TERMINUS DAM
AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

WATER CONTROL MANUAL

APPENDIX III TO
MASTER WATER CONTROL MANUAL
TULARE LAKE BASIN, CALIFORNIA

US Army Corps
of Engineers ®
Sacramento District

JUNE 1962
REVISED NOVEMBER 1971
REVISED JULY 2005

[R]

WATER CONTROL MANUAL

TERMINUS DAM AND LAKE KAWEAH

Kaweah River
California

APPENDIX III
TO
MASTER WATER CONTROL MANUAL

Tulare Lake Basin
California

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

June 1962
Revised November 1971
Revised July 2005

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DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION, U.S. ARMY CORPS OF ENGINEERS
333 Market Street, Room 923
San Francisco, California 94105-2195

REPLY TO
ATTENTION OF:

13 APR 2006

CESPD-DE

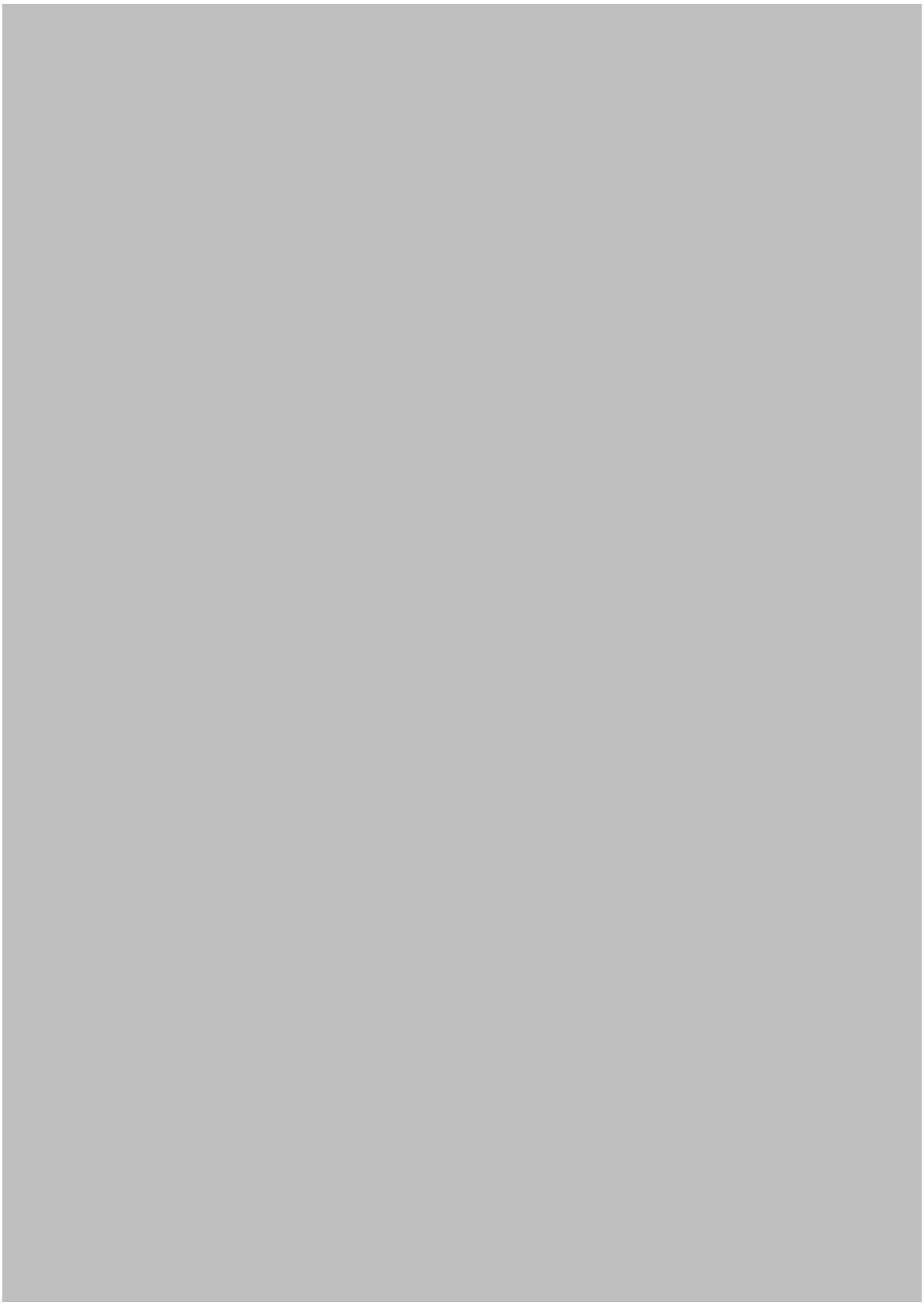
MEMORANDUM FOR Commander, U.S. Army Corps of Engineers, Sacramento District, (CESPK-ED-EW), 1325 J Street, Sacramento, CA 95814

SUBJECT: Water Control Manual, Terminus Dam and Lake Kaweah

1. The South Pacific Division, Water Control/District Support Team, has completed the policy and quality assurance review of subject document.

2. Water Control Manual, Appendix III, Terminus Dam and Lake Kaweah, Kaweah River, California, Revised July 2005, is hereby approved.

JOSEPH SCHROEDEL
BG, USA
Commanding



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NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be published in loose-leaf form in a hard copy binder, and only those sections, or parts thereof, requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so that inserts can be added to make the manual current. Changes to individual pages must indicate the date of revision, which is also the Division's approval date. Pages or sections that are changed after the revision is approved and distributed will indicate the new change month/year.

All elevations in this manual are based on the National Geodetic Vertical Datum of 1929 (NGVD29), unless noted. As directed by EM 1110-1-1004 Engineering and Design – Geodetic and Control Surveying, the datum has been changed to the North American Vertical Datum of 1988 (NAVD88). However, the elevations in this manual do not reflect the NAVD88.

Soft metrics are used throughout the manual for information purposes only. They are not to be used as exact measurements.

WATER CONTROL PERSONNEL

In the event that unusual conditions arise during non-duty hours, communication can be achieved by contacting the personnel listed in the front of this manual and in Exhibit A.

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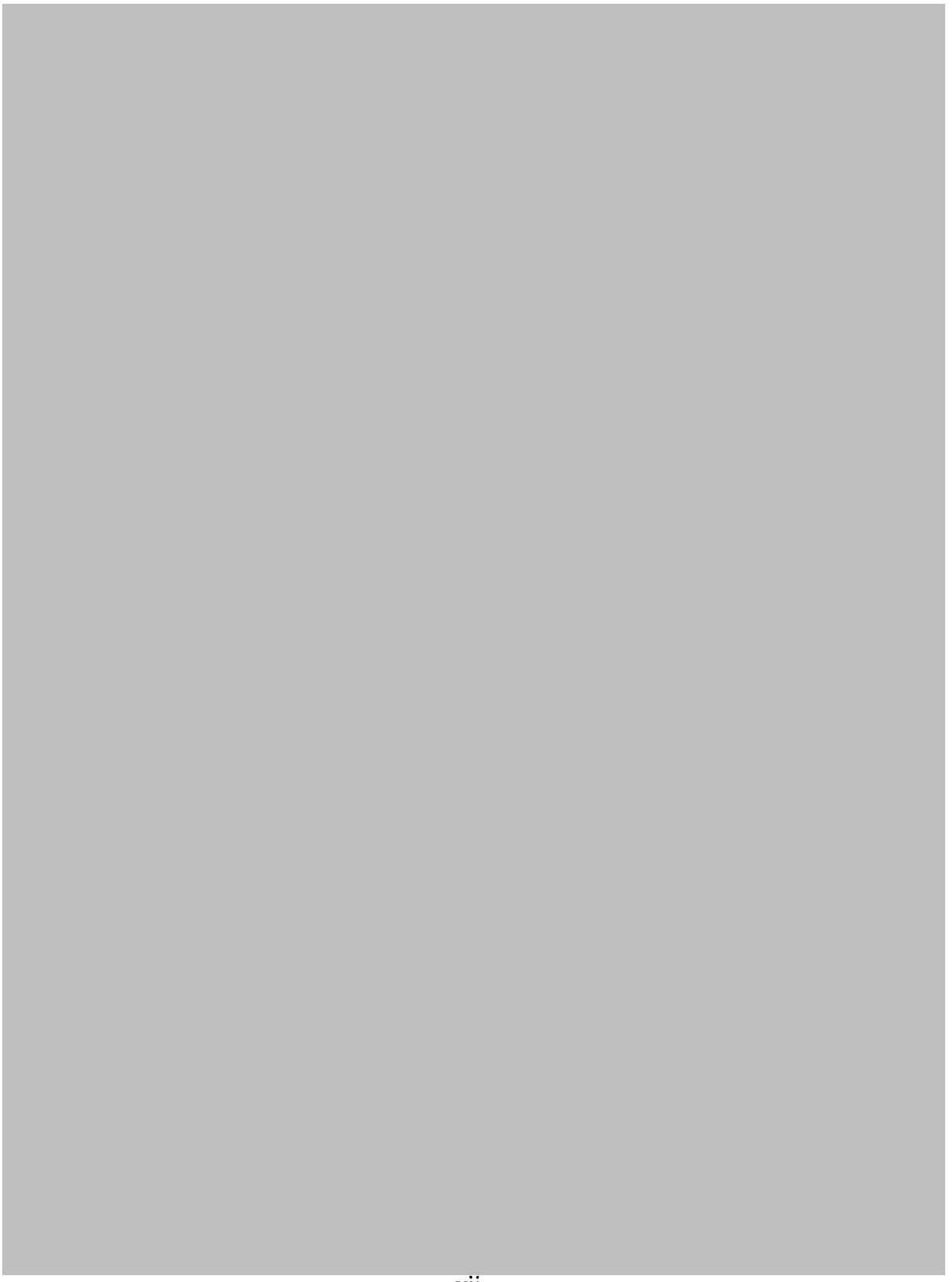

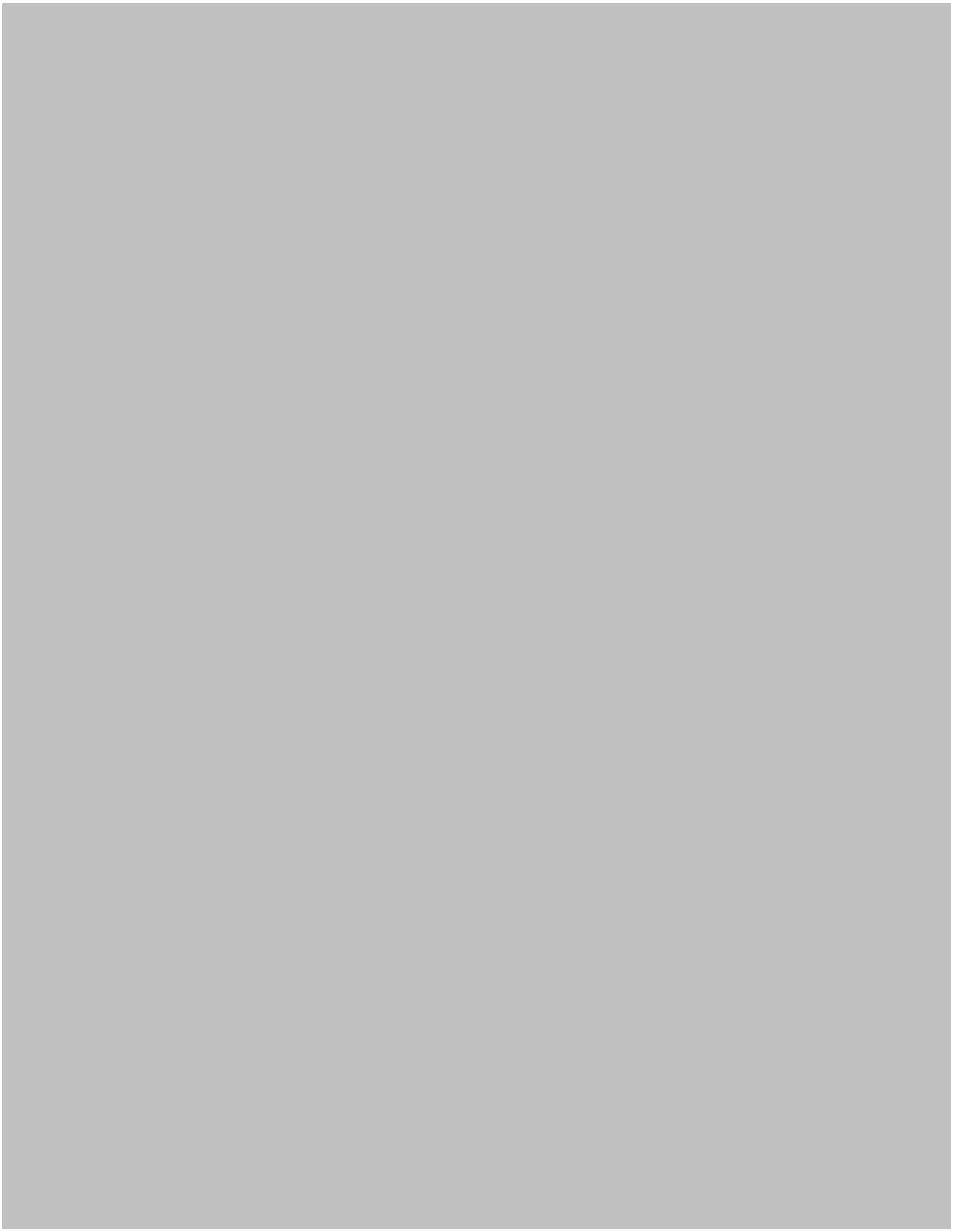

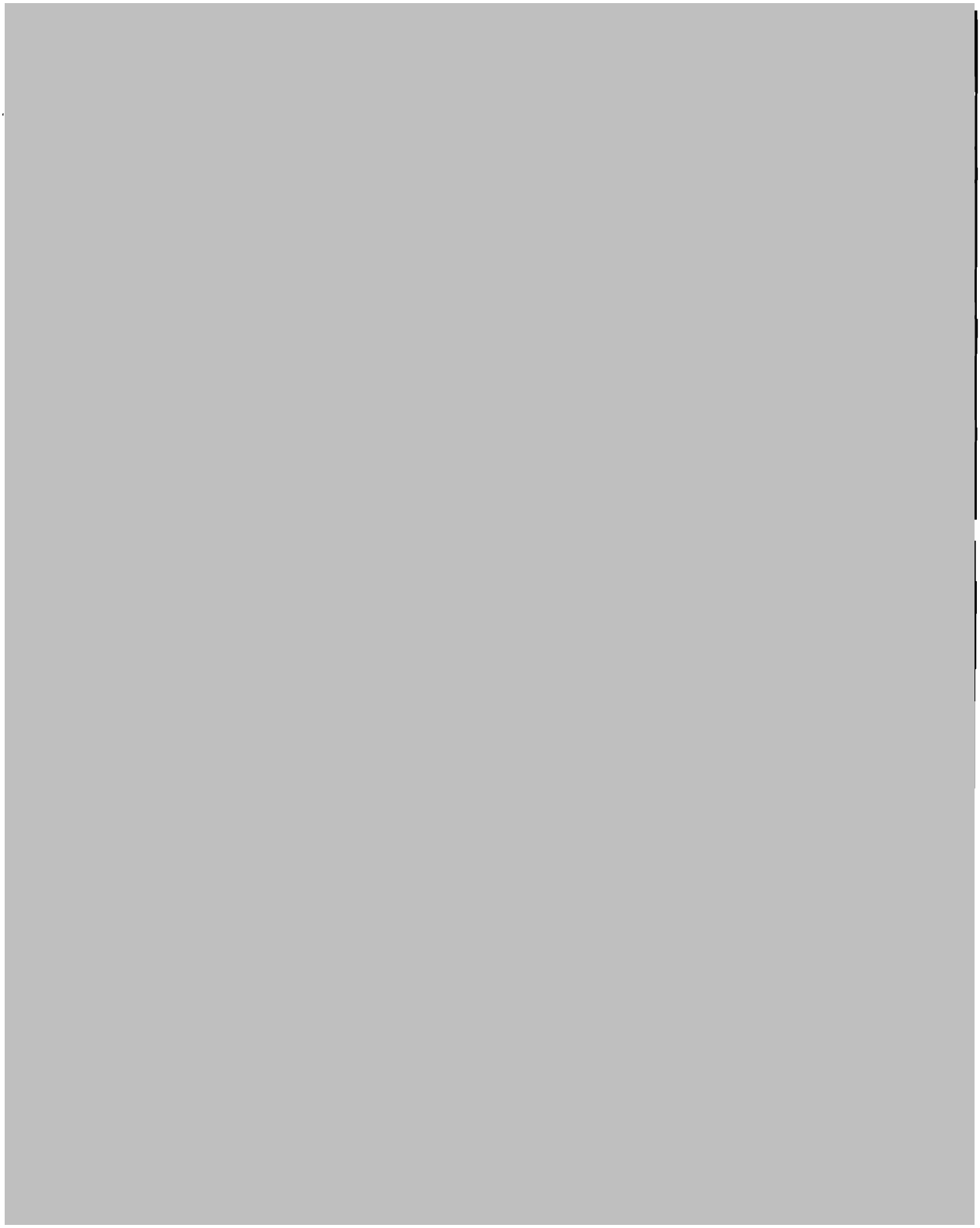

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TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

U.S. Army Corps of Engineers
Sacramento District
July 2005

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EXHIBITS

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Abbreviations and Acronyms

ac	acres
ac-ft	acre-feet (the volume of an acre one foot deep)
API	Antecedent Precipitation Index
BMP	Basin Mean Precipitation
BOR	United States Bureau of Reclamation
C	Celsius
CDEC	California Data Exchange Center
CESPD	U.S. Army Corps of Engineers, South Pacific Division
CESPK	U.S. Army Corps of Engineers, Sacramento District
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
Corps	U.S. Army Corps of Engineers
cu-yd	cubic yards
CWMS	Corps Water Management System
dam^3	cubic dekameter
DCP	Data Collection Platforms
dm	decimeter
DWR	California Department of Water Resources
EA	environmental assessment
EIP	Environmental Inventory Paper
EIS	Environmental Impact Statement
elev	elevation
EM	Engineering Manual, U.S. Army Corps of Engineers
EOC	Emergency Operations Center
ERB	Environmental Review Board
ESA	Endangered Species Act
ER	Engineering Regulation, U.S. Army Corps of Engineers
ETL	Engineering Technical Letter, U.S. Army Corps of Engineers
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulation Commission
ft	feet
GOES	Geostationary Operational Environmental Satellite
ha	hectare
HADA	Hydrometeorologic Automatic Data Acquisition System
hm	hectometer
hm^2	square hectometer
hm^3	cubic hectometer
in	inches
km	kilometer
km^2	square kilometer
kv	kilovolts
kVA	kilovolt-Ampere
kW	kilowatt
kWh	kilowatt hours
LOS	Line-of-sight (radio)
m	meter
m^2	square meter
m^3	cubic meter
m^3/s	cubic meters per second
mgd	million gallons per day
mi	mile
mi^2	square mile
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSL	Mean Sea Level
MW	Megawatts
NAP	Normal Annual Precipitation

NAVD	North American Vertical Datam
NEPA	National Environmental Policy Act
NEXRAD	The Next Generation Weather Radar System
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanographic Atmospheric Administration
NWS	National Weather Service (an organization of NOAA)
OMP	Operations Management Plan
PAO	Public Affairs Officer
PC	Personal Computer
pf	power factor
PL	Public Law
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PMS	Probable Maximum Storm
PPM	parts per million
PRV	Pressure Regulator Valve
QPF	Quantitative Precipitation Forecast
RDF	Reservoir Design Flood
RFC	Joint Federal-California State River Forecast Center
RKM	River Kilometer
RM	River Mile (Pacific Southwest Interagency Committee)
RPM	Revolutions Per Minute
SDAT	California State Drought Action Team
SDF	Spillway Design Flood
SFD	Second Foot Day
SOP	Standard Operation Procedure (or standard format)
SPF	Standard Project Flood
SPK	U.S. Army Corps of Engineers, Sacramento District
TDS	Total Dissolved Solids
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
WAN	Wide Area Network
WCD	Water Control Diagram
WCM	Water Control Manual
WCDS	Water Control Data System
WCP	Water Control Plan
WRDA	Water Resources Development Act
yr	year

Abbreviations Special to this Manual

KDWCD	Kaweah Delta Water Conservation District
KRPA	Kaweah River Power Authority
MTBE	Methyl Tertiary-Butyl Ether
RTU	Remote Telemetry Unit
SCE	Southern California Edison
SHEF	Standard Hydrologic Exchange Format
TLBWSD	Tulare Lake Basin Water Storage District
TRMPC	Terminus Dam Project Computer
UPS	Uninterrupted Power Supply

CONVERSION CONSTANTS

LENGTH AND HEIGHT		
TO CONVERT ENGLISH UNITS	MULTIPLY BY	TO OBTAIN METRIC
in	2.54	cm
ft	0.3048	m
mi	1.609	km
AREA		
ft^2	0.0929	m^2
ac	4047	m^2
ac	0.4047	ha
mi^2	2.590	km^2
VOLUME		
ft^3	0.02832	m^3
mgd	0.04381	m^3/day
ac-ft	0.001233	hm^3
ac-ft	1233	m^3
MISCELLANEOUS		
Slope in ft/mi	0.1894	m/km
ac-ft/mi^2	476.1	m^3/km^2
Fahrenheit	(F - 32) 5/9	Celsius

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USACE Sacramento District Datum Documentation Report

Project: Terminus Dam/Lake Kaweah

NGVD 29To NAVD 88 Datum Conversion Factor: add 2.59ft.

Datum Conversion Procedure: The USACE Mapping Unit and A-E Contractor performed field measurements with known historical elevations. All documentation and raw data is filed with the USACE Sacramento District Mapping Unit. All survey and gage control is in US feet and is tied to NGS monument DH6689. For questions or comments contact the Sacramento District Datum Coordinator. The results of this survey produced an averaged difference between NGVD 29 and NAVD 88 of 2.59 feet for the USACE Terminus Dam/ Lake Kaweah civil works project

Station ID	COE-NGVD29 record	NAVD 88	Difference
KT2-66	775.00	777.68	2.68
KT2-60	749.68	752.38	2.70
Term Azimuth	758.09	760.67	2.58
Term Base	764.76	767.15	2.39
			2.587
Averaged Delta = 2.59ft conversion factor Terminus Dam/Lake Kaweah			

Accuracy Statement: The NAVD88 datum conversion accuracy is: =/- 0.25 feet to real work NAVD 88 elevations per EC- 1110-2-6065 Comprehensive Evaluation of Project Datums. The stated conversion factor is for planning, operations, water management and legacy conversion only. All future design work and survey work shall adhere to the NAVD 88 datum and follow EM 1110-1-1005 Control and Topographic Surveying. Contact the USACE Sacramento District's survey unit or the district's datum coordinator for current survey control.

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER
Tulare County, California

PERTINENT DATA
(IP Units)

GENERAL

Location	
[redacted]	[redacted]
County	Tulare
State	California
Drainage areas	
Kaweah River at McKay Point	647 sq mi
Kaweah River at Terminus Dam	561 sq mi
Kaweah River at Three Rivers	418 sq mi
Dry Creek near Lemon Cove	80 sq mi
Flows at Terminus	
Mean annual (1904-2004)	431,300 ac-ft
Average depth on basin	14.1 in
Average flow	595 cfs
Maximum flow (6 December 1966)	105,000 cfs
Minimum flow	8 cfs
Standard project peak inflow	117,700 cfs
Standard project peak outflow	47,370 cfs
Spillway design peak inflow	337,500 cfs
Spillway design peak outflow	308,400 cfs

RESERVOIR

Elevation	
Dead pool	520.0 ft
Conditional winter pool	584.8 ft
Gross pool	715.0 ft
Taking line	720.0 ft
Spillway design flood pool	747.1 ft
Area	
Dead pool	16 ac
Conditional winter pool	425 ac
Gross pool	2,154 ac
Taking line	2,215 ac
Spillway design flood pool	2,528 ac
Storage capacity	
Dead Pool	33 ac-ft
Conditional winter pool	12,000 ac-ft
Gross pool	185,630 ac-ft
Taking line	196,552 ac-ft
Spillway design flood pool	261,270 ac-ft
Reservoir length at gross pool elevation	6 mi

SPILLWAY

[redacted]

MAIN DAM

[redacted]

AUXILIARY DAM

[redacted]

MOTEL DIKE

MAIN OUTLET

Total capacity of outlets with water surface at
Elevation 584.8 ft (conditional winter pool) 5,200 cfs
Elevation 715.0 ft (gross pool) 8,900 cfs

POWER OUTLET

FOOTHILL DITCH DIVERSION
AND CONTROL WEIR

Discharge at elevation 496.0 ft 40 cfs
Required discharge 40 cfs

RUNOFF

1" precipitation runoff= 29,901 ac-ft

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER
Tulare County, California

PERTINENT DATA
(SI Units)

GENERAL

Location	
County	Tulare
State	California
Drainage areas	
Kaweah River at McKay Point	1,675 sq km
Kaweah River at Terminus Dam	1,453 sq km
Kaweah River at Three Rivers	1,083 sq km
Dry Creek near Lemon Cove	207 sq km
Flows at Terminus	
Mean annual (1904-2004)	532 hm^3
Average depth on basin	35.8 cm
Average flow	16.9 m^3/s
Maximum flow (6 December 1966)	2,793 m^3/s
Minimum flow	0.22 m^3/s
Standard project peak inflow	3,333 m^3/s
Standard project peak outflow	1,342 m^3/s
Spillway design peak inflow	9,558 m^3/s
Spillway design peak outflow	8,734 m^3/s

RESERVOIR

Elevation	
Dead pool	158.5 m
Conditional winter pool	178.2 m
Gross pool	217.9 m
Taking line	219.5 m
Spillway design flood pool	227.7 m
Area	
Dead pool	6 ha
Conditional winter pool	172 ha
Gross pool	872 ha
Taking line	896 ha
Spillway design flood pool	1,023 ha
Storage capacity	
Dead Pool	0.4 hm^3
Conditional winter pool	14.8 hm^3
Gross pool	228.9 hm^3
Taking line	242.3 hm3
Spillway design flood pool	322.1 hm^3
Reservoir length at gross pool elevation	9.7 km

SPILLWAY

MAIN DAM

AUXILIARY DAM

MOTEL DIKE

MAIN OUTLET

Total capacity of outlets with water surface at
Elevation 178.2 m (conditional winter pool) 147.3 m^3/s
Elevation 217.9 m (gross pool) 252.0 m^3/s

FOOTHILL DITCH DIVERSION
AND CONTROL WEIR

Discharge at elevation 496.0 ft 1.1 m^3/s
Required discharge 1.1 m^3/s

RUNOFF

2.5 cm precipitation runoff= 36.9 hm^3

I - INTRODUCTION

1-01. Authorization. This Water Control Manual is for the Terminus Dam and Lake Kaweah Project, located on the Kaweah River in California, and is Appendix III to the Tulare Lake Basin Master Water Control Manual. It is prepared in accordance with instructions contained in:

EM 1110-1-1004	Engineering and Design – Geodetic and Control Surveying	1 June 2002
ER 1110-2-240	Engineering and Design – Water Control Management	8 October 1982
ER 1110-2-249	Management of Water Control Data Systems	31 August 1994
EM 1110-2-3600	Management of Water Control Systems	30 November 1987
ER 1110-2-8156	Preparation of Water Control Manuals	31 August 1995
ETL 1110-2-335	Development of Drought Contingency Plans (1944 Flood Control Act)	1 April 1993
CESPD-R-1110-2-8	Guidance on the Preparation of Deviations from Approved Water Control Plans	12 September 2002

All instructions pertain to requirements for reports on reservoir regulation.

1-02. Purpose and Scope. This manual contains descriptive information, a detailed plan for water control management, and a Water Control Diagram for the Terminus Dam and Lake Kaweah Project on the Kaweah River in California. It also assigns responsibilities for water control operation of the project. A description of the overall Tulare Lake Basin plan for flood control is given in the "Master Water Control Manual, Tulare Lake Basin, California."

1-03. Related Manuals and Reports. This manual replaces the "Terminus Dam (Lake Kaweah) Reservoir Regulation Manual" dated June 1962, revised November 1971. The Terminus Dam and Lake Kaweah Water Control Manual is Appendix III to the Tulare Lake Basin Master Water Control Manual. Other related manuals and reports are as follows:

Manuals	Date
[redacted]	[redacted]

Reports	Date
[redacted]	[redacted]
DM 1 Relocations	1 Jul 1956
Supplement #1	11 Mar 1959
DM 2 Real Estate	22 Oct 1956
Supplement #1	1 Jul 1957
[redacted]	
[redacted]	[redacted]
DM 7 Reservoir Clearing	15 Feb 1959
DM 8 Initial Public-Use Facilities	Apr 1961
[redacted]	[redacted]
DM9B-C1 Recreational Development at Areas 2, 3, 4, 5, and 6	Dec 1964
[redacted]	[redacted]
Kaweah River Basin Investigation, Reconnaissance Report	Jul 1987
Kaweah River Basin Hydrology	Aug 1990
Kaweah River Basin Investigation Feasibility Study, California – Final Feasibility Report	Sep 1996
Kaweah River Basin Investigation Feasibility Study, California – Final Environmental Impact Statement/ Environmental Impact Report	Sep 1996
[redacted]	[redacted]

1-04. Project Owner. The Terminus Dam and Lake Kaweah Project is owned by the U.S. Government and represented by the U.S. Army Corps of Engineers, Sacramento District.

1-05. Operating Agency. The U.S. Army Corps of Engineers, Sacramento District, operates the Terminus Dam and Lake Kaweah Project. [redacted] Operational responsibilities are explained in detail in Exhibit A. [redacted]

1-06. Regulating Agencies. The U.S. Army Corps of Engineers, Sacramento District, regulates the Terminus Dam and Lake Kaweah Project. The Corps developed the Water Control Plan for

Lake Kaweah with the objective of obtaining the greatest possible benefits from flood control, irrigation, and recreation. The Kaweah Delta Water Conservation District (KDWCD) directs releases for purposes other than flood control. For more detailed information on KDWCD operational responsibilities, refer to Exhibit A. Personnel responsible for project operation are listed in the front of this manual and in Exhibit A.

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II - DESCRIPTION OF PROJECT

2-01. Location. The Terminus Dam and Lake Kaweah Project is located in the southern half of the Central Valley in Tulare County, California, on the Kaweah River, approximately 21 miles (33.8 km) east of the city of Visalia. Lake Kaweah is located entirely within Tulare County and is accessible via State Highway 198. The location of the project is shown on the General Map, Plate 2-1. Its geographic coordinates are:

2-02. Purpose

a. The Terminus Dam and Lake Kaweah Project was authorized for the purposes of flood control, irrigation, and recreation. In addition, general congressional acts have authorized fish and wildlife purposes. The capability for hydropower is incidental to these purposes. Details of hydropower construction history and operation are in Paragraph 7-10. The hydropower facilities, however, are not to be considered part of the federally funded facilities.

b. The following Congressional acts apply to Terminus Dam and Lake Kaweah:

(1) PL 85-624 Fish and Wildlife Coordination Act of 1958

(2) PL 93-205 Endangered Species Act of 1973

(3) PL 92-500 Federal Water Pollution Control Act Amendments of 1972 (water quality)

(4) PL 102-240 Clean Air Act of 1990

(5) PL 91-190 National Environmental Policy Act of 1969 (environmental protection)

(6) PL 89-665 National Historic Preservation Act of 1966 (historical and archaeological data preservation)

(7) PL 87-874 Flood Control Act of 1962

(8) PL 101-640 Water Resources Development Act of 1990, Section 310(b)

(9) Water Resources Development Act (WRDA) of 1996

2-03. Physical Components. An Area Map is shown on Plate 2-2. All elevations in this manual are based on the National Geodetic Vertical Datum of 1929 (NGVD29). As directed by EM 1110-1-1004, the datum has been changed to the North American Vertical Datum of 1988 (NAVD88). The elevations in this manual do not reflect the NAVD88. Pertinent data for the project are tabulated at the front of this manual.

a. Reservoir. Lake Kaweah has a shoreline of approximately 30 miles (48.3 km) and is 6 miles (9.7 km) in length. At gross pool, 715.0 feet MSL (217.9 m), the reservoir water surface area is 2,154 acres (871.7 ha) and has a maximum depth of about 215 feet (65.5 m). Lake capacity at gross pool is 185,630 acre-feet (228.9 hm^3), of which a maximum of 173,630 acre-feet (214.1 hm^3) is allocated during the rainflood season. The entire storage capacity of the reservoir may be allocated for snowmelt runoff, if required. Lake Kaweah is shown on the Area Map, Plate 2-2 and Photo 2-1. The Area-Capacity Curves and the Area-Capacity Table for the lake are shown on Plates A-1 and A-2, respectively.

b. Embankments.

c. Dike. In 2003, as construction was under way to raise Terminus Dam 21 feet (6.4 m), several alternatives were being considered to protect a private motel at the upstream end of the lake from flood damage during a 1 percent event. With the completion of the dam raise in December 2003 and without mitigation, at approximately gross pool (715 feet (217.9 m)) water would have reached the motel property; at approximately 716.5 feet (218.4 m) it would have reached the buildings. Construction of a dike to protect the motel was begun in October 2004 and completed in April 2005.

d. Outlet Works.

A stage-discharge rating curve for the Kaweah River below Terminus Dam is shown on Plate A-7, and the stage-discharge rating curve for Foothill Ditch is shown on Plate A-8.

[redacted]

[redacted] Several spillway designs and sizes were studied during the reconnaissance and feasibility studies for enlarging the reservoir capacity. The decision to raise the spillway by using fusegates was based on the costs involved, the required modification of the existing spillway channel, and the ability to pass the Spillway Design Flood with the required freeboard.

The Probable Maximum Flood (PMF) was used to establish the number of gates needed to pass the PMF. The number of gate failures was determined from various flood events. The first gate failure would occur during an approximate 0.01 percent flood. The maximum PMF pool was established as 747.12 feet MSL (227.7 m) and 2.88 feet (0.9 m) of freeboard. The Plan, Profile, and Intake of the spillway are shown on Plate 2-7. The Spillway Rating Curve for Terminus Dam is presented on Plate A-4.

[redacted]

[redacted]

[redacted]

2-04. Related Control Facilities. The Terminus Dam and Lake Kaweah Project consists of the dam, reservoir, dike, and appurtenant facilities. Mitigation for the raised spillway's effects on wildlife habitat will occur at four locations.

The riparian mitigation site is located along Dry Creek about 2 miles (3.2 km) from Lake Kaweah. The site consists of about 35 acres (14.2 ha) and is located adjacent to the creek. Cattle have grazed the site in the past. Vegetative communities consist of sycamore alluvial woodland, grassland, and cottonwood/willow riparian scrub. The site has good potential for re-vegetation of riparian forest and scrub habitat.

The endangered species mitigation site is located on Corps property downstream from Terminus Dam adjacent to the pond below the reservoir. The site includes two mitigation areas totaling about 4.2 acres (1.7 ha). Vegetation in the area consists of elderberry plants with associated riparian forest and scrub species.

The oak woodland mitigation area consists of 4,300 acres (1,740.2 ha) located at the Davis Ranch. The ranch is located on the divide between Dry Creek and the north fork of the Kaweah River, about 5 miles (8.0 km) north of Lake Kaweah in Tulare County. The ranch includes three drainages: Mankins Creek, Greasy Creek, and the east fork of Dry Creek. Elevations on the Davis

Ranch range from a low elevation of 1,600 feet (487.7 m) to a high elevation of 3,552 feet (1,082.6 m). The ranch is an operating cattle ranch with little vegetation manipulation since moderate clearing in the 1950's. Most of the property is relatively untouched by humans and is in a near natural condition. Small stock ponds are scattered over the ranch. Vegetation on the ranch includes blue oak woodland, mixed woodland, valley oak woodland, non-native grassland, and chaparral vegetation. Due to the near natural condition, this vegetation provides high value habitat for wildlife.

The mitigation site for flooded agricultural areas in Tulare Lakebed is located in Kings County, north of the city of Corcoran. The mitigation site is located east of State Highway 43, north of Nevada Avenue, west of Sixth Street, and south of Kansas Avenue. The site encompasses 1,289.62 acres (521.9 ha) and includes 11 wells. Cattle grazing occurs year-round depending upon vegetation. There has been no surface irrigation water applied or used on the mitigation site. In the past the site has generally not been farmed. As landowner, Corcoran Irrigation District now owns the fee title to the underlying land encumbered by the easement. Canal levees exist along the west and northern portions of the mitigation site, and an estimated 25-acre pond (10.1 ha) has intermittently formed in a former borrow area on the site. Surface runoff is the source of the water for this pond.

No other improvements outside the reservoir area, except the mitigation areas listed above, were made under the authority of this project; however, local interests have made channel improvements downstream.

2-05. Real Estate Acquisition. Project lands consist of approximately 5,263.5 acres (21.3 km^2) acquired in fee, 635.1 acres (2.6 km^2) under easement, and 0.2 acres (809.4 m^2) under lease or permit. The real estate boundaries are shown on Plate 2-9.

2-06. Public Facilities. Most recreation use at Lake Kaweah occurs in and originates from the developed south and west shores of the lake. Some use occurs in undeveloped areas and the wildlife management area. Recreation at Lake Kaweah includes picnicking, camping, fishing, water skiing, swimming, boating, hiking, and sightseeing. Recreational facilities available at Lake Kaweah are shown on Plate 2-9.

Visitation records have been kept for Lake Kaweah since 1962. Since that time, visitation has fluctuated considerably, with the highest visitation recorded in 1982 (3,030,000 visitor hours). Annual visitation is shown in Table 2-1 for the years 1962 through 2004.

TABLE 2-1
LAKE KAWEAH ESTIMATED ANNUAL VISITATION
(1,000 Visitor Hours)

Year	Attendance	Year	Attendance
1962	324	1984	1,953
1963	558	1985	2,025
1964	1,029	1986	1,988
1965	1,272	1987	1,997
1966	1,107	1988	2,192
1967	601	1989	1,948
1968	918	1990	2,238
1969	839	1991	2,192
1970	960	1992	2,333
1971	993	1993	2,035
1972	807	1994	1,705
1973	691	1995	1,953
1974	786	1996	1,955
1975	1,048	1997	1,679
1976	915	1998	2,012
1977	864	1999	1,973
1978	1,453	2000	1,864
1979	1,477	2001	2,208
1980	1,417	2002	2,385
1981	1,844	2003	2,811
1982	3,030	2004	2,676
1983	2,483	Average	1,617

Source: U.S. Army Corps of Engineers, Sacramento District, Operations Technical Section

Photo 2-1. Lake Kaweah, looking east.

Photo 2-2. Terminus Dam-Lake Kaweah, looking north.

Photo 2-3. Terminus Dam, looking north from control tower road.

Photo 2-4. Terminus Dam outlet

Photo 2-5. Terminus Dam gates

Photo 2-6. Terminus Dam fusegate intake

Photo 2-7. Terminus Dam fusegate spillway

Photo 2-8. Terminus Power Project powerhouse and tailrace

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III - HISTORY OF PROJECT

3-01. Authorization. The Terminus Dam and Lake Kaweah Project was authorized by the Flood Control Act of 1944, approved 22 December 1944. The pertinent portion of the Flood Control Act of 1944 is as follows:

> "The plans for Terminus and Success Reservoirs on the Kaweah and Tule Rivers for flood control and other purposes in the San Joaquin Valley, California, in accordance with the recommendations of the Chief of Engineers in Flood Control Committee Document Number 1, Seventy-Eighth Congress, Second Session, is approved, and there is hereby authorized $4,600,000 for initial and partial accomplishment of the plan."

By joint resolution of the Senate and House of Representatives, Public Law 87-858, Eighty-Seventh Congress, House Joint Resolution 417, 6 August 1962, the reservoir formed by the Terminus Dam was designated as "Lake Kaweah." All document references to "Terminus Reservoir" refer to the reservoir formed by Terminus Dam and designated as "Lake Kaweah" in H.J. Res. 417.

The Water Resources Development Act (WRDA) of 1996 authorized the modifications to the Terminus Dam spillway and expansion of the reservoir pool. Details of the modifications and related documentation can be found in the following reports: "Kaweah River Basin Investigation Feasibility Study, California – Final Feasibility Report," September 1996; Kaweah River Basin Investigation Feasibility Study, California – Final Environmental Impact Statement/ Environmental Impact Report," September 1996, and [redacted]. The Environmental Impact Statement/Environmental Impact Report includes documentation on the affected environment, mitigation measures and environmental requirements pertaining to the WRDA authorization.

3-02. Planning and Design. In Committee Document Number 1, Seventy-Eighth Congress, Second Session, dated 1944, the Chief of Engineers recommended a reservoir capacity of 100,000 acre-feet (123.3 hm^3). In the Comprehensive Report on Sacramento-San Joaquin Basin Streams and the Supplement thereto, published as House Document 367, Eighty-First Congress, First Session, dated 1944, the Chief of Engineers recommended a reservoir capacity of 145,000 acre-feet (178.8 hm^3). No specific reservation for sediment accumulation was defined. The reservoir capacity was increased from 100,000 acre-feet (123.3 hm^3) to the recommended 145,000 acre-feet (178.8 hm^3) by letter from Sacramento District to South Pacific Division dated 28 September 1951, subject "Supplement No. 2, Preliminary Definite Project Report, Terminus Project, Kaweah River, California." By the Sixth Endorsement, dated 3 December 1952, the Chief of Engineers stated that the capacity of 145,00 acre-feet (178.8 hm^3) would be approved for design purposes if the State of California would not actively oppose the increased capacity. Subsequent to that date, the State appeared before the Bureau of the Budget and Appropriations Committees in support of

the project as modified for the 145,000 acre-foot (178.8 hm^3) capacity.

At a 9 May 1956 conference, representatives of the Office, Chief of Engineers, USACE South Pacific Division (SPD), and USACE Sacramento District (SPK) decided to increase the total reservoir capacity to 150,000 acre-feet (184.9 hm^3), including a reservation of 8,000 acre-feet (9.9 hm^3) of that amount for future sedimentation and for other project uses. The 8,000 acre-feet (9.9 hm^3) of inactive storage space could be used for a recreation pool by local interests if they provided the necessary water.

Storage was required to be evacuated to a minimum pool level of 8,000 acre-feet (9.9 hm^3) from 1 November to 31 March, and the entire capacity of 150,000 acre-feet (184.9 hm^3) was reserved when needed for control of forecasted snowmelt runoff. Storage of irrigation water from 1 April was made conditional upon the amount of snowmelt runoff predicted to occur between the given date and 31 July. The latest Water Control Diagram permits conditional carryover storage during the November through March period, based on watershed precipitation.

3-03. Construction. Construction funds were initially appropriated in fiscal year 1957, but relatively little was accomplished until fiscal year 1959, due to the inadequacy of authorized funds. Construction on the main dam and appurtenances was begun during February 1959. Closure of the dam was completed in November 1961, and the project was certified complete and accepted by the government for operation on 1 June 1962. State highway and county roads were relocated.

In August 1986, the Kaweah River Power Authority was granted FERC license number 3747 to construct and operate a 17 MW capacity power plant at Lake Kaweah. Construction of the Terminus Power Project was initiated in 1987 with completion in 1990. The Terminus Power Project is described fully in Paragraph 2-03f.

Construction of the Terminus Dam spillway raise and associated projects was initiated in 2002 and was completed in February 2004. Mitigation areas associated with the spillway raise are discussed in Section 2-04.

3-04. Related Projects. The Terminus Dam and Lake Kaweah Project provides flood protection to the Kaweah River, and is also part of a system of reservoirs providing flood protection to the Tulare Lakebed and adjacent areas. Major releases to the Tulare Lakebed may come from Pine Flat Lake on the Kings River, Success Lake on the Tule River, and Isabella Lake on the Kern River.

The Friant-Kern Canal, part of the Bureau of Reclamation's Central Valley Project (CVP), crosses the St. Johns and Kaweah rivers approximately 6 miles (9.7 km) downstream from Terminus Dam. The Friant-Kern Canal delivers irrigation water to the Kaweah River and has the potential to export floodwaters out of the basin. Related mitigation sites are discussed in Section 2-04.

3-05. Modifications to Regulations. Throughout the years, various changes have been made to the Water Control Diagram based on physical changes in the project and on updated hydrology. In 1972, the Water Control Diagram was changed to permit conditional carryover storage of water, up to 7,000 acre-feet (8.6 hm^3) above minimum pool level 8,000 acre-feet (9.9 hm^3), during the November through March period. This conditional carryover is based on the basin watershed precipitation and is discussed in Exhibit A.

Sediment surveys made in 1977 show that the reservoir capacity has decreased from 150,000 acre-feet (184.9 hm^3) to 143,000 acre-feet (176.3 hm^3). The Water Control Diagram was adjusted by decreasing the sediment pool. Sedimentation is discussed in Section 4-04.

The current Water Control Diagram was developed based on historical operation and new hydrology in conjunction with the gross pool of the reservoir being raised 21 feet (6.4 m).

3-06. Principal Regulation Problems. The Terminus Dam and Lake Kaweah Project is operated so that flows will not exceed 5,500 cfs (155.8 m^3/s) on the Kaweah River at McKay Point. Dry Creek and Yokohl Creek are the major uncontrolled tributaries to the Kaweah River below Terminus Dam. These tributaries can produce high magnitude flows that require rapid release changes from the dam. During rain floods, flows on Dry Creek must be considered on a short-term basis. Local flow from Dry Creek must be added to reservoir releases to assure that the desired flow at McKay Point is not exceeded. Yokohl Creek enters the Kaweah River below McKay Point. Downstream channel capacities are discussed in Section 4-09 and shown on Plate A-12.

The Kaweah River is part of the closed Tulare Lakebed basin. Releases above irrigation and spreading demands cause damaging flows to agricultural lands in the lakebed. The irrigation and spreading demands are substantial, but are reduced during periods of heavy rainfall.

As part of the spillway raise project, a mitigation site has been established in the Tulare Lakebed. The area is discussed in Section 2-04. Flood releases, as designated by the Corps of Engineers, in excess of irrigation and spread demands will be diverted as required in the Tulare Lakebed operations and maintenance manual.

Although Terminus Dam is operated for flows in the Kaweah River, it is part of a four-reservoir system contributing water to the Tulare Lakebed area. The Tulare Lakebed area has an extensive levee and diversion system designed to manage irrigation flows and minor flood flows from the four projects and the surrounding uncontrolled drainage area. However, flows in the Kaweah River which are less than the design flows and large uncontrolled runoff may cause flooding damage to agricultural areas in the Tulare Lakebed area. The magnitude of flows may exceed the diversion system capacity and damage land protected by the levee system or adjacent areas. Whenever possible, releases from the reservoir should reflect consideration of the conditions in all downstream channels and the operation of the other three projects.

In the winter, due to wet conditions and sedimentation in the reservoir, the Water Control Diagram requires the reservoir to be lowered to a minimal level, causing problems for the marina. Large inflow to Lake Kaweah can cause the lake to rise at a rapid rate. Rapid rises in the pool elevation require that boat docks, portable restrooms, the marina, and other project facilities be quickly moved to higher elevations.

Sedimentation since the project was constructed has been much greater than originally anticipated. Lake Kaweah was constructed with 8,000 acre-feet (9.9 hm^3) of space for sediment accumulation; however, a 1977 survey indicated that 7,000 acre-feet (8.6 hm^3) of sediment had accumulated by that time. Sedimentation is discussed in Section 4-04.

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics. The Kaweah River Basin is located in Central California, on the western slope of the Sierra Nevada. The Kaweah River flows in a westerly direction through the mountains and foothills, and then across the valley floor to Tulare Lakebed. For descriptive purposes, the project area is divided into the mountainous area above Terminus Dam and the foothill and valley floor below the dam. A map of the area is shown on Plate 4-1.

Above Terminus Dam, the watershed portion of the project is a fan-shaped mountainous area extending 35 miles (56.3 km) upstream into the western slope of the southern Sierra Nevada. Four main forks, flowing from the high eastern border of the basin in a southwesterly or westerly direction to their junction near the foothill line, form the Kaweah River. The slope of the north, middle, east, and south forks averages approximately 350 feet per mile (172 meters per kilometer), while numerous small tributary streams have slopes ranging from 400 to 1,000 feet per mile (196 to 490 meters per kilometer). These streams drain a combined area of 561 square miles (1453.0 km^2) at the dam. Basin features are shown on the General Map, Plate 2-1 and Photos 4-1 and 4-2.

Vegetative cover varies within the basin. Above Terminus Dam, the steep hillsides in the upper basin range from bare rock to coniferous forest. Vegetation on lower elevations consists of deciduous forests, brush, and grasslands. A discontinuous bank of riparian growth stretches through much of the lower basin. The area is sparsely settled and suitable for grazing, lumbering, mining, and recreation. More than half of the basin is within the Sequoia National Park and the Sequoia National Forest. Table 4-1 shows the Land Coverage Distribution on the Kaweah River basin above Terminus Dam.

TABLE 4-1
LAND COVERAGE DISTRIBUTION

DESCRIPTION	ELEVATION (feet)	PERCENT OF BASIN AREA
Grasslands (with scattered brush)	1,000 - 2,000	0.5
Brushlands (chaparral, etc.)	3,000 - 9,000	22.7
Deciduous Forest (with brush, scattered conifers, and grass)	500 - 6,000	26.3
Light Coniferous	5,000 -12,000	30.1
Heavy Coniferous	5,000 - 9,000	6.8
Sub-Alpine Forest	8,000 -10,000	4.3
Bare Rock, Lakes, etc.	9,000 -12,600	9.3
TOTAL		100.0

Source: Kaweah River Basin, California Hydrology Report, August 1990, U.S. Army Corps of Engineers

Dry Creek (Photo 4-3) enters the Kaweah River (Photo 4-4) about 1 mile (1.6 km) below Terminus Dam. Approximately 3 miles (4.8 km) below Terminus Dam at McKay Point weir (Photo 4-5), the flow may be split between the Kaweah (Photo 4-6) and St. Johns rivers. The northerly channel, known as the St. Johns River, flows westerly for about 23 miles (37.0 km), passes the city of Visalia on the north, and joins Cottonwood Creek to form Cross Creek. Cross Creek flows southwesterly about 35 miles (56.3 km) into Tulare Lakebed. The southerly channel, which retains the name Kaweah River, continues south for about 4 miles (2.4 km) and then divides into numerous channels above Visalia. Mill Creek flows in a westerly direction through the city of Visalia before entering Cross Creek. These channels normally transport water for irrigation and spreading. Flows in excess of this demand eventually join the Tule River and then enter the Tulare Lakebed. Tulare Lakebed is a closed basin with no natural drainage to the ocean. Flooding in the Lakebed will continue until excess water is evaporated and/or pumped out of the basin.

The area below Lake Kaweah is predominately agricultural; however, there are numerous towns in the area. Visalia, 12 miles (19.3 km) west, is the largest, with a population of approximately 100,000.

4-02. Topography. The area above the dam is steep mountainous terrain. Below the dam there are foothills which transition into an alluvial fan, and flatlands that gently slope to Tulare Lakebed. Elevations range from about 12,600 feet MSL (3,840.5 m) in the upper basin to 510 feet MSL (155.4 m) at the dam, and 325 feet MSL (99.1 m) at Visalia down to about 175 feet MSL (53.3 m) at Tulare Lakebed. The topographic map is on Plate 4-1. The Area-Elevation Curve and Stream Profiles of principal streams are shown on Plates 4-2 and Plate 4-3, respectively. Table 4-2 shows the elevation distribution of the basin area above Terminus Dam.

TABLE 4-2
ELEVATION DISTRIBUTION

ELEVATION (Feet)	PERCENT OF BASIN AREA ABOVE ELEVATION
510	100
2,000	88
4,000	67
5,000	57
6,000	45
8,000	22
10,000	10
12,000	1

Source: Kaweah River Basin, California Hydrology Report, August 1990, U.S. Army Corps of Engineers

4-03. Geology and Soils. The Kaweah River flows in a westererly direction over a portion of the igneous rock of the southern Sierra Nevada batholith. These igneous rocks vary in mineral composition and color, but are collectively referred to as granite. The Kaweah River is deeply entrenched in its present course and is a degrading stream, having relatively thin alluvial deposits on the valley floor. Most of the regional rock in the Kaweah River is granite, which covers approximately three fourths of the basin. Rocks in this area of the Sierra Nevada and the foothill region can be categorized into one of four groups: (1) Paleozoic metamorphic rock (Calaveras Complex and equivalents), (2) late Paleozoic-Mesozoic metamorphic rock (Kings River ophiolite and Kings-Kaweah suture), (3) Mesozoic metamorphic rock (Mariposa and Logtown Ridge formations), and (4) Mesozoic granitic rock (Sierra Nevada batholith). Rocks in the Calaveras Complex are found as numerous roof pendants with the Jurassic-Cretaceous plutonic rocks of the Sierra Nevada batholith. These rocks had originally extended across much of the Sierra Nevada but have been stripped off by uplift and subsequent erosion. The Lemoncove Schist and Quartzite that underlie Terminus Dam probably belong to this unit. The basic intrusives, meta-volcanic, and meta-sediments form prominent, resistant ridges. These rock types, due to their prominence, appear to be more extensive than they actually are. In general, the rock formations of the Kaweah River region are characteristic of the bedrock complex of the western slope of the Sierra Nevada: generally metamorphosed sediments and volcanics, mostly metamorphosed diorite and gabbro intrusives and granite batholith. The younger sediments of the area include old terrace deposits and recent alluvium.

Several minor faults are located in the area. Regionally, the dam is within 90 miles (144.8 km) of the Garlock and San Andreas fault, 75 miles (120.7 km) of the White Wolf fault, and about 50 miles (80.5 km) of the Sierra Nevada and Pond-Poso faults.

4-04. Sediment. The allocation of sediment space is discussed in Paragraphs 3-02 and 3-05. When Terminus Dam construction was completed in 1962, it was believed that Lake Kaweah had a capacity of 150,000 acre-feet (185.0 hm^3). A 1977 survey showed that Lake Kaweah had a capacity of 143,000 acre-feet (176.3 hm^3). Recent studies on the Kaweah River indicated that the normal rate of sediment accumulation in the reservoir is about 0.21 acre-feet per square mile (1 m^3 per 1 km^2) per year. Since Kaweah River basin above Lake Kaweah is 561 square miles (1,453 km^2), this amounts to 120 acre-feet (0.1 hm^3) of sediment per year. These ranges were not revised with the spillway crest elevation raise.

Twenty-seven monumented sedimentation ranges, as indicated on Plate 4-4, were established before any reservoir operation was initiated. These sedimentation ranges are used to measure sedimentation within the reservoir. Two of these range lines cross the river below the dam, while the remaining range lines are spaced so that no range represents more than 10 percent of the potential sediment accumulation in the reservoir. Each profile is recorded on a permanent drawing to a horizontal scale of 1 inch to 20 feet. Reconnaissance surveys of the sedimentation ranges are made as deemed necessary.

General surveys of the reservoir area were made in 1961 and 1977. The data from these surveys are shown in Table 4-3. Area capacity tables were revised after each survey.

TABLE 4-3 RESERVOIR SEDIMENTATION			
DATE	SURFACE AREA (acres)	CAPACITY (acre-feet)	SEDIMENT (acre-feet below elev. 694.0 ft)
November 1961	1,945	149,600	0
October 1977	1,913	143,000	6,600
Source: U.S. Army Corps of Engineers, Sacramento District, Water Management Section			

There has not been a sediment survey of Lake Kaweah since October 1977. All storage capacities discussed within this Water Control Manual are based on the 1977 storage capacity data.

4-05. Climate

a. General. The climate of the valley area of the Kaweah River Basin is classified as dry and sub-humid, characterized by two well-defined seasons: long, hot, dry summers with very little rain, and moderate, wet winters. At high elevations the summers are cool and the winters severe. The location of climatological stations, normal annual precipitation isohyets, and snow courses are shown on Plate 4-5.

b. Temperature. Temperatures in the basin vary considerably. Temperatures on the valley floor range from lows slightly below freezing during the winter, to highs over 100 degrees Fahrenheit (37.8°C) during the summer. During the winter, the temperatures at 5,000 feet (1.5 km) and higher may remain below freezing for extended periods. The Mean Monthly and Annual Temperatures at Terminus Dam, Grant Grove, Three Rivers Edison Powerhouse 1, and Visalia are shown in Table 4-4.

c. Precipitation. Normal annual precipitation (NAP) varies throughout the Kaweah River drainage area, ranging from 15 inches (38.1 cm) on the valley floor to about 55 inches (139.7 cm) at the headwaters. Normal annual precipitation for the Kaweah River above Terminus Dam is about 33.0 inches (83.8 cm), with approximately 90 percent of the precipitation occurring between November through April. It generally occurs as rain below 5,000 feet (1.5 km) and as snow above that elevation; however, warm weather storms have produced rain up to 11,000 feet (3,353 m), which would cover most of the basin. Snow has occurred on the valley floor below the dam.

Winter precipitation is largely orographic and results from air masses traveling inland from the Pacific Ocean. From November through April, Pacific storms frequently cross the coasts of Northern and Central California. Severe winter storms may involve warm and moist maritime tropical air from the central Pacific. Occasionally, in winter or spring, a large circulation pattern will develop and steer many successive low-pressure systems across the coast, resulting in

prolonged periods of wet weather. Summer precipitation is usually in the form of occasional showers or thunderstorms, and occurs largely above the foothill portion of the basin. Such precipitation may be quite intense for short periods of time, but it is confined to relatively small areas. Although summer precipitation can produce a moderate rise in flow on minor tributaries, it generally does not significantly affect flow on the main streams.

The distribution of Normal Annual Precipitation (NAP) is shown on Plate 4-5. The Mean Monthly and Annual Precipitation at selected stations is given in Table 4-5.

TABLE 4-4
MEAN MONTHLY AND ANNUAL TEMPERATURES (°F)

Month	Terminus Dam (570 feet)	Grant Grove (6,600 feet)	Three Rivers Edison PH 1 (1,140 feet)	Visalia (325 feet)
January	45.8	34.7	47.1	45.8
February	50.1	34.7	50.8	51.4
March	54.2	35.6	54.2	55.9
April	59.0	39.8	59.6	60.9
May	66.8	46.9	67.6	67.8
June	73.9	56.5	75.9	74.7
July	79.8	63.2	82.1	79.5
August	78.6	62.9	81.1	77.9
September	73.8	57.6	75.2	73.1
October	64.6	49.2	65.2	64.9
November	54.9	40.1	53.2	53.0
December	47.4	35.7	46.6	45.2
Average Annual	62.5	46.5	63.3	62.6
Source:	USACE 1965-2004	NOAA 1949-2004	NOAA 1972-2004	NOAA 1952-2004

TABLE 4-5
MEAN MONTHLY AND ANNUAL PRECIPITATION

Month	Terminus Dam (570 feet)		Atwell (6,480 feet)		Bear Trap Meadow (6,800 feet)		Giant Forest (6,400 feet)		Hockett Meadow (8,500 feet)	
	inches	%	inches	%	Inches	%	inches	%	inches	%
Oct	0.85	5.60	1.64	4.06	1.89	4.02	1.59	3.85	1.51	3.83
Nov	1.75	11.54	4.49	11.11	4.95	10.53	3.60	8.73	3.83	7.18
Dec	2.29	15.10	6.03	14.92	7.44	15.82	6.45	15.64	5.99	15.19
Jan	2.88	18.98	7.31	10.00	8.04	17.10	7.00	16.97	6.80	17.25
Feb	2.51	16.55	6.56	16.23	8.46	17.99	7.80	18.91	7.16	18.16
Mar	2.57	16.94	6.36	15.73	7.33	15.59	6.29	15.25	6.58	16.69
Apr	1.35	8.90	3.44	8.51	3.83	8.14	3.47	8.41	3.68	9.34
May	0.44	2.90	1.78	4.40	2.06	4.38	1.50	3.64	1.62	4.11
Jun	0.17	1.12	0.75	1.86	0.77	1.64	0.74	1.79	0.72	1.83
Jul	0.02	0.13	0.48	1.19	0.53	1.13	0.71	1.72	0.71	1.80
Aug	0.02	0.13	0.48	1.19	0.30	0.64	0.56	1.36	0.54	1.37
Sep	0.32	2.11	1.10	2.72	1.42	3.02	1.54	3.73	1.28	3.25
Average Annual	15.17	100.0	40.42	100.0	47.02	100.0	41.25	100.0	40.76	100.0
Maximum Annual	28.87 (1969)		73.1 (1983)		99.2 (1969)		95.7 (1969)		72.3 (1969)	
Minimum Annual	5.50 (1977)		14.4 (1977)		16.4 (1977)		13.9 (1989)		15.9 (1977)	
Period of Record	1963-2004		1966-2004		1966-2004		1921 -2004		1965-2004	

Source: U.S. Army Corps of Engineers, Sacramento District, Water Management Section

d. Snowfall. Snow cover below 5,000 feet (1.5 km) is generally transient and may accumulate and melt a number of times during the winter season. Above 5,000 feet (1.5 km), the snow generally accumulates until late March, when the snowmelt season begins. Basin snowpack data for representative snow courses are presented in Table 4-6. Snow surveys are done each year by various agencies. The locations of the snow courses are shown on Plate 4-5. Table 4-7 (Tables Section, Page T4-1) presents the Forecasted and Actual Snowmelt Runoff into Lake Kaweah from 1933 through 2004.

TABLE 4-6
BASIN SNOWPACK

Snow Course / Elevation	Record Began	Depth in Inches			Water Content in Inches			
		1969 (Wet)	1996 (Avg)	1977 (Dry)	Average 1 Apr *	1983 (Wet)	1996 (Avg)	1977 (Dry)
# 243 Panther Meadow (9,500 feet)	1925	217.5	101.2	30.3	36.7	98.8	44.6	8.8
# 244 Hockett Meadow (8,500 feet)	1930	144.2	73.5	20.3	27.5	71.6	31.4	6.5
# 245 Mineral King (8,000 feet)	1948	138.0	44.8	9.5	20.6	63.8	21.8	2.5
# 246 Giant Forest (6,400 feet)	1930	108.4	25.7	4.4	14.7	49.9	11.8	1.6
# 292 Farewell Gap (9,500 feet)	1952	219.4	93.5	32.2	35.8	99.3	38.6	11.0

*Average for 1951-2000
Source: California Department of Water Resources
http://cdec.water.ca.gov/snow/current/snow/SNOWTAB7.html

e. Evaporation. Historical Mean Monthly and Total Evaporation rates for Lake Kaweah are shown in Table 4-8. The weather station was moved from the Terminus Power Project Substation site to the Park Headquarters in July 1987. The site was again moved to the Corps storage area below the dam in August 1996.

f. Wind. Historical Mean Monthly and Annual Wind movement at Terminus Dam are shown in Table 4-9. The weather station was moved from the Terminus Power Project Substation site to the Park Headquarters in July 1987. The site was again moved to the Corps storage area below the dam in August 1996.

TABLE 4-8 MEAN MONTHLY AND TOTAL EVAPORATION	
MONTH	MEAN EVAPORATION (in)
October	6.78
November	3.01
December	1.52
January	1.42
February	2.07
March	3.28
April	5.10
May	8.20
June	10.63
July	12.77
August	12.17
September	9.77
Annual Total	76.72
Source: U.S. Army Corps of Engineers Water Management Section Period of Record 1963-2004	

TABLE 4-9 MEAN MONTHLY AND ANNUAL WIND MOVEMENT	
MONTH	MEAN WIND (miles)
October	2,434.8
November	1,909.4
December	2,089.7
January	1,917.5
February	1,775.3
March	2,254.7
April	1,749.1
May	1,840.1
June	1,922.4
July	2,150.4
August	2,215.3
September	2,253.5
Annual Total	24,512.2
Source: U.S. Army Corps of Engineers Water Management Section Period of Record 1965-2004	

4-06. Storms and Floods. Floods on the Kaweah River are of two types: winter rainfloods and spring snowmelt floods. Rainfloods are characterized by high sharp peaks and small volumes and are usually of short duration, seldom lasting more than four days. These winter floods normally occur during the period November to March and are caused by intense rains that are sometimes augmented by snowmelt in the lower elevations.

Almost unprecedented precipitation in early December 1966 resulted in record-breaking flood runoff on most of the streams in the Tulare Lakebed basin. Continuing storms resulted in flooding in many areas in the Central Valley from December 1966 through March of 1967. Snowpack ultimately reached approximately 2½ times normal, with a abnormal delay in runoff because of continued cool weather through May. Flood damage in the Kaweah River Basin from the December storm totaled $4,750,000. Three lives were lost during the December rainfloods in the Tulare Lakebed basin.

The rainflood of record on the Kaweah River at Terminus Dam was the flood of December 1966, which had an estimated peak flow of 105,000 cfs (2,973.6 m^3/s). The 1966 rainflood produced a 3-day runoff volume of 153,280 acre-feet (189.0 hm^3). Runoff from the upper basin was completely controlled by Lake Kaweah. No releases were made from Terminus Dam until the

flows from the downstream tributaries subsided. However, downstream tributaries produced substantial flows in this flood. A peak of 14,500 cfs (410.6 m^3/s) occurred on Dry Creek. Extensive flooding was prevented in Visalia and other valley floor communities and on thousands of acres of crop and orchard land in the Kaweah River delta and Tulare Lakebed.

During the December 1955 and January 1956 storms, before Terminus Dam was built, the Kaweah River flooded about 126,000 acres (50,992.2 ha) of land. The storm began moderately heavy from 5-9 December, depositing 3 to 7 inches (7.6 to 17.8 cm) of rain along the whole length of the Sierra Nevada. By 15 December, ground conditions in the basin were moderate. Appreciable amounts of rain began to fall on the 18th and substantial quantities of precipitation occurred on the 26th and 27th. The relatively warm moist air, high winds, heavy rains, and the "blanket" afforded by dense clouds melted existing snowpacks at rather rapid rates. In the 4-day period beginning on the 23rd, as much as 2½ feet (.76 m) of snow was observed to melt away. Estimates show that snowmelt water was being added to the flood runoff at daily rates as high as 4.0 inches (10.2 cm) at 5,500 foot (1676.4 m) elevation and 1.7 inches (4.3 cm) at the 7,000 foot (2133.6 m) level. The estimated peak flow of the Kaweah River at the Terminus Dam site was 84,300 cfs (2,387.5 m^3/s). The flooded area extended from the Terminus Dam site on the east to Cross Creek on the west, and from Cottonwood Creek on the north to Elk Bayou on the south. Floodwaters from the Kaweah River and other streams entered Tulare Lakebed and caused damage to that area. Most of the flooded area was along the river and its principal distributaries: St. Johns River, Mill Creek, Cameron Creek, Packwood Creek, Cross Creek, and Elk Bayou.

The December 1955 flood inundated portions of Visalia and portions of the communities of Farmersville, Three Rivers, and Woodlake. In January 1956, much of the same area was flooded again. Damage in Visalia business district and a portion of the residential area was heavy. Water in some homes was about 30 inches (76.2 cm) deep for up to six days. Most of the irrigation diversion structures on the river were also washed out. Water and debris piled up against the Friant-Kern Canal, causing overtopping, which washed away large sections of the canal embankment. Large quantities of debris accumulated against bridges and canal crossings, causing severe damage to most of these structures. Stream bank erosion was severe in many places and great quantities of sand were deposited on farmlands adjacent to the streams. Nearly all roads in the flooded areas were damaged.

The New Year's flood of 1997 was caused by one of the largest storms of the century in Northern California. The storm presented a classic orographic event with warm winds from the southwest blowing over the Sierra Nevada and dropping astounding amounts of rain at middle and high elevations. Even though the majority of the flood damages from this event occurred on the Sacramento, San Joaquin, and coastal river basins, the event produced the 3rd largest peak flow of record, 56,595 cfs (11,602.7 hm^3/s), on the Kaweah River. Terminus Dam was able to control runoff to downstream channel capacities. The volume for 1-day was 35,600 acre-feet (43.9 hm^3) and 3-day was 80,421 acre-feet (99.2 hm^3). Climatologists classify the 1996-97 season as neither El Niño nor La Niña. Statewide, this storm is ranked as second of the 10 most costly California Storms at $1.88 billion.

The largest flows of record for the years 1904-2004 for a variety of durations are shown in Table 4-10.

TABLE 4-10
MAXIMUM UNREGULATED RAINFLOOD FLOWS ON
KAWEAH RIVER AT TERMINUS DAM

DATE (Peak)	PEAK (cfs)	1-DAY (cfs)	3-DAY (cfs)	7-DAY (cfs)	15-DAY (cfs)	30-DAY (cfs)
6 Dec 66	105,000	53,280	25,736	12,461	6,445	3,569
23 Dec 55 *	84,332	44,512	22,918	12,248	6,323	3,693
2 Jan 97	56,595	17,948	13,515	7,478	4,461	3,890
19 Nov 50 *	54,332	16,640	9,741	5,126	2,766	2,395
25 Jan 69	35,200	22,437	13,425	8,519	6,057	3,773
11 Dec 37 *	34,799	11,232	7,720	3,958	2,842	2,258

*Computed from "Kaweah River near Three Rivers" gage flow records
Source: U.S. Army Corps of Engineers, Water Management Section
Period of Record 1904-2004

Snowmelt floods, while not producing as high a peak as rainfloods, have a much larger runoff volume. These floods normally occur during the months of April through July.

The largest snowmelt flood of record on the Kaweah River at the Terminus Dam site was that of 1906. This flood had a maximum mean daily flow of 7,260 cfs (205.6 m^3/s) and a runoff volume during the period April through July of 815,260 acre-feet (1,005.2 hm^3). The snowmelt flood of 1969 approached that of the1906 flood with a total April through July volume of 800,905 acre-feet (987.5 hm^3) and maximum daily flow of 6,824 cfs (193.3 m^3/s). The effects of this flood were greatly reduced by regulation of Lake Kaweah. Flow rates were reduced to a maximum outflow of 5,600 cfs (158.6 m^3/s), which was generally contained in existing channels of the Kaweah and St. Johns rivers. Of the April through July inflow to Lake Kaweah, plus downstream accretions, about 172,000 acre-feet (212.1 hm^3) reached Tulare Lakebed and about 640,000 acre-feet (779.1 hm^3) was diverted and absorbed within the Kaweah Delta service area. With regulation provided by Lake Kaweah, only in years of exceptionally high snow accumulation will snowmelt runoff cause damage downstream along the Kaweah River and distributaries. Serious flooding in the Tulare Lakebed may occur whenever the total annual runoff is in excess of about 120 percent of normal, about 509,000 acre-feet (627.6 hm^3).

The largest snowmelt flows of record for the years 1904-2004 for a variety of durations are shown in Table 4-11.

TABLE 4-11
MAXIMUM UNREGULATED SNOWMELT FLOOD FLOWS ON
KAWEAH RIVER AT TERMINUS DAM

DATE (1-Day)	1-DAY (cfs)	15-DAY (cfs)	30-DAY (cfs)	60-DAY (cfs)	90-DAY (cfs)	120-DAY (cfs)
28 May 06 *	7,260	5,881	5,338	4,553	3,913	3,397
1 Jun 69	6,824	5,985	5,398	4,347	3,752	3,339
29 May 83	6,671	5,393	5,236	4,474	3,606	3,120
16 Jun 98	5,332	4,644	4,376	3,646	3,147	2,797
23 May 67	5,226	4,227	3,532	3,439	2,900	2,546
27 May 52 *	5,170	4,632	4,235	3,406	2,851	2,455

*Computed from "Kaweah River near Three Rivers" gage flow records
Source: U.S. Army Corps of Engineers, Water Management Section
Period of Record 1904-2004

The largest water year of record on the Kaweah River was 1983. Although releases during 1983 did not exceed 5,000 cfs (141.6 m^3/s), close to 500,000 acre-feet (616.5 hm^3) of water was sent to Tulare Lakebed. Table 4-12 (in the Tables Section, Page T4-4) presents the Historical Unregulated Monthly Inflows to Terminus Dam and Lake Kaweah Project from 1904 to 2004.

4-07. Runoff Characteristics. At the beginning of the rainy season the ground is extremely dry. At such times, it may take approximately 3 to 5 inches (7 to 12 cm) of rain to saturate the soil before any significant runoff will occur. Later in the season, when the ground is usually wet, heavy rainfall over the basin can cause large flood runoff.

Approximately 65 percent of the annual runoff into Lake Kaweah occurs during snowmelt season, April through July. The Mean Monthly and Annual Runoff into Lake Kaweah is presented in Table 4-13.

TABLE 4-13
MEAN MONTHLY AND ANNUAL RUNOFF
INTO LAKE KAWEAH

MONTH	AVERAGE INFLOW (1,000 acre-feet)	PERCENT OF ANNUAL STREAM FLOW
January	27.0	6.26
February	32.0	7.42
March	45.8	10.62
April	65.3	15.14
May	103.8	24.07
June	81.5	18.89
July	31.0	7.19
August	8.5	1.97
September	4.6	1.07
October	5.1	1.18
November	9.1	2.11
December	17.6	4.08
Annual Total	431.3	100.00
Period of Record	Water Years 1904-2004	

Source: U.S. Army Corps of Engineers, Sacramento District, Water Management Section

Annual runoff volumes are subject to wide variation. A graphical presentation of historical operation is shown on Plate 4-6. Recorded runoff data from three upstream gages on the Kaweah River are shown in Table 4-14. The U.S. Army Corps of Engineers maintains the official operation records for Terminus Dam.

TABLE 4-14
RECORDED RUNOFF DATA

	Kaweah River at Three Rivers	South Fork Kaweah River at Three Rivers	Kaweah River near Three Rivers
Period of Record (Water Yrs)	1958-2004	1959-1990	1903-1961
Drainage Area (sq mi)	418	86.7	520
Daily flow (cfs)			
Maximum	37,100 (6 Dec '66)	7,760 (6 Dec '66)	80,700 (23 Dec '55)
Minimum	14 (29 Sep '77)	0 (at times 1960-62)	8.5 (19 Sep '34)
Mean	516	71	554
Daily flow (cfs/sq mi)			
Maximum	88.75	89.50	155.19
Minimum	0.03	0.00	0.02
Mean	1.23	0.82	1.07
Instantaneous flow (cfs)			
Maximum	73,000 (5 Dec '66)	11,600 (6 Dec '66)	80,700 (23 Dec '55)
Minimum	14 (29 Sep 1977)	0 (1962)	8.5 (Sep 34)
Instantaneous flow (cfs/sq mi)			
Maximum	174.64	133.79	155.19
Minimum	0.03	0.00	0.02
Annual flow (ac-ft)			
Maximum	1,176,000 (1983)	183,500 (1983)	1,104,000 (1906)
Minimum	86,360 (1977)	8,050 (1977)	102,000 (1924)
Mean	374,200	51,440	401,100
Annual flow (inches)			
Maximum	52.75	39.68	39.81
Minimum	3.87	1.74	3.68
Mean	16.79	11.12	14.46
April-July flow (ac-ft)			
Maximum	712,300 (1969)	98,170 (1983)	750,000 (1906)
Minimum	56,800 (1977)	5,688 (1977)	75,500 (1924)
Mean	246,630	32,990	287,500
April-July flow (inches)			
Maximum	31.95	21.23	27.04
Minimum	2.55	1.23	2.72
Mean	11.06	7.14	10.37

Source: U.S. Geological Survey and U.S. Army Corps of Engineers, Sacramento District, Water Management Section

4-08. Water Quality. There is no significant agriculture or industry in the basin above Terminus Dam which would affect the water quality of the lake. Tests of inflows and lake storage at Lake Kaweah indicate that the water quality is generally good. The Terminus Dam and Lake Kaweah Project does not operate for water quality purposes.

The chemical, physical, and biological properties of surface water at any given point are the product of a multitude of factors including geography, geology, climatic conditions, discharge, floral and faunal communities, ground water supply, and, of major significance, the effect of man's activities and his domestic animals.

Field data and water samples are collected at Lake Kaweah during April and August of each water year. The field data collected at the time of water sample collection are temperature, electrical conductivity, dissolved oxygen, and pH. The field data are evaluated at various depths within the lake in order to get a better idea of how these characteristics change with depth. The lake Secchi depth for the summer of 2002 was 5.75 feet (1.8 m). The Secchi depth is used as a gage of water clarity in the lake.

Laboratory tests are done on water samples collected in April and August each year at Lake Kaweah. Analysis is done to test for the presence of Methyl Tertiary-Butyl Ether (MTBE), heavy metals, general chemicals, and biological organisms. In 2001, pesticides and herbicides were discontinued as a parameter for testing, since the results from 1995 to 2000 were consistently at non-detectable levels. The results of the field data analysis and the laboratory tests are presented in the Annual Water Quality Report that is published each year. The 2002 water quality report can be found at: <http://www.spk.usace.army.mil/cespk-ed/EnvirProj/AWQM-WY2002/Kaweah_Lake_WY2002.pdf>.

In water year 2002, dissolved heavy metals did not exceed the drinking water standard or the freshwater fishery criteria during either spring or summer, except for dissolved manganese. Table 4-15 provides a summary of water quality data collected in 2002.

TABLE 4-15
WATER QUALITY DATA (2002)

Constituent or Measurement	Kaweah River at Three Rivers		Lake Kaweah	
	April	August	April	August
Secchi Disk	N/A	N/A	10.85 feet	5.75 feet
Surface Water Temperature	N/A	N/A	61.7°F	77.8°F
Bottom Water Temperature	N/A	N/A	49.3°F	54.5°F
River Water Temperature	61.7°F	68.8°F	N/A	N/A
Surface Dissolved Oxygen	N/A	N/A	12.67 mg/l	4.31 mg/l
Bottom Dissolved Oxygen	N/A	N/A	8.07 mg/l	0.79 mg/l
pH	7.52	7.76	7.74	7.19
Phytoplankton	N/A	N/A	837.43 μg/l	2655.39 μg/l
Dissolved Manganese	N/A	N/A	N/A	85 ppb
Dissolved Mercury	N/A	N/A	.003 ppb	.0043 ppb
MTBE	N/A	N/A	3 ppb	8 ppb

N/A = test not done at this site
Source: U.S. Army Corps of Engineers, Sacramento District, Environmental Engineering Division
http://www.spk.usace.army.mil/cespk-ed/EnvirProj/AWQM-WY2002/Kaweah_Lake_WY2002.pdf

4-09. Channel and Floodway Characteristics. Flooding in the valley floor areas occurs where the stream gradients are fairly flat and the channels do not have sufficient capacity to carry large flood flows. Inadequate drainage facilities, obstruction of natural channels by reeds, brush, and tules, and road and railroad fills across the floodplain also contribute to flooding problems.

The Kaweah River, from Terminus Dam to the Tulare Lakebed, is about 60 miles (96.6 km) long. The channel capacity of the Kaweah River at McKay Point is 5,500 cfs (155.8 m^3/s). At McKay Point, the flow is divided between the St. Johns and the Kaweah rivers. The St. Johns carries flows northwest and the Kaweah River flows southwesterly. Below McKay Point the controlling total capacity of distributary channels is 5,500 cfs (155.8 m^3/s) for short periods (up to a week) and 5,000 cfs (141.6 m^3/s) for long periods (up to 90 days). Such flows would be reduced (by channel losses, irrigation, and spreading) to a flow which, although larger than some within-bank capacities, would not cause significant damage along the channels. Flooding of agricultural areas along the Kaweah River system channels has been observed at flows of 5,500 cfs (155.8 m^3/s) and less. The Kaweah River and its distributaries ultimately terminate in Tulare Lakebed. In most instances, it is expected that the critical reach would be on Cross Creek, southwest of Highway 99.

The channel capacities within the system vary widely, and in many cases are unknown. The estimated non-damaging capacities of various distributary systems and channels throughout the Kaweah River area between Terminus Dam and Tulare Lakebed are shown on Plate A-12.

4-10. Upstream Structures. There are three non-federal powerhouses above Terminus Dam. Southern California Edison owns and operates these small power plants and their regulatory storage is insignificant. None of these projects, or other projects, affects the operation of Lake Kaweah.

4-11. Downstream Structures. At McKay Point, approximately 3 miles (4.8 km) downstream from Terminus Dam, the flow is divided between the St. Johns and the Kaweah rivers. The Friant-Kern Canal part of the Bureau of Reclamation's Central Valley Project (CVP) crosses the St. Johns and Kaweah rivers approximately 2 miles (3.2 km) west of McKay Point. There are turnouts at the canal siphon crossing these rivers. In the valley portion of the watershed are numerous privately constructed flood control levees, irrigation distribution systems, and groundwater recharge areas. The private irrigation diversion systems and recharge areas have both flood control and irrigation purposes. Except during large floods, most releases from Terminus Dam are used to meet irrigation and spreading demands at the McKay Point Diversion structure based on conditions at the time.

4-12. Economic Data. The Kaweah River Basin lies in Tulare and Kings counties. Tulare County, population (2002) of 379,200 and a work force of 170,900, along with Kings County, population (2002) of 133,100 and a work force of 46,110, is dotted with rural farms, ranches, orchards, vineyards, and small communities.

a. Population. The main population center in the Kaweah River Basin is the city of Visalia. Visalia has experienced rapid growth along with the rest of the Kaweah River Basin. The population of Tulare and Kings counties, along with the city of Visalia, are given in Table 4-16.

b. Agriculture. The valley floor below Terminus Dam is a highly developed agricultural area. Agricultural pursuits in the valley include irrigated pasture for beef and dairy cattle, vineyards, extensive orchards, and the production of alfalfa, nursery and greenhouse products, cotton lint, hay, oranges, and vegetables. Untilled portions of the basin support livestock (primarily cattle). Tables 4-17 and 4-18 indicate the value of agricultural activities in the region.

c. Industry. The agricultural industry is the largest employer in the area. Other economic activities in the Kaweah River Basin include governmental agencies, mining, sand and gravel operations, food processing industries, and recreation. Table 4-19 indicates employment and sales in Tulare County by trade category.

TABLE 4-16
POPULATION

LOCALITY	POPULATION BY YEAR				
	1970	1980	1990	2000	2003
Tulare County	188,403	245,738	311,921	368,021	390,791
Visalia	N/A	N/A	75,600	91,565	98,900
Kings County	64,610	73,738	102,500	129,461	138,564

Source: U.S. Bureau of the Census: http://www.census.gov/population/cencounts/ca190090.txt, http://quickfacts.census.gov/qfd/states/06/06031.html, http://quickfacts.census.gov/qfd/states/06/06107.html
California Employment Development Department (2002):
http://www.calmis.ca.gov/file/COsnaps/tularsnap.pdf, http://www.calmis.ca.gov/file/COsnaps/kingssnap.pdf

TABLE 4-17
GROSS VALUE OF COMMODITY GROUP PRODUCTION
IN TULARE COUNTY (2003)

COMMODITY GROUP	GROSS VALUE OF AGRICULTURAL PRODUCTION ($1,000)
Livestock, Poultry, and Products	1,523,506
Fruit and Nut Crops	1,356,387
Field Crops	290,115
Nursery, Flowers, and Foliage	66,775
Apiary Products	34,589
Vegetable Crops	22,212
Timber Products	1,862
Seed Crops	1,076
TOTALS	3,296,522

Source: Summary of County Agricultural Commissioners' Reports, California Agricultural Statistics Service, ftp://www.nass.usda.gov/pub/nass/ca/AgComm/200308cavtb00.pdf

TABLE 4-18
GROSS VALUE OF FIVE MAJOR CROPS GROWN
IN TULARE COUNTY (2003)

CROP	GROSS VALUE ($1,000)	PERCENT STATE TOTAL
Oranges	442,504	46.6 %
Grapes	378,511	12.5 %
Plums	85,500	36.4 %
Alfalfa Hay	84,019	10.2 %
Peaches	70,092	16.8 %

Source: Summary of County Agricultural Commissioners' Reports, California Agricultural Statistics Service, ftp://www.nass.usda.gov/pub/nass/ca/AgComm/200308cavtb00.pdf

TABLE 4-19
EMPLOYMENT AND TOTAL SALES BY TRADE CATEGORY
IN TULARE COUNTY (2002)

TRADE CATEGORY	TOTAL EMPLOYEES	TOTAL SALES ($1,000)
Manufacturing	11,300	3,167,304
Mining and Construction	5,600	Not Available
Wholesale Trade	21,900	2,527,654
Retail Trade	13,400	2,135,741
Taxable Services	16,228	791,522
Agricultural Workers	33,700	See Table 4-18
Government (All)	29,600	Not Available

Sources: California Employment Development Department (2002), http://www.calmis.ca.gov http://www.calmis.ca.gov/file/COsnaps/tularSNAP.pdf, U.S. Census Bureau, (1997) Economic Census, http://www.census.gov/epcd/ec97/ca/CA107.HTM

d. Flood Damages. Rainfloods along the Kaweah River, below Terminus Dam, are characterized by comparatively high peaks, small volumes, and short durations, and are damaging to both urban and agricultural areas. These floods also damage channel improvements and adjacent areas. Volumes that exceed irrigation and spreading capabilities continue on to Tulare Lakebed to pond on cropland. Prior to construction of Terminus Dam and Lake Kaweah, rainfloods frequently caused extensive soil erosion, damaged farm equipment and structures, silted in irrigation canals, washed out diversion structures, and washed out reaches of highways. The December 1950 flood, which reached a peak of approximately 54,000 cfs (1529.3 m^3/s) at the Terminus Dam site, extensively damaged agricultural and industrial areas and caused flooding in Visalia. The December 1955 flood, which peaked at approximately 84,000 cfs (2378.9 m^3/s) at the dam site, caused extensive damage to Visalia and its suburbs.

Snowmelt floods have much lower peak flows than rainfloods but larger volumes. Kaweah River snowmelt flood flows, combined with runoff from adjacent basins, flood large areas in Tulare Lakebed for long periods of time. In some cases, inundation can last more than a year.

A number of large floods have occurred since the project was built. The December 1966 flood, with a peak inflow to Lake Kaweah of 105,000 cfs (2973.6 m^3/s), was the largest of record. The estimated damages prevented by Terminus Dam and Lake Kaweah are listed in Table 4-20.

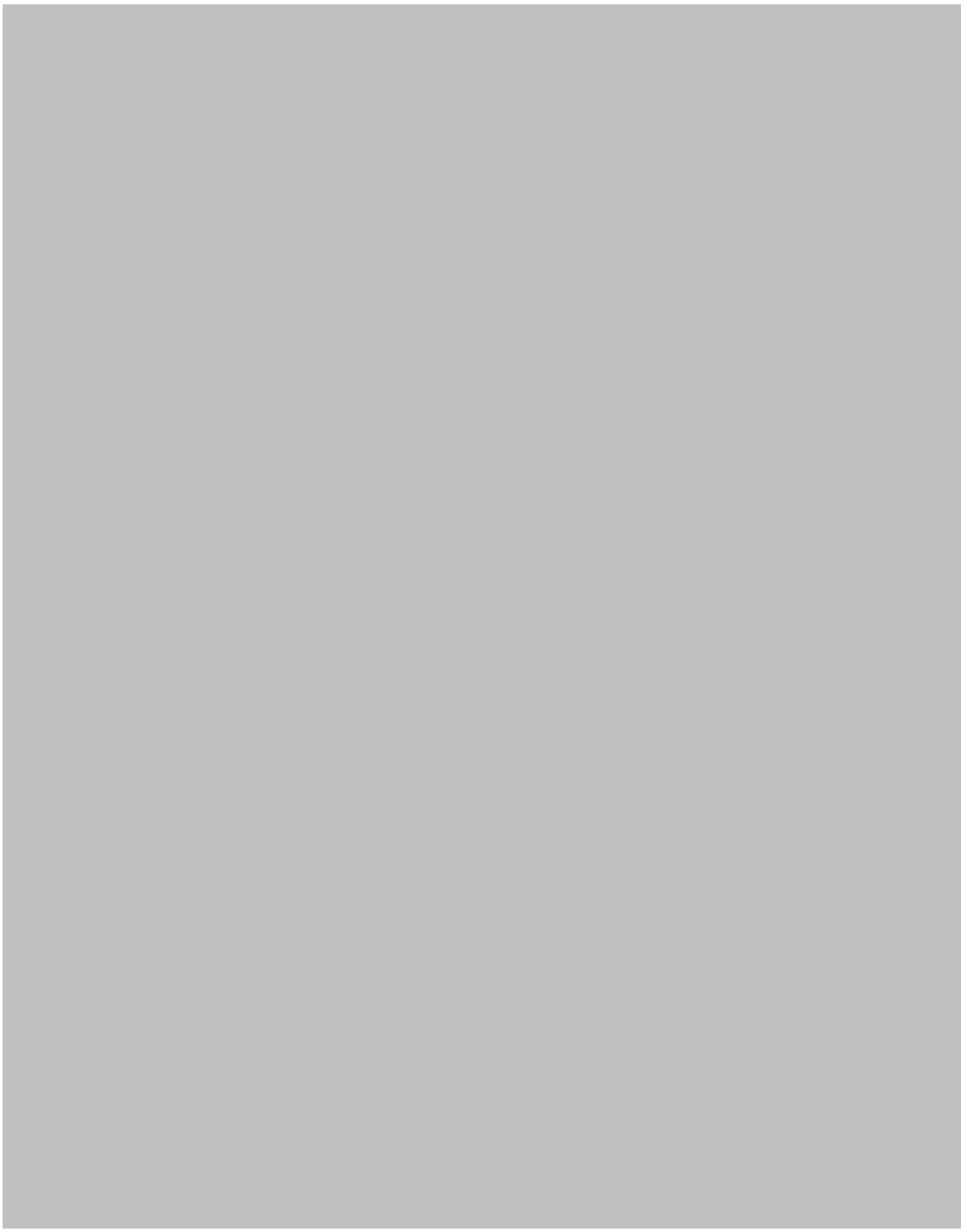

Photo 4-1. Kaweah River headwaters

Photo 4-2. Kaweah River at Three Rivers

Photo 4-3. Dry Creek near Lemoncove

Photo 4-4. Kaweah River below Terminus Dam

Photo 4-5. McKay Point diversion structure

Photo 4-6. Kaweah River below McKay Point diversion structure

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V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometeorological Stations

a. Facilities. Precipitation, snow, temperature, stream stage, and reservoir pool elevation data are collected at locations both upstream and downstream from Terminus Dam. Plate 4-1 shows the location of stream gages operated by the Corps (USACE), the U.S. Geological Survey (USGS), Southern California Edison (SCE), and the California Department of Water Resources (DWR). Plate 4-5 shows the location of climatological gages operated by the USACE, DWR, and the National Weather Service (NWS).

The Sacramento District Office (CESPK) maintains its own network of Data Collection Platforms (DCP) to collect pertinent hydrometeorological data for Corps projects. This District-wide system is known as the Hydrometeorologic Automatic Data Acquisition (HADA) system. Gages are added to the HADA system when CESPK Water Managers deem a gage site to be necessary for the proper operation of a project. Table 5-1 lists the HADA system gages used by CESPK Water Managers for the real-time flood control regulation of Terminus Dam.

In addition to the hydrometeorological gages listed in Table 5-1, pool elevation staff gages are located on the upstream face of Terminus Dam. The stream gage locations also have staff gages which can be used to confirm the pool or stage instrument reading and to make manual readings, should the automated instrumentation fail.

b. Reporting. Hydrometeorological data at Terminus Dam and Lake Kaweah, and elsewhere in the Kaweah River Basin, are monitored through the Hydrometeorologic Automatic Data Acquisition (HADA) System. The Terminus Dam Project Office Computer (TRMPC) automatically polls the DCP's for parameters listed in Table 5-2. The pool elevation, local river stages (Photo 5-1), and weather station (Photo 5-2) are polled every 15 minutes while the remote precipitation gages (Photo 5-3) are polled/received every hour. Data from TRMPC are transferred via Wide Area Network (WAN) or telephone to the District Office at least once an hour.

Other agencies collect and publish hydrometeorologic data for other sites throughout the Kaweah River Basin and adjacent basins. These sites are shown on Plates 4-1 and 4-5.

c. Maintenance. The Water Management Section is responsible for maintaining the Corps gages listed in Table 5-1. Kaweah Delta Water Conservation District (KDWCD), along with the Corps, is responsible for the maintenance of the flow measuring instruments located at McKay Point, Yokohl Creek, and Cross Creek. The Sacramento District contracts with private contractors to perform monthly stream flow measurements and maintain most gages in this region.

TABLE 5-1
TERMINUS DAM AND LAKE KAWEAH REAL-TIME
HYDROMETEOROLOGIC DATA COLLECTION SITES

Station Name and Mnemonic		Collected Parameters	Via	Agency
Atwell	ATW	Precipitation Temperature	R	Corps
Beartrap Meadow	BRM	Precipitation Temperature	R	Corps
Cross Creek at Houston	CRS	Stage	P	Corps, KDWCD
Dry Creek near Lemoncove	LCV	Stage	R, P	Corps
Foothill Ditch below Terminus Dam	FTH	Stage	R	Corps
Giant Forest	GNF	Precipitation, Snow Temperature	R	Corps
Hockett Meadow	HCK	Precipitation Temperature	R	Corps
Kaweah River below Terminus Dam	TRMQ	Stage, Water Temperature	R	Corps
Kaweah River at Three Rivers	TRR	Stage	R, P	Corps
Lemoncove Ditch below Terminus Dam	LMN	Stage	R	Corps
McKay Point (Kaweah and St. Johns Rivers)	MK1 / MK2	Stage	R	Corps, KDWCD
Paradise Peak	PR1 / PR2	Temperature	R	Corps
Terminus Dam (Pool)	TRMP	Pool Elevation	R	Corps
Terminus Weather Station	TRMW	Evaporation Precipitation Temperature, Wind	R	Corps
Yokohl Creek at Garcia Bridge	YKL	Stage	P	Corps, KDWCD

KEY
Via: R=Radio
P=Phone
Agency: Indicates the agency responsible for the gage
Corps: U.S. Army Corps of Engineers
KDWCD: Kaweah Delta Water Conservation District

TABLE 5-2
HYDROMETEOROLOGIC DATA COLLECTED AT TERMINUS DAM

Station and Mnemonic		SHEF Physical Element Code										
		ED	HG	HP	PC	SW	TA	TP	TW	UC	UD	US
Terminus Dam	TRMP			x								
Kaweah River below Terminus Dam	TRMQ		x						x			
Foothill Ditch below Terminus Dam	FTH		x									
Lemoncove Ditch below Terminus Dam	LMN		x									
Dry Creek near Lemoncove	LCV		x									
Kaweah River at Three Rivers	TRR		x									
McKay Point	MK1 / MK2		x									
Yokohl Creek at Garcia Bridge	YKL		x									
Cross Creek at Houston	CRS		x									
Terminus Dam Weather	TRMW	x			x		x	x		x	x	x
Atwell	ATW				x		x					
Beartrap Meadow	BRM				x		x					
Giant Forest	GNF				x	x	x					
Hockett Meadow	HCK				x		x					
Paradise Peak	PR1 / PR2						x					

Key to Standard Hydrologic Exchange Format (SHEF) Physical Element Codes:

ED - Evaporation, Pan Depth (in)
HG - Height, River Stage (ft)
HP - Height, Pool Elevation (ft)
PC - Precipitation, Accumulated (in)
SW - Snow, Water Equivalent (in)
TA - Temperature, Air (°F)
TP - Temperature, Evap. Pan (°F)
TW - Temperature, Water (°F)
UC - Wind, Accumulated Wind Travel (mi)
UD - Wind, Direction (Degrees)
US - Wind, Speed (mi/hr)

5-02. Water Quality Stations

a. Facilities. Two types of water quality data are collected for Terminus Dam:

(1) Temperature data are collected from the Kaweah River below Terminus Dam gage site (TRMQ). These data are collected at 15-minute intervals.

(2) Lake Kaweah pool and inflow water samples and measurements are collected by manual field sampling methods. Other agencies that collect and monitor water quality in the surrounding area include USGS and DWR. The Corps of Engineers contracts for water quality measurements, taken every April and August, on the lake and at its inflow. Private, commercial, state-certified laboratories are utilized to perform the lab analysis. An algologist at the University of California at Davis does the biological analysis. Parameter measurements include: temperature, dissolved oxygen, biological oxygen demand, pH, suspended solids, general chemicals, heavy metals, contaminates such as MTBE's, algae enumerations, nutrients, and light transparency (Secchi disk).

b. Reporting. Except for the continuous temperature data, water quality data are not available on a real-time basis at SPK. The water temperature data collected at the outflow and the reservoir water quality analysis are published in the Sacramento District's "Annual Water Quality Report," according to ER 1110-2-8154 "Water Quality and Environmental Management for Corps Civil Works Projects," dated 31 May 1995.

c. Maintenance. The Water Management Section is responsible for maintaining the water temperature gage at the Terminus Dam Outflow gage. The Section fulfills this responsibility through a small private company under contract to the District. Other water quality gages are maintained by various agencies.

5-03. Sediment Stations

a. Facilities. CESPK does not maintain or collect any sediment data on either the upstream or downstream tributaries of Terminus Dam. This type of data is not required for the real-time flood control operation of Terminus Dam. Reservoir sedimentation is discussed in Section 4-04. Sedimentation Ranges are shown on Plate 4-4.

b. Reporting. Sediment data are not currently collected, reported, or maintained by CESPK for Terminus Dam.

c. Maintenance. CESPK has no maintenance responsibilities with respect to sediment stations.

5-04. Recording Hydrologic Data. In general, the agency or organization responsible for a particular gage is also responsible for maintaining the official record for that gage. Therefore, the

Sacramento District maintains the official record for the Corps gages listed in Table 5-1. Kaweah Delta Water Conservation District is responsible for maintaining the official record of flow and stage data collected at Cross Creek at Houston, McKay Point, and Yokohl Creek at Garcia Bridge.

The hydrometeorological parameters listed in Table 5-2, along with additional maintenance information, are initially recorded at the gaging site using the gage's Data Collection Platform. The data loggers log data every 15 minutes and have the capacity to store from 6 months to two years' worth of data. The amount of data that can be stored locally by the data logger is dependent upon the number of parameters collected at the site.

The Terminus Dam Project Office Computer (TRMPC) automatically polls the Data Collection Platform listed in Table 5-1 and stores the data in a local database. Data from TRMPC are transferred, via Wide Area Network (WAN) or telephone, to the District Office at least once an hour.

Once data are transmitted to the District Office, the data are stored and maintained in database files located on the District's Corps Water Management System (CWMS) computers. Both the raw hydrometeorological data listed in Table 5-1 and data computed from the raw data (e.g., reservoir storage, inflow, outflow, precipitation, and stream flows) are maintained in the database. This data will be kept on file, for archival purposes, for the life of the project and beyond.

5-05. Communication Network. Both voice radio, WAN, and telephone communications are maintained between the Sacramento District Office and Terminus Dam. Communication is either by voice radio, WAN, or telephone. Radios in each office have backup power from batteries and standby generators.

The Corps Water Management System can interrogate the project PC's either by WAN or telephone. The Water Control Data System utilizes backup power from an Uninterrupted Power Supply (UPS) and standby generators.

5-06. Communication with Project

a. Regulating Office with Terminus Dam and Lake Kaweah Project Office. Direct communication between the Water Management Section, Sacramento District Office, and the Terminus Dam Project Office is normally conducted via telephone for all matters relating to the single operating purpose of flood control. Communication can be by voice radio or WAN (e-mail). In the event that all communication is interrupted, a set of "Standing Instructions to Project Operators" has been compiled for Terminus Dam, and a copy of these instructions is included in Exhibit A of this manual. Personnel responsible for project operation are listed in the front of this manual and in Exhibit A.

b. Between Regulating Office and Others. Close coordination, via telephone, between the Corps, the Kaweah Delta Water Conservation District (KDWCD), and Tulare Lakebed interests is necessary when transitioning to and from flood operation. Direct communication between the Corps and other local and/or federal agencies is normally conducted via telephone or radio for all matters relating to the operation of the project.

c. Between Terminus Dam Project Office and Others. Direct communication between the Project Office and other local and federal agencies is normally conducted via telephone or WAN for all matters relating to the operation of the project. Pertinent agencies are listed in the front of the manual and in Exhibit A. Exhibit D identifies the various agencies that require notification in the event of a seismic emergency.

5-07. Project Reporting Instructions. Communications between the Water Management Section and the Terminus Dam and Lake Kaweah Project Office may be made to provide special instructions regarding the Terminus Project. The Terminus Dam and Lake Kaweah Project operators should use voice radio, WAN, or telephone communication to report any failure of machinery or other equipment, or to report any other unusual conditions at the dam. Also, hydrologic data should be reported in the same manner, if requested, based on the operational data requirements described in Exhibit A. Personnel responsible for the project operation are listed in the front of this manual and in Exhibit A.

All significant inquiries received from citizens, constituents, or interest groups regarding water control procedures or actions must be referred directly to the Water Management Section. Press inquiries must be referred to the Public Affairs Office (PAO), Sacramento District.

5-08. Warnings. CESPK maintains contact with the local district office of the National Weather Service (NWS) at all times concerning general meteorological conditions.

The Corps of Engineers provides release information at Corps reservoirs; however, the Corps does not issue flood warnings. Flood warnings are the responsibility of the NWS.

Personnel from the NWS Office in Sacramento and the California Department of Water Resources (DWR) are assigned to the Joint Federal-State River Forecast Center in Sacramento, which monitors weather conditions and river stages on a year-round basis. When floods are imminent, the State Flood Operations Center is activated. It operates on a 24-hour basis in conjunction with the River Forecast Center. In addition, among other flood emergency activities, the center advises interested parties of flood situations as they develop. The Joint Operations Center furnishes flood information and flood warnings to the local news media, law enforcement agencies, and other agencies for dissemination to the public.

The Park Manager of Terminus Dam and Lake Kaweah will issue warnings to local agencies by telephone. Exhibit D lists the various agencies that will be notified in the event of a serious seismic emergency. An Emergency Action Plan is kept at the Park Headquarters.

The DWR, through the Joint Operations Center, coordinates flood-fighting activities throughout the state and is authorized to receive requests from local public agencies for assistance during floods. The Corps responds to requests from the DWR Joint Operations Center for flood fighting and rescues, and from the California Office of Emergency Services (OES) when the emergency is beyond the capabilities of state and local government agencies.

Pursuant to the provisions of Section 8589.5, Government Code of California, emergency procedures must be established for the evacuation and control of potential flood areas, in the event of sudden failure of dams. The local jurisdiction must then adopt emergency procedures that include, among other things, specific routes to be used for evacuation, traffic control measures, movement of people without their own transportation, shelter of evacuees, evacuation and care of people from institutions, and perimeter security, interior security, and re-occupation of evacuation areas.

Photo 5-1. Kaweah River below Terminus Dam stream gaging station

Photo 5-2. Terminus Dam weather station

Photo 5-3. Giant Forest climatological station

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VI - HYDROLOGIC FORECASTS

6-01. General. Most of California is unique in that general rainfloods during the late spring and summer are extremely rare. Therefore, runoff into the reservoirs can be fairly accurately predicted during the spring and summer based on snowmelt in the mountains. This allows the space required for flood control to be varied during snowmelt season based on the forecasted runoff. These snowmelt forecasts are important in optimizing reservoir operation for all project purposes.

Reliable long-term rainflood forecasts are not available at this time. However, short-term precipitation forecasts are useful for anticipating release changes based on increased inflow or changes in downstream conditions. Precipitation forecasting may also aid in the anticipation of damaging flows and allow for the earliest possible warnings. Based on antecedent basin conditions and forecasted runoff, flood control space should be kept at a level that allows storage of an event without releases exceeding downstream channel capacity.

a. Role of the U.S. Army Corps of Engineers. The Corps of Engineers, by regulation, cannot furnish forecasts of flows into Lake Kaweah to the public. That mission is the responsibility of the NWS. However, during flood conditions, the Corps of Engineers provides the Department of Water Resources with flood release forecasts. The DWR then coordinates with the National Weather Service's River Forecast Center, which uses the information to aid in forecasting river flows.

b. Role of Other Agencies

(1) The National Weather Service (NWS) provides Quantitative Precipitation Forecasts (QPF) for the Kaweah River Basin and river flow forecast data for the Kaweah River above Terminus Dam. The QPF is for the succeeding 24-hour period and is broken down into 6-hour increments. These short-term forecasts are updated twice daily at 4:00 a.m. and 4:00 p.m. The NWS also provides freezing levels, an index of loss potential for the basin, and short-term local precipitation forecasts up to 24-hours in advance.

(2) The Joint Federal-State River Forecast Center (RFC) monitors weather conditions and river stages on a year-round basis. The RFC will forecast stages and flows on major river systems; however, only flow forecasts are made for the Kaweah River. The flows are for the succeeding 24-hour period and are broken down into 6-hour increments. These short-term forecasts are updated twice daily at 4:00 a.m. and 4:00 p.m.

(3) The California Department of Water Resources' Snow Surveys provide April through July snowmelt runoff forecasts for the Kaweah River Basin. Forecasts are made 1 February, 1 March, 1 April, and 1 May each year. Updates are provided when conditions change

appreciably from the last forecast. The forecasts are published about 5 days after the date to which they apply. A summary of forecasted runoff compared to actual runoff is shown on Table 4-7 in the Tables Section following Chapter IX of this manual.

(4) The Kaweah Delta Water Conservation District monitors water supply and irrigation demands within the basin.

6-02. Flood Condition Forecasts

a. Requirements. Knowledge of current basin conditions and general basin characteristics aids in forecasting flows during flood conditions. Information from the NWS, real-time climatological data, antecedent basin wetness, inflow recession values, and local flow estimates can all be used to help determine the forecast during flood conditions.

Uncontrolled local flows (occurring downstream during a rainfall flood event) may be substantial and would require that the release from the project be reduced. The release should be adjusted to maintain the combination of project release plus uncontrolled local flow at or below the objective flow of 5,500 cfs (155.8 m^3/s), for as long as possible. For a discussion of downstream channel capacities, see Section 4-09 and Plate A-12.

b. Methods. The forecast of basin mean precipitation over the Kaweah River Basin is conducted by the NWS, and is issued as part of the QPF. The QPF contains 6-hour rainfall forecasts covering river basins all over California. The NWS River Forecast Center also provides information on forecasted flows and the freezing level for the Kaweah River Basin. Real-time stream flow data and the anticipated precipitation amounts can be translated into estimated future flows by means of a unit hydrograph method.

Since the conditional space required for flood control is determined from snowmelt forecasts, they are of primary concern in the operation of the Terminus Dam and Lake Kaweah Project. The Kaweah Delta Water Conservation District and the Corps of Engineers use snowmelt forecasts made by the California Department of Water Resources to maximize the operation of the project.

6-03. Conservation Purpose Forecasts

a. Requirements. The operation of Lake Kaweah for conservation is generally as requested by the Kaweah Delta Water Conservation District. The Corps is not currently required to perform water quality forecasts for Lake Kaweah. Section 5-02, Water Quality Stations, contains further information related to water quality.

b. Methods. The Corps of Engineers relies on irrigation demand estimates from the Kaweah Delta Water Conservation District to evaluate the timeliness of releases when balancing

flood control and conservation storage space requirements. The required flood control space for any given time of the year is as shown on the Water Control Diagram, Plate A-13.

6-04. Long-Range Forecasts. Long-range forecasts are snowmelt runoff forecasts, and are characterized by large flow volumes, several months in duration, and low to moderate peak inflows. Other than the snowmelt forecasts discussed above, no long-range forecasts are used by the Corps of Engineers for the Kaweah River basin.

6-05. Drought Forecasts. The Corps of Engineers' Drought Contingency Plan for the Terminus Dam and Lake Kaweah Project is presented in Exhibit C.

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VII - WATER CONTROL PLAN

7-01. General Objectives. The primary operating objectives of the Terminus Dam and Lake Kaweah Project are to protect areas below Terminus Dam from floods and provide maximum possible conservation yield for irrigation. Recreation and hydroelectric power generation, although also provided by the project, are secondary purposes.

7-02. Constraints. The maximum discharge capacity of the outlet works at given elevations are shown in the pertinent data table at the front of this manual and on Plate A-3; known channel capacities below Terminus Dam are shown on Plate A-12 and discussed in Section 4-09. The maximum objective flow of the Kaweah River at McKay Point is 5,500 cfs (155.8 m^3/s).

Lake Kaweah is part of a system of reservoirs contributing water to the Tulare Lakebed. At gross pool elevation of 715.0 feet (217.9 m) Lake Kaweah has a capacity of 185,630 acre-feet (228.8 hm^3). Releases greater than irrigation and spreading demands have the potential to pond on the valuable Tulare Lakebed cropland. Diversion opportunities of unwanted floods are very limited above Tulare Lakebed; most of the water that cannot be used (or placed in groundwater recharge basins) will end up in the lakebed. Since water flowing to the lakebed may be from many sources, releases from Lake Kaweah are coordinated with releases or uncontrolled flows from other sources to the extent possible, giving consideration to downstream storage and diversion capabilities. For a complete description of the Tulare Lakebed system, refer to the Master Water Control Manual for the Tulare Lake Basin.

To the extent possible, non-damaging releases will be made through the outlet works and/or power plant to avoid surcharging the reservoir.

7-03. Overall Plan for Water Control. The Water Control Plan for the Terminus Dam and Lake Kaweah Project coordinates flood control space, irrigation storage, and recreational uses in order to meet the following objectives:

a. Restrict flows in the downstream reaches of the Kaweah River at McKay Point to non-damaging rates of 5,500 cfs (155.8 m^3/s).

b. Provide the maximum practical amount of storage for conservation of irrigation water without impairment of the flood control functions of the reservoir.

c. Minimize damaging flows from the Kaweah River into Tulare Lakebed.

During the rainflood season, the required rainflood space is set for a given date, with variations based on antecedent precipitation. During the snowmelt season, the required flood control space is varied, based on forecasted inflow minus irrigation and spreading demands, to satisfy both flood control and conservation objectives. The irrigation requirements and infiltration capability

in the Kaweah River service area play an important role in the flood control operation of the project. Since the Kaweah River has no outlet to the ocean, all flood flows not stored in Lake Kaweah must be utilized or disposed of within the service area, otherwise they enter the Tulare Lakebed as damaging floodwater. When flood releases must be made from Lake Kaweah, all possible diversions for irrigation purposes are made. The normal anticipated irrigation demands are shown on the Water Control Diagram, Plate A-13. In addition, extensive areas of permeable soils have been reserved by local interests for disposal of floodwater by ponding and percolation, with a two-fold purpose of recharging the heavily pumped groundwater storage, while simultaneously preventing inundation of valuable agricultural cropland in Tulare Lakebed. As part of the spillway raise project, a mitigation site has been established in the Tulare Lakebed. The area is discussed in Section 2-04. Flood releases, as designated by the Corps of Engineers, in excess of irrigation and spread demands will be diverted to mitigation areas as required in the mitigation site operation and maintenance manual. The snowmelt portion of the Water Control Diagram (Plate A-13) is designed to fill the reservoir, if runoff and irrigation demands permit, but not spill.

7-04. Standing Instructions to Project Operators. During normal flood periods, Lake Kaweah will be regulated in accordance with the normal regulations for flood control operation, as explained in Paragraph 7-05 and Exhibit A of this manual. Instructions for project operators in the event of a communication outage are presented in Section 7-05b. Exhibit A is designed to function as a separate and complete document, and is to be used as a flood management guide. To facilitate independent use of Exhibit A, plates required for the flood control operation of the Terminus Dam and Lake Kaweah are provided therein.

The storage and release of floodwater in the flood control space is under the control of the Water Management Section, Sacramento District, Corps of Engineers. Standing instructions to Project Operators for flood emergencies are contained in Exhibit A, Paragraph A-03.

7-05. Flood Control. A detailed explanation of flood control operation is included in the text of Exhibit A.

a. Normal Regulation for Flood Control. Flood control regulation begins when storage in Lake Kaweah exceeds the flood control space required at any time, according to the Water Control Diagram, Plate A-13, located in Exhibit A. The Water Control Diagram and this manual are the authorized project documents regarding flood control operations. The diagram is the result of analyses of flood frequency, seasonal flood potential, and downstream channel capacities consistent with project objectives. The diagram requires the following:

(1) Uniformly increasing flood control reservation from a minimum requirement of zero on 1 September to 185,630 acre-feet (228.8 hm^3) by 15 November.

(2) Conditional rainflood reservation up to a maximum of 185,600 acre-feet (228.8 hm^3) from 15 November through 28 February, decreasing to zero as early as 1 May,

depending upon the rainflood parameter (a precipitation index of basin wetness).

(3) Conditional snowmelt flood reservation up to a maximum of 185,630 acre-feet (228.8 hm^3) from 1 March through 31 July, decreasing to zero as early as 1 May and as late as 31 July, depending on the snowmelt runoff forecast.

The basin wetness parameter is computed from daily mean basin precipitation, weighted according to station normal annual precipitation at the five project hydrometeorological system gages. The index is computed by adding previous daily mean basin precipitation values decayed by 3 percent each day to the current date and is reset to a zero parameter at midnight on 31 August. For additional information, see Exhibit A, Section A-02(a)8 and A-02(a)9.

Water stored in Schedule 1 or 2 flood control space will be released in accordance with the schedule that applies to that space. This criteria is established to ensure the timely release of floodwater from flood control space in the reservoir and, therefore, such releases shall not be restricted by the storage and diversion rights under the Kaweah Delta Water Conservation District agreements. The Corps of Engineers may direct that flood control space be increased or decreased from what is required by the Water Control Diagram based on conditions prevailing at the time.

If the reservoir storage is encroached within the flood control reservation, then flood control releases are made as quickly as possible. However, flood control releases have the following limitations, also indicated on the Water Control Diagram, Plate A-13:

(1) Releases from conservation and conditional rainflood space will be for irrigation demands.

(2) Releases from Schedule 1 rainflood space will be for irrigation and spreading demands.

(3) Releases from Schedule 2 rainflood space will be for irrigation and spreading demands, plus a supplemental flood release.

(4) Releases from conditional snowmelt space will be computed based on 1 April-31 July runoff forecast, irrigation demand, and spreading capability.

(5) No flood control reservation is required during the month of August.

(6) Releases shall be limited such that flows in the Kaweah River at McKay Point do not exceed 5,500 cfs (155.8 m^3/s). For detailed information on responsibilities for flood control, refer to Chapter IX.

When the reservoir pool elevation is below gross pool (715 feet) (217.9 m), flood control

releases will be made in accordance with the release schedule shown on the Water Control Diagram, Plate A-13. During floods in which the pool level exceeds the spillway crest (715 feet) (217.9 m), the Spillway Rating Curve and Table (shown on Plates A-4 and A-5) should be checked frequently. During small and moderate floods it will be necessary to make only normal flood releases through the outlet gates. However, occasionally during large floods it will be necessary to gradually close the outlet gates as pool elevation rises above gross pool, in order to control total outflow from the spillway and outlet to an objective outflow as long as possible. During such floods, outlet gates will remain closed as long as spillway outflow exceeds required release, to maintain desired flow at McKay Point. Subsequently, as the spillway outflow recedes, the gates will be gradually re-opened to maintain the maximum objective outflow as long as needed, in accordance with the Water Control Diagram, Plate A-13.

b. Emergency Regulation. If communications with the project are disrupted, the following procedures will be followed for project operation:

(1) Continue releases in accordance with the last instructions from the Water Management Section and make every attempt to re-establish communication.

(2) If communications cannot be re-established, make releases in accordance with the Water Control Diagram (Plate A-13) and consult the Spillway Rating Curve and the Spillway Rating Table (Plates A-4 and A-5) frequently and make adjustments to releases as described in Section 7-05a, if spilling is occurring.

c. Constraints. Releases from Terminus Dam, insofar as possible, will be restricted to the non-damaging channel capacity of 5,500 cfs (155.8 m^3/s) at McKay Point. See Section 7-16 for rate-of-release constraints.

7-06. Recreation. The recreation features at Lake Kaweah, shown on Plate 2-9, generally do not require specific control of releases for recreation purposes; however, the marina, boat docks, and portable restrooms require movement when the pool rises or falls quickly.

7-07. Water Quality. Lake Kaweah is not operated for water quality. Although water quality control may not be an authorized project purpose, compliance with Public Law 92-500 requires that all federal facilities be managed, operated, and maintained to protect and enhance the quality of water and land resources through conformance with applicable federal, state, interstate, and local substantive standards. Water quality measurements and water quality of the lake are discussed in Section 4-08.

7-08. Fish and Wildlife. The Terminus Dam and Lake Kaweah Project is not operated specifically for fish and wildlife purposes, although the lake supports a significant and diverse fish, bird and mammal population. Approximately 160 acres (0.6 sq km) immediately west of the Terminus Dam main embankment have been set aside as a wildlife management area. The 160 acres (0.6 sq km) is dominated by a pond upstream of the "Kaweah River below Terminus

Dam" stream-gaging site weir. Approximately 1/3 of the area is comprised of riparian habitat. Five acres have been planted for endangered species mitigation. The remainder is unimproved.

7-09. Water Supply. Space not reserved for flood control is operated for water supply, as directed by the Kaweah Delta Water Conservation District. [redacted]. The Project Coordination Agreement (PCA) dated February 2001 also provides for operation and maintenance of flood control and agricultural supply.

7-10. Hydroelectric Power. In August 1986, the Kaweah River Power Authority was granted FERC license number 3747 to construct and operate a 17 MW capacity power plant at Lake Kaweah. Construction of the Terminus Power Project was initiated in 1987 with completion in 1990. The Terminus Power Project is described fully in paragraph 2-03(f).

[redacted]

[redacted]

7-11. Navigation. Navigation is not a project purpose. However, navigable waters include all "waters of the United States," which are in turn defined by Title 33 CFR Part 329 to include all waters which might be susceptible to use in interstate commerce and all other waters, such as lakes and wetlands, which could affect interstate commerce, including those from which fish could be taken and sold in interstate commerce.

7-12. Drought Contingency Plans. ER 1110-2-1941 (Drought Contingency Plans) requires the development and implementation of drought management plans as part of the overall water control management activities for all projects with controlled storage. A detailed Drought Contingency Plan is included in Exhibit C.

The Governor can declare a statewide drought emergency. The Governor's State Drought Action Team (SDAT) has been formed to address drought planning. This team, established 1 February 1991 by the Governor's Executive Order No. W-3-91, consists of key state and federal personnel who are responsible for overseeing and coordinating state and federal responses to droughts. The Division Engineer is an SDAT member. Any drought declaration, drought forecasts, or drought planning that may impact project operation will be the responsibility of this entity.

7-13. Flood Emergency Action Plans. The Project Office has a copy of the emergency notification plan for serious emergencies and imminent dam failure. Procedures and responsibilities during emergencies are presented in Chapter IX and Exhibit A. The emergency Seismic Action Plan for Terminus Dam and Lake Kaweah is presented in Exhibit D.

The flood emergency activities of the Sacramento District, U.S. Army Corps of Engineers, is divided into the following four phases:

a. Normal Phase (Normal Operations). This phase is in effect during normal day-to-day operations. Emergency functions will be conducted by the normal organizational units assigned to this type of work. The Chief, Water Management Section, will determine the need for obtaining hydrologic and meteorologic data during non-duty hours. If the assistance of reservoir personnel is needed, a request will be sent directly to the Park Manager, or to the Project Operators. Prior to the flood season, personnel assigned to the emergency flood organization will review ER 500-1-1 and District Supplements A, B, and C, and then ready themselves to accomplish their duties.

b. Information Phase. The Chief of the Water Management Section will place the District in Information Phase upon indication of impending floods, flash floods, localized short duration floods, minor floods, and the early stages of major floods, when property damage is not extensive and danger to life is not serious. An alert or warning will be issued to all District personnel, including field offices, and local interests in the area affected. The District may assign liaison personnel to the federal or state center during non-duty hours.

c. Alert Phase. Whenever the flood situation becomes so severe that forecast gage heights indicate that river stages will reach or exceed the bank-full stages, the Chief, Water Management Section, will recommend to the Chief, Engineering Division, to advise the District Engineer to declare an Alert Phase. The Chief, Construction-Operations Division, will activate the Flood Emergency Operations Center (EOC). The EOC will be staffed with personnel necessary to maintain a close, continuous check on weather and hydrological conditions, and issue situation reports to all District elements concerned. Liaison Engineers will be assigned to the Federal/State Flood Center.

d. Mobilization Phase. The District Engineer will order Mobilization Phase whenever major flooding appears imminent, and when the District may be called to furnish major emergency assistance. Notification will be given to all parties as rapidly as possible, and flood emergency activities will be given priority over all other District activities for the duration of the mobilization period. In addition, the District's flood emergency organization will be fully activated.

7-14. Other. There are no other project purposes.

7-15. Deviation from Normal Regulation. Deviations from approved Water Control Plans occur because every possible circumstance cannot be accounted for in a Water Control Plan. Because of the often competing goals and complex interactions of interested groups/agencies, even seemingly inconsequential deviations from an approved plan can lead to unforeseen environmental and legal complications. Deviations from approved Water Control Plans are intended, therefore, to address unforeseen and unique circumstances. They are not intended as a means for identifying or initiating new opportunities to reoperate or reallocate storage in response to new and changing public needs. Exhibit B of this manual provides general information for preparing all deviations.

7-16. Rate of Release Change. Release changes should not be made without prior notification to the Kaweah Delta Water Conservation District. There are numerous irrigation structures downstream from the dam which may require adjustments prior to any release change. In addition, during periods of high releases, the Kaweah River channel must be patrolled for debris removal and to assure proper functioning of flood control works. This is done in order to permit orderly evacuation of people and personal property in advance of rising water downstream, and to minimize bank caving after extended periods of high water flows. In the absence of any downstream constraints, releases from Terminus Dam should not be increased or decreased by more than 500 cfs (14.2 m^3/s) per hour.

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VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. The Terminus Dam and Lake Kaweah Project regulates flood flows in the Kaweah River Basin to obtain the maximum practical reduction in flood damages, increase water available for irrigation during irrigation season, and increase the recreational opportunities within the Kaweah River Basin. The flood control storage in Lake Kaweah is sufficient to impound up to 185,630 acre-feet (228.9 hm^3) of floodwater from the 561 square mile (1,453.0 km^2) drainage area of the Kaweah River above Terminus Dam. The Historical Operation of Lake Kaweah is shown graphically on Plate 4-6.

8-02. Flood Control. The main objectives of the flood control plan are to prevent the inundation of areas in the lower Kaweah River Basin and to function as part of a system of reservoirs that provide flood protection to the Tulare Lakebed and adjacent areas.

a. Spillway Design Flood. The original Spillway Design Flood (SDF) for Lake Kaweah was based on a storm averaging 32.2 inches (81.8 cm) of precipitation and the equivalent of 6.7 inches (17.0 cm) of snowmelt over the entire basin, resulting in a total runoff of 24.8 inches (69.0 cm). The SDF had a peak inflow of 290,000 cfs (8,212.8 m^3/s) and a 5-day volume of 740,000 acre-feet (912.4 hm^3). The flood was routed through the reservoir using the initial storage of 107,000 acre-feet (131.9 hm^3), 43,000 acre-feet (53.0 hm^3) less than gross pool, and 5,500 cfs (155.8 m^3/s) release through the outlets, which was progressively reduced to zero as the spillway discharge reached 5,500 cfs (1,55.8 m^3/s). The initial storage was based on the reservoir being full 7 days prior to the beginning of the flood and subsequent releases being made in accordance with the Water Control Diagram. The reservoir pool peaked at an elevation of 745.1 feet (227.1 m), with a corresponding freeboard of 4.9 feet (1.5 m). The maximum outflow was 274,000 cfs (7,759.8 m^3/s).

In 1971, the Probable Maximum Flood (PMF) was revised using HMR 36. The revised PMF was based on a storm averaging 37.1 inches (94.2 cm) of precipitation and the equivalent of 5.0 inches (12.7 cm) of snowmelt over the entire basin, resulting in a total runoff of 23.9 inches (60.9 cm). The revised PMF had a peak inflow of 330,000 cfs (9,345.6 m^3/s) and a 5-day volume of 713,000 acre-feet (879.1 hm^3). The flood was routed through Lake Kaweah assuming the reservoir was at gross pool at the start of the flood due to preceding storms. The reservoir pool peaked at an elevation of 747.4 feet (227.1 m), with a corresponding freeboard of 2.6 feet (0.8 m). The maximum outflow was 295,600 cfs (8,371.4 m^3/s).

In 1998, the Probable Maximum Flood (PMF) was again revised using HMR 58. The revised PMF was based on a storm averaging 37.3 inches (94.7 cm) of precipitation and the equivalent of 4.1 inches (10.4 cm) of snowmelt over the entire basin, resulting in a total runoff of 21.8 inches (55.4 cm). This revised PMF had a peak inflow of 337,500 cfs (9,558.0 m^3/s) and a 5-day volume of 652,256 acre-feet (804.2 hm^3). The flood was routed through the enlarged Lake Kaweah assuming the reservoir was at gross pool at the start of the flood due to preceding

storms. The reservoir pool peaked at an elevation of 747.12 feet (227.7 m), with a corresponding freeboard of 2.88 feet (0.9 m). The maximum outflow was 308,400 cfs (8733.9 m^3/s). A routing of the SDF flood, using the revised PMF, is shown on Plate 8-1.

b. Reservoir Design Flood. Selection of the storage capacity of Lake Kaweah was based primarily on the following flood control requirements:

(1) Protection of the urban area of the city of Visalia against all reasonable probable floods, including the Standard Project Flood. At that time, a flow of 22,000 cfs (623.0 m^3/s) was considered non-damaging to the area. The non-damaging flow to the urban area is now considered to be 10,000 cfs (283.2 m^3/s). Reevaluated flood frequency analysis and increased Standard Project Flood potential developed subsequent to the December 1966 flood event (see 8-02c below) indicate that Visalia is actually only protected from the 2.5 percent flood, due to uncontrolled local flows below Terminus Dam.

(2) Protection of agricultural lands in the Kaweah River floodplain by controlling the floods of record and the Reservoir Design Flood to 5,500 cfs (155.8 m^3/s) at McKay Point.

(3) Prevention of damaging flows into Tulare Lakebed area, in all except the extreme flood years, and minimizing damaging flows in those extreme years.

(4) Provision of 8,000 acre-feet (9.9 hm^3) of space for sedimentation. The 1977 reservoir sediment survey revealed that 7,000 acre-feet (8.6 hm^3) of sediment had accumulated in Lake Kaweah since completion of the project.

In 2003, the spillway was raised by 21 feet (6.6 m), increasing the gross pool and flood control pools to 185,630 acre-feet (228.9 hm^3). The Reservoir Design Flood (RDF) represents the maximum flood controllable to project objective outflows of 5,500 cfs (155.8 m^3/s) utilizing 173,630 acre-feet (214.1 hm^3) of flood control space. The RDF was derived from using 59.5 percent of the Standard Project Flood. Routings of the RDF and the 1 Percent Flood through Terminus Dam and Lake Kaweah are shown on Plates 8-2 and 8-3.

c. Standard Project Flood. The Standard Project Flood (SPF) used in design studies for Terminus Dam defined standard project runoff at the dam site based on the largest recorded event at that time, the December 1955 storm. A reevaluation subsequent to the December 1966 flood event indicates a somewhat greater potential runoff from the Kaweah River basin above the dam and a much larger coincident accretion between the dam and the downstream damage areas, principally from the Dry Creek drainage area. The recomputed Standard Project Flood, developed in 1970, was developed by transposing the center of the December 1966 storm (on the basis of percent of mean annual precipitation) directly over the drainage basin and computing the resulting flood by unit hydrograph methods. Loss curves used allow for variation of loss rate with accumulated total loss and rainfall intensity. They were based on analysis of the 1955 and 1966 floods, and indicate losses averaging 0.22 inches (0.6 cm) per hour during the standard

project storm. The resulting Kaweah River SPF hydrograph had a peak flow of 119,000 cfs (3,370.1 m^3/s) and a four-day volume of 248,000 acre-feet (305.8 hm^3). The standard project runoff from Dry Creek has a peak flow of 20,500 cfs (580.6 m^3/s) and a four-day volume of 32,000 acre-feet (39.5 hm^3). Routing of the revised SPF through Lake Kaweah demonstrates the effect of larger local flows entering the river between Terminus Dam and McKay Point on Terminus Dam releases. Impairment of release capability during periods when the coincident local flows preempt all or an appreciable portion of available channel capacity results in an earlier loss of control during the SPF.

The Standard Project Flood used for the raised spillway is from the "Kaweah River Basin Hydrology Report," dated August 1990. This office report was prepared in support of the Kaweah River Feasibility Study. This SPF was centered over the Kaweah River basin above Terminus Dam with a total basin mean precipitation, including snowmelt, of 23.42 inches (59.5 cm) over 5 days. The SPF volume is 245,000 acre-feet (302.1 hm^3) and the peak flow is 117,700 cfs (3,333.3 m^3). A concurrent flood, developed for Dry Creek near Lemoncove, has a peak flow and volume of 16,768 cfs (472.9 m^3/s) and 25,435 acre-feet (31.4 hm^3), respectively.

The routing of the SPF through Terminus Dam and Lake Kaweah is shown on Plate 8-4.

d. Floods of Record. Hypothetical flood routings of the December 1966 rainflood are shown on Plate 8-5. Plate 8-6 presents hypothetical flood routings of the 1906 and 1969 snowmelt floods. Historical Operation for the period 1962-2004 is shown in Plate 4-6.

8-03. Recreation. Table 2-1 shows the estimated annual visitation hours since 1962. Lake Kaweah provides opportunities for many types of recreation. A description of the recreational development at the lake is presented in Paragraph 2-06.

8-04. Water Quality. Water quality sampling and testing are conducted in April and August of every year. The results of the water quality testing program are presented in Paragraph 4-08 and Table 4-15. Although the recreational activities at the lake and the warming of the ponded water may have some detrimental affect on water quality, Lake Kaweah provides water for recreation and irrigation at times when there would otherwise be none. The quality of water is "good to excellent" relative to its beneficial uses.

8.05. Fish and Wildlife. Lake Kaweah supports an excellent warm water fishery with bass, crappie, bluegill, and catfish being the predominant species. This is a considerable enhancement, given that the natural flow in the Kaweah River often falls to zero. Wildlife habitat mitigation areas associated with the spillway raise are discussed in Paragraph 2-04.

8-06. Water Supply. Under natural conditions, a large portion of annual runoff may occur during one or more relatively short flood events. Nearly all rainflood events occur from early winter through early spring (December through March). Approximately 66 percent of the annual runoff generally occurs during the snowmelt season (April through July). The annual natural

runoff is highly variable, so relatively dry periods can occur over several years. Historical inflows to Lake Kaweah can be found in Table 4-12 in the Tables Section immediately following Chapter IX of this manual. Prior to the spillway raise, Lake Kaweah provided approximately 100,000 acre-feet (123.3 hm^3) of additional irrigation water annually. With the spillway raise, approximately 8,490 acre-feet (10.5 hm^3) of additional irrigation water will be provided annually for use within the upper Kaweah service area below Terminus Dam.

[redacted]

8-08. Navigation. Navigation is not a project purpose. However, navigable waters include all "waters of the United States," which are in turn defined by Title 33 CFR Part 329 to include all waters which might be susceptible to use in interstate commerce and all other waters, such as lakes and wetlands, which could affect interstate commerce, including those from which fish could be taken and sold in interstate commerce.

8-09. Drought Contingency Plans. A detailed explanation of the Drought Contingency Plan is included in Exhibit C.

8-10. Flood Emergency Action Plans. During flood emergencies, project operation provides benefits by defining procedures for warning downstream interests. Benefits can also be expected during non-flood emergencies, such as pollution abatement. Procedures and responsibilities during emergencies are presented in Chapter IX, Exhibit A, and Exhibit D.

8-11. Frequencies

a. Unregulated Flow Frequency. Unregulated rain flows and statistical parameters representing the peak, 1-day, 3-day, 7-day, 15-day, and 30-day flows were developed for the Kaweah River below Terminus Dam and for Dry Creek near Lemoncove. The unregulated rainflood frequency curves for the Kaweah River below Terminus Dam and for Dry Creek near Lemoncove are shown on Plates 8-7 and 8-8. The computed and adopted statistics supporting Plates 8-7 and 8-8 are presented in tabular form in Tables 8-1 and 8-2 in the Table Section. Unregulated snowmelt flows and statistical parameters, representing the 1-day, 15-day, 30-day, 60-day, 90-day, and 120-day flows, were developed for the Kaweah River below Terminus Dam. The unregulated snowmelt flood frequency curves for the Kaweah River below Terminus Dam are shown on Plate 8-9. The computed and adopted statistics supporting Plate 8-9 are presented in tabular form in Table 8-3 in the Table Section following Chapter IX.

Flow records on the Kaweah River near Three Rivers began in April 1903. The flow record for the Kaweah River below Terminus dam was extended back to water year 1904 based on the Three Rivers data. Rainfall season flows at the Kaweah River near Three Rivers gage were

increased by 4 percent to account for drainage area. The rainflood curves for the Kaweah River below Terminus Dam were computed based on the 100-year period from 1905 through 2004, while the snowmelt curves for the Kaweah River below Terminus Dam were computed based on the 101-year period from 1904 through 2004.

These curves were derived using procedures contained in Bulletin 17B, "Guidelines for Determining Flood Flow Frequency," published by the U.S. Water Resources Council. The final statistics have been adjusted to allow for orderly transition between curves of different durations.

b. Regulated Flow Frequency. Regulated rainflood and snowmelt flow frequency curves for the Kaweah River below Terminus Dam are shown on Plates 8-10 and 8-11, respectively. These curves reflect the historical operation of Terminus Dam from 1963-2004. The curves were extended to reflect very rare events by routing hypothetical floods through Lake Kaweah.

c. Pool Elevation, Duration, and Frequency. Elevation-Duration and Elevation-Frequency curves of reservoir storage frequency for Lake Kaweah are shown on Plates 8-12 and 8-13. These curves reflect the historical operation of Lake Kaweah from 1963-2003. Data for water year 2004 was not included on these plates, as operational changes occurred during the water year due to the completion of the spillway raise in February.

d. Seasonal Variation of Storage. The historical seasonal variation of storage frequency is shown on Plate 8-14. The level of storage is highest from late spring through mid-summer (May through July) as a result of snowmelt runoff stored for water supply and flood control. Subsequent releases made through the summer for water supply and downstream rights draw the reservoir system down for the beginning of the winter flood season. Data for water year 2004 was not included on this plate, as operational changes occurred during the water year due to the completion of the spillway raise in February.

8-12. Other Studies. The Corps of Engineers does not have any studies in progress for the Terminus Dam and Lake Kaweah Project.

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IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization

a. Role of the U.S. Army Corps of Engineers. The primary responsibility for operating Terminus Dam and Lake Kaweah Project is delegated to units of the Water Management Section (Engineering Division) and Operations and Readiness Branch (Construction-Operations Division) of the Sacramento District, U.S. Army Corps of Engineers, as outlined below. The Sacramento District's Public Affairs Office (PAO) coordinates with local press regarding floods and other aspects of the project operation. Names, addresses, and telephone numbers of those individuals whose responsibilities are outlined in the following paragraphs are listed in the front of this manual and in Exhibit A.

(1) Water Management Section (Engineering Division). The Water Management Section responsibilities are as follows:

(a) Obtaining current hydrometeorological data and weather forecasts for the region.

(b) Analyzing current reservoir information, hydrometeorologic data, and weather forecasts for the region, making regulation decisions which are in accordance with the approved water control plan, and issuing appropriate operating instructions to the designated damtender.

(c) Providing training to the Project Operators in the Water Control Plan, operations procedures, and instrumentation.

(d) Providing maintenance for hydrometeorological instrumentation and gage control equipment at the project, and supervising its operation.

(e) Preparing monthly operation reports and other reports about the operation of the project as requested by the Office, Chief of Engineers, and as needed for operational purposes.

(f) Making revisions to this Water Control Manual and distributing them.

(g) Advising the District Engineer whenever there has been a departure from operating instructions, or when there is a need for making a temporary modification to those instructions.

(h) Staying informed at all times of downstream channel conditions and making periodic field inspections.

(i) Arranging with local interests for collection of flow and diversion data.

(j) Obtaining from local interests each month a summary of requested flows, and maintaining a record of the instructions issued, data transmitted to other agencies, and requests received from other agencies.

(k) Keeping the Kaweah Delta Water Conservation District (KDWCD) and other local interests continuously advised of the operation of the project.

(2) Terminus Dam and Lake Kaweah Park Manager (Construction-Operations Division) has the following responsibilities:

(a) Keeping well informed of the operating rules contained in this Water Control Manual and bringing to the attention of the Water Management Section any feature of the manual that may require clarification or revision.

(b) Keeping familiar with the operation of all recording and communication equipment and keeping informed of current hydrological and meteorological conditions (i.e., pool elevation, river flows, precipitation, etc.). Reporting by radio, telephone, or e-mail to the Water Management Section the data outlined in Exhibit A.

(c) Accomplishing the physical operation of the dam in accordance with instructions contained in this manual, or as issued by the Water Management Section. During storms, this may require 24-hour attendance at the dam.

(d) Calculating and maintaining a continuous record of inflow, outflows, storage, Dry Creek flow, weather data, and other data specified by the Water Management Section.

(e) Reporting any unusual conditions of the dam embankment, the reservoir, and the downstream channel of the Kaweah River that might interfere with the planned operation of the reservoir.

(f) Obtaining necessary information on scheduled downstream irrigation and downstream spreading activities, and keeping local interests continually advised of the routine operation of the reservoir.

(g) Maintaining a log of gate operation containing the following information: change in position of gates, date and time when such changes are made, reservoir water level, and initials of the individual accomplishing the change.

(h) Maintaining records of instructions received from the Water Management Section and requests from the Kaweah Watermaster.

(i) Making and recording weekly checks on reservoir and flow gage readings to assure proper operation of all recording equipment.

(j) Immediately after the end of each month, transmitting to the Water Management Section the data specified in Exhibit A.

(k) Making emergency operational changes when contact with the Water Management Section is broken and a clearly defined change occurs that warrants immediate action.

(l) Assisting with obtaining samples for water quality and sedimentation analysis as required.

(3) Operations and Readiness Branch (Construction-Operations Division) has the responsibly of budgeting project operation and maintenance funds.

b. Other Federal Agencies

(1) The Bureau of Reclamation (BOR) acts as the agent for the United States in the execution of the repayment contract , wherein water users repay a percentage of the capital for the construction of Terminus Dam with annual operational and maintenance costs. The final payment was made 1 May 2004.

(2) The National Oceanic and Atmospheric Administration (NOAA), through its National Weather Service (NWS), maintains year-round surveillance of weather conditions. NOAA weather and storm forecasts, pertinent to the area, are furnished to the NWS office in Sacramento for distribution to agencies responsible for flood protection. The NWS furnishes meteorological data and weather forecasts on a 24-hour basis. When the meteorological situation indicates general area precipitation, NWS furnishes Quantitative Precipitation Forecasts (QPF). (See Paragraph 6-01b.)

(3) Personnel from the NWS office in Sacramento and the California Department of Water Resources are assigned to the Joint Federal-State River Forecast Center (RFC), which monitors weather conditions and river stages on a year-round basis. The RFC forecasts stages and flows on major river systems, including inflow to Lake Kaweah on the Kaweah River.

(4) The Federal-State Flood Operations Center furnishes flood warnings and forecasts of river stages and flows to the local news media, law enforcement agencies, and other responsible agencies for their use and for dissemination to the public.

c. State and County Agencies

(1) The California Department of Fish and Game enforces fish and game laws on the lake and within the wildlife area. They also stock the lake with fish.

(2) The California Division of Forestry is responsible for firefighting on project land.

(3) The County of Tulare provides normal law enforcement at the project and patrol of the lake by boat. During periods of peak visitation, additional law enforcement is provided under a contract with the Corps.

(4) The Kaweah Delta Water Conservation District directs the use of conservation storage in Lake Kaweah and manages the mitigation areas that are not located on U.S. Army Corps of Engineers property.

d. Private Organizations. None

9-02. Interagency Coordination. To ensure that the flood control operation of Terminus Dam will be as effective as possible, it is essential that the Corps be continually apprised of possible flood hazards, weather conditions, inflow to the reservoir, and flows at key locations in the Kaweah River. This requires close liaison between the U.S. Army Corps of Engineers, the National Weather Service (NWS), the Federal-State River Forecast Center (RFC), the California Department of Water Resources (DWR), Kaweah Delta Water Conservation District (KDWCD), U.S. Bureau of Reclamation (USBR), and the Tulare Lake interests.

a. Local Press and Corps Bulletins. The Sacramento District, U.S. Army Corps of Engineers, Public Affairs Office (PAO), coordinates with the local press regarding floods and other aspects of project operation. The Water Management Section, Sacramento District, maintains official records on Corps projects. Current reservoir status information is available on the Corps' Sacramento District Water Control Data Systems web site: <http://www.spk-wc.usace.army.mil/>.

b. National Weather Service. Congress has given the National Weather Service responsibility for providing flood warnings to the public. The NWS office in Sacramento maintains a year-round surveillance of weather conditions. The National Weather Service also prepares and distributes weather forecasts to agencies responsible for flood protection, and to the public by way of the local news media. The NWS furnishes meteorological data and weather forecasts on a 24-hour basis. Regular forecasts are made twice a day. When the meteorological situation indicates general area precipitation, Quantitative Precipitation Forecasts are also furnished.

c. U.S. Geological Survey. The U.S. Geological Survey (USGS) operates and maintains

gaging stations on a cooperative basis with local, state, and federal agencies. The USGS publishes records of their own measurements and those furnished by other agencies, such as the Bureau of Reclamation and the Corps of Engineers. Complete records of flows for Corps of Engineers flow gages were published by USGS prior to water year 1991. Since 1991, the Corps has operated and serviced these gages and now maintains the complete official record for gaging stations used in the operation of Terminus Dam. Refer to Plate 4-1 for the gaging station locations operated by various agencies within and around the basin.

d. California Department of Water Resources. The Corps of Engineers furnishes the Department of Water Resources (DWR) with precipitation and temperature data from climatological stations it maintains in the Kaweah River Basin (Atwell, Bear Trap Meadow, Giant Forest, Hockett Meadow, and Terminus Dam). Lake Kaweah pool elevation and flow data at Corps sites are also provided to DWR. The DWR publishes most of this data.

e. Kaweah Delta Water Conservation District. All releases from Lake Kaweah should be coordinated with the Kaweah Delta Water Conservation District, since they have first-hand knowledge of downstream conditions and may have to operate downstream structures to accommodate a release change. Kaweah Delta Water Conservation District owns and operates the McKay Point Diversion Structure downstream from the dam and many gaging stations below this structure.

f. Other Agencies. The Terminus Dam and Lake Kaweah Project is operated so that flows do not exceed 5,500 cfs (141.6 m^3/s) at McKay Point. Under certain conditions, it may be necessary to consider critical conditions in the Tulare Lakebed. Major releases from Pine Flat Dam and Lake, Success Dam and Lake, and Isabella Dam and Lake (all operated by the Corps of Engineers) have the potential to release floodwaters to the Tulare Lakebed. The flood control operation of these reservoirs must be coordinated with that of Lake Kaweah to take advantage of any opportunity to minimize flood damage.

During floods and other high releases, seepage and erosion along the Kaweah and St. Johns rivers should be a considered while operating Terminus Dam.

(1) Federal-State River Forecast Center. Personnel from the California-Nevada River Forecast Center, the National Weather Service Office in Sacramento, and the California Department of Water Resources are assigned to the Joint Federal-State Forecast Center (RFC), which monitors weather conditions and river stages on a year-round basis. The RFC forecasts stages and flows on major river systems, including flows on the Kaweah River.

(2) Federal-State Flood Operations Center. The Federal-State Flood Operations Center is activated when floods on major streams become imminent. This center operates on a 24-hour basis and, among other flood emergency activities, advises all interested parties of flood situations as they develop. The center furnishes flood warnings and forecasts of river stages to local news media, law enforcement agencies, and other responsible agencies for their use and for

dissemination to the public.

9-03. Interagency Agreements. The provisions for payment of project, operations, and maintenance costs by local interests are set forth in the Bureau of Reclamation contract number 14-06-200-1729A as well as the Department of Army Cooperative Agreement dated February 9, 2001.

9-04. Commissions, River Authorities, Compacts, and Committees. None.

9-05. Non-Federal Hydropower. The Kaweah River Power Authority operates the Terminus Power Project at Terminus Dam.

9-06. Reports. The Kaweah and St. Johns River Association publishes an annual report listing precipitation, discharges, unit entitlements, storages, and water diversions. Other reports required for the operation of the Terminus Dam and Lake Kaweah Project are listed in Exhibit A.

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

U.S. Army Corps of Engineers
Sacramento District
Revised July 2005

TABLES

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TABLE 4-7
FORECASTED AND ACTUAL SNOWMELT RUNOFF INTO LAKE KAWEAH
(Flow in 1,000 Acre-Feet)

Water Year	1 APRIL THROUGH 31 JULY									GIVEN DATE THROUGH 31 JULY							
	Actual	1 FEBRUARY			1 MARCH			1 APRIL			1 MAY				1 JUNE			
		Forecast	Error	% Error	Forecast	Error	% Error	Forecast	Error	% Error	Actual	Forecast	Error	% Error	Actual	Forecast	Error	% Error
1933	230	NR	NR	NR	NR	NR	NR	276	46	17 %	186	NR	NR	NR	125	NR	NR	NR
1934	68	NR	NR	NR	NR	NR	NR	NR	NR	NR	37	NR	NR	NR	16	NR	NR	NR
1935	291	NR	NR	NR	NR	NR	NR	NR	NR	NR	205	NR	NR	NR	101	NR	NR	NR
1936	345	NR	NR	NR	NR	NR	NR	335	-10	-3 %	241	NR	NR	NR	104	NR	NR	NR
1937	454	NR	NR	NR	NR	NR	NR	394	-60	-15 %	354	NR	NR	NR	161	NR	NR	NR
1938	562	NR	NR	NR	NR	NR	NR	400	-162	-41 %	440	NR	NR	NR	241	NR	NR	NR
1939	159	NR	NR	NR	NR	NR	NR	130	-29	-22 %	92	NR	NR	NR	32	NR	NR	NR
1940	323	NR	NR	NR	NR	NR	NR	250	-73	- 29 %	230	NR	NR	NR	89	NR	NR	NR
1941	445	NR	NR	NR	NR	NR	NR	400	-45	-11 %	373	NR	NR	NR	200	NR	NR	NR
1942	362	NR	NR	NR	NR	NR	NR	315	-47	-15 %	288	NR	NR	NR	168	NR	NR	NR
1943	388	NR	NR	NR	NR	NR	NR	320	-68	-21 %	272	NR	NR	NR	120	NR	NR	NR
1944	235	NR	NR	NR	NR	NR	NR	270	35	- 13 %	197	NR	NR	NR	90	NR	NR	NR
1945	381	NR	NR	NR	NR	NR	NR	360	-21	-6 %	296	NR	NR	NR	163	NR	NR	NR
1946	224	NR	NR	NR	NR	NR	NR	270	46	-17 %	147	NR	NR	NR	53	NR	NR	NR
1947	148	NR	NR	NR	NR	NR	NR	150	2	1 %	106	NR	NR	NR	32	NR	NR	NR
1948	226	NR	NR	NR	NR	NR	NR	120	-106	-88 %	176	NR	NR	NR	77	NR	NR	NR
1949	181	NR	NR	NR	NR	NR	NR	210	29	14 %	123	NR	NR	NR	40	NR	NR	NR
1950	222	NR	NR	NR	NR	NR	NR	195	-27	-14 %	148	NR	NR	NR	62	NR	NR	NR
1951	172	NR	NR	NR	NR	NR	NR	65	-107	-165 %	125	NR	NR	NR	53	NR	NR	NR
1952	588	NR	NR	NR	NR	NR	NR	600	12	2 %	489	NR	NR	NR	253	NR	NR	NR
1953	213	300	87	29 %	200	-13	-6 %	140	-73	-52 %	162	119	-43	-36 %	104	NR	NR	NR
1954	231	200	-31	-15 %	220	-11	-5 %	282	51	18 %	157	160	3	2 %	52	NR	NR	NR
1955	194	280	86	31 %	260	66	25 %	170	-24	-14 %	158	146	-12	-8 %	78	NR	NR	NR
1956	336	400	64	16 %	350	14	4 %	280	-56	-20 %	267	230	-37	-16 %	134	NR	NR	NR
1957	232	200	-32	-16 %	190	-42	-22 %	160	-72	-45 %	201	140	-61	-44 %	114	NR	NR	NR
1958	502	265	-237	-89 %	290	-212	-73 %	500	-2	0 %	391	NR	NR	NR	196	185	-11	-6 %
1959	88	155	67	43 %	195	107	55 %	105	17	16 %	53	NR	NR	NR	19	NR	NR	NR
1960	129	125	-4	-3 %	175	46	26 %	125	-4	-3 %	86	83	-3	-4 %	29	NR	NR	NR

TABLE 4-7
FORECASTED AND ACTUAL SNOWMELT RUNOFF INTO LAKE KAWEAH
(Flow in 1,000 Acre-Feet)

Water Year	1 APRIL THROUGH 31 JULY									GIVEN DATE THROUGH 31 JULY							
	Actual	1 FEBRUARY			1 MARCH			1 APRIL			1 MAY				1 JUNE			
		Forecast	Error	% Error	Forecast	Error	% Error	Forecