16	10/19	11/19	12/14	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

TABLE 33: CALIFORNIA AQUEDUCT AT CHECK 59*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	189	245	297	328	244	253	261	281	338	355	383	426	300
Total Hardness**	80	100	119	130	99	103	106	113	134	140	150	166	120
Chlorides**	36	53	69	78	53	55	58	64	81	86	95	108	70
Sulfates**	29	47	63	73	46	49	52	58	76	82	91	104	64
Sodium**	31	46	60	68	46	48	50	55	70	75	82	94	60
Percent Sodium**	46	50	52	53	50	51	51	52	54	54	55	55	52
Electrical Conductivity***	318	428	532	593	426	444	460	500	614	647	702	789	538
Electrical Conductivity	323	439	554	614	429	440	489	480	608	629	672	756	536
pH	8.0	7.8	8.3	8.2	8.1	8.0	8.0	7.1	7.9	7.9	7.8	8.0	8.0
Boron	0.1	0.2	0.3	0.4	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.2	0.2
Fluoride	0.2	0.3	0.3	0.3	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.00	0.00	0.01	0.02	0.10	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
Manganese	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.02	0.00	0.01
Magnesium	10	14	15	17	12	12	13	12	15	17	17	18	14
Copper	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01
Calcium	16	22	25	31	20	22	22	21	20	21	21	22	22
Zinc	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.00	0.03	0.01	0.01	0.01
Phenol													
Color (units)	3	6	5	4	5	7	5	2	5	4	5	5	5
Sampling Date	01/21	02/18	03/18	04/15	05/20	06/17	07/15	08/19	09/16	10/21	11/18	12/23	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

TABLE 34: CALIFORNIA AQUEDUCT AT INLET TO MOJAVE SIPHON*
1987

Constituents	JAN 1/	FEB 1/	MAR 1/	APR 1/	MAY 1/	JUNE	JULY	AUG	SEP 1/	OCT 1/	NOV 1/	DEC 1/	Annual Average
Total Dissolved Solids**	183	310	335	370	238	248	264	269	321	365	359	403	305
Total Hardness**	82	116	129	144	102	102	108	110	116	122	122	134	116
Chlorides**	38	61	71	74	57	60	67	69	122	129	142	150	87
Sulfates**	29	53	72	88	37	49	54	56	38	37	35	49	50
Sodium**	29	46	59	63	44	47	52	53	79	84	88	100	62
Percent Sodium**	43	45	49	48	48	50	51	51	59	59	60	61	52
Electrical Conductivity***	315	463	565	590	412	435	465	475	617	618	656	726	528
Electrical Conductivity	315	463	565	590	412	451	486	471	617	618	656	726	531
pH	8.0	7.8	8.5	8.1	7.9	8.2	8.1	8.0	8.0	7.9	7.9	8.1	8.1
Boron	0.1	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2
Fluoride	0.2	0.1	0.3	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manganese	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.01	0.01	0.00	0.01	0.00	0.01
Magnesium	9	13	15	16	12	13	13	12	16	17	17	21	15
Copper	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Calcium	18	25	27	31	21	21	21	21	20	21	21	19	22
Zinc	0.00	0.02	0.02	0.00	0.00	0.02	0.06	0.02	0.00	0.03	0.01	0.01	0.02
Phenol													
Color (units)	4	6	6	5	3	4	3	7	5	5	5	4	5
Sampling Date	01/21	02/18	03/18	04/15	05/19	06/17	07/15	08/19	09/16	10/21	11/18	12/23	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

1/ This month's data are all lab values.

TABLE 35: SILVERWOOD LAKE AT OUTLET TO MOJAVE RIVER*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	194	254	238	231	260	249	280	285	312	324	314	304	270
Total Hardness	84	92	101	102	107	106	108	106	110	112	105	106	103
Chlorides	42	47	52	55	60	61	65	76	90	107	108	106	72
Sulfates	30	37	44	48	52	42	43	40	40	37	38	36	41
Sodium	34	38	41	44	48	48	48	54	62	70	72	70	52
Percent Sodium	46	46	46	48	49	48	48	52	54	57	59	57	51
Electrical Conductivity	336	375	394	400	445	453	458	470	534	535	547	557	459
pH	8.0	8.0	8.1	7.6	8.0	8.2	8.0	8.3	7.8	8.1	8.0	8.0	8.0
Boron	0.1	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2
Fluoride	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manganese	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00
Magnesium	10	11	13	12	12	13	13	13	14	15	14	15	13
Copper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Calcium	17	19	19	21	23	21	22	21	21	20	19	18	20
Zinc	0.00	0.00	0.00	0.01	0.00	0.03	0.01	0.01	0.00	0.02	0.01	0.00	0.01
Phenol													
Color (units)	4	4	4	5	4	5	5	4	4	5	3	3	4
Sampling Date	01/22	02/18	03/17	04/14	05/20	06/16	07/14	08/18	09/15	10/22	11/17	12/15	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

TABLE 36: SILVERWOOD LAKE AT INLET TO SAN BERNARDINO TUNNEL*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	188	254	240	230	260	234	283	288	295	323	306	316	268
Total Hardness	84	94	102	104	107	108	106	106	110	112	105	109	104
Chlorides	42	46	50	53	60	62	64	72	88	105	108	108	72
Sulfates	29	34	42	46	54	44	42	40	40	38	37	38	40
Sodium	33	34	39	43	48	48	48	54	62	69	72	72	52
Percent Sodium	45	43	45	47	49	48	49	52	54	56	59	57	50
Electrical Conductivity	335	358	385	393	451	450	456	470	516	531	543	544	453
pH	8.1	8.0	8.0	8.5	8.0	8.2	8.0	8.2	8.0	8.0	8.2	8.0	8.1
Boron	0.1	0.1	0.1	0.2	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2
Fluoride	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.3	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manganese	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.09	0.00	0.00	0.01
Magnesium	10	12	12	13	12	13	16	13	14	15	14	15	13
Copper	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Calcium	17	18	21	20	23	22	16	21	21	20	19	19	20
Zinc	0.02	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01
Phenol													
Color (units)	3	3	3	3	3	5	5	5	3	5	4	5	4
Sampling Date	01/22	02/18	03/17	04/14	05/20	06/16	07/14	08/18	09/15	10/22	11/17	12/15	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

TABLE 37: DEVIL CANYON AFTERBAY*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids**	175	184	206	212	253	247	243	258	280	310	320	325	251
Total Hardness**	79	82	87	89	100	98	97	101	107	114	117	118	99
Chlorides**	33	36	45	47	63	61	59	65	74	85	89	91	62
Sulfates**	29	31	36	37	46	45	44	47	52	59	61	62	46
Sodium**	30	32	37	38	48	47	46	50	55	62	64	66	48
Percent Sodium**	45	46	48	49	52	51	51	52	53	54	55	55	51
Electrical Conductivity***	308	324	362	372	445	434	427	454	492	545	563	572	442
Electrical Conductivity	336	354	417	410	463	449	454	471	515	527	540	546	457
pH	8.0	8.0	7.9	8.2	8.0	7.8	7.8	8.0	8.0	7.7	7.7	8.1	8.0
Boron	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.2
Fluoride	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Lead	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
Manganese	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.16	0.02	0.01	0.02
Magnesium	10	11	11	12	13	12	14	12	15	15	14	14	13
Copper	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00
Calcium	17	19	19	22	22	22	20	22	19	20	20	20	20
Zinc	0.00	0.03	0.01	0.01	0.01	0.04	0.09	0.01	0.04	0.02	0.02	0.01	0.02
Phenol													
Color (units)		3		3	4	5	2		3	3	4	5	4
Sampling Date	01/21	02/18	03/18	04/15	05/20	06/17	07/15	08/19	09/16	10/21	11/18	12/23	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. The second Electrical Conductivity shown is from a once-monthly sample, as are all constituents following.
** Values correlated from continuous EC.
*** Continuous EC value.

TABLE 38: LAKE PERRIS AT INLET*
1987

Constituents	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual Average
Total Dissolved Solids	205	254	216	220	205	241	245	244	234	250	217	215	229
Total Hardness	80	85	82	82	82	84	87	91	90	88	85	92	86
Chlorides	50	54	52	43	52	51	52	54	55	56	57	56	53
Sulfates	35	34	36	36	37	36	37	38	41	37	38	37	37
Sodium	40	41	41	36	42	42	42	44	45	45	45	45	42
Percent Sodium	51	50	51	48	52	51	50	50	51	52	52	50	51
Electrical Conductivity	375	378	368	348	362	377	391	394	404	381	374	374	377
pH	8.0	8.2	8.2	8.1	7.8	8.2	8.5	8.0	7.9	7.9	7.8	7.9	8.1
Boron	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2
Fluoride	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2
Lead	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexavalent Chromium													
Arsenic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manganese	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Magnesium	11	11	11	12	11	12	12	13	12	14	11	12	12
Copper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00
Calcium	14	16	15	13	15	14	15	15	16	12	16	17	15
Zinc	0.00	0.00	0.01	0.01	0.02	0.01	0.00	0.01	0.00	0.01	0.02	0.00	0.01
Phenol													
Color (units)	2	1	2	3	4	2	3	2	5	0	2	5	3
Sampling Date	01/21	02/17	03/16	04/13	05/18	06/15	07/13	08/17	09/14	10/19	11/16	12/14	

* Electrical Conductivity is in microsiemens/cm (microsiemens are equivalent to micromhos; to obtain millisiemens, divide by 1,000). All other constituents are in milligrams per liter except for pH, percent Sodium, and as otherwise noted. Each value is obtained from a once-monthly sample.

TABLE 39: WATER QUALITY
MINIMUM DETECTION CONCENTRATIONS FOR TESTED SUBSTANCES*

CHLORINATED HYDROCARBON PESTICIDES AND PCB's

	Detection Limits (ppm or mg/liter)
Alachlor	.00001
Aldrin	.00001
Atrazine and/or Simazine	.00001
BHC	.00001
Captan	.00001
Chlordane	.00001
Chlorpropham	.00001
Dacthal	.00001
DDD	.00001
DDE	.00001
DDT	.00001
Dicofol	.00001
Dieldrin	.00001
Difolatan	.00001
Diuron	.00001
Endosulfan	.00001
Endrin	.00001
Heptachlor	.00001
Heptachlor Epoxide	.00001
Lindane	.00001
Methoxychlor	.00002
Nitrofen	.00001
PCB 1016	.00025
PCB 1242	.00025
PCB 1254	.00025
PCB 1260	.00025
Perthane	.00001
Pronamide	.00001
Propanil	.00001
Toxaphene	.00025

ORGANIC PHOSPHORUS PESTICIDES

	Detection Limits (ppm or mg/liter)
Bidrin	.00001
Carbophenthion	.00001
Crufomate	.00010
Demeton	.00001
Diazinon	.00001
Dioxathion	.00001
Dursban	.00001
Ethion	.00001
Ethyl Parathion	.00001
Fenthion	.00002
Malathion	.00001
Methidathon	.00001
Methyl Parathion	.00001
Paraoxon	.00001
Phorate	.00003
Phorate Sulfone	.00001
Phosmet	.00001

HERBICIDES AND FUNGICIDES

2,4-D + esters & salts	.00001
2,4,5-T + esters & salts	.00001
2,4,5-TP/Silvex + esters & salts	.00001
MCPA	.00001
Pentachlorophenol	.00001
Tetrachlorophenol	.00001

MISCELLANEOUS COMBINATIONS

CDEC	.00001
Thiobencarb	.00001

* Listed are those pesticides that would be detected by lab scans currently used for pesticide analysis, and the minimum concentration at which these substances can be detected. Detected amounts from the quarterly sampling program are shown below:

PESTICIDES IN THE CALIFORNIA AQUEDUCT 1987

STATION	FEB	MAY	AUG	NOV
HARVEY O.BANKS DELTA PUMPING PLANT				
Chlorinated Hydrocarbons				
Atrazine/Simazine	.00004		.00060	
Unknowns				
Organic Phosphorous	.00002[A]			
Phenoxy Acid Herbicides				
Miscellaneous				.0006[E]
O'NEILL PUMPING PLANT DISCHARGE				
Chlorinated Hydrocarbons				
Atrazine/Simazine	.00013		Not Sampled	
Organic Phosphorous	.000045[A] .000016[B]	.0002[A]		
Unknowns				
Phenoxy Acid Herbicides				
2, 4-D				
Miscellaneous				
NEAR KETTLEMAN CITY (CHECK 21)				
Chlorinated Hydrocarbons				
Atrazine/Simazine	.00011		.00015	
Unknowns				
Dacthal				
Organic Phosphorous	.000034[A] .000018[B]	.00010[C]		
Phenoxy Acid Herbicides				
2, 4-D				
Miscellaneous			.0012[D]	.00043[D]
TEHACHAPI AFTERBAY				
Chlorinated Hydrocarbons				
Atrazine/Simazine	.00009	.00047	.00020	
Unknowns				
Organic Phosphorous	.00006[A] .00003[B]	.00002[A]		
Phenoxy Acid Herbicides				
Miscellaneous				

A/ Diazinon
B/ Ethyl Parathion
C/ Metalaxyl
D/ PCP
E/ Toluene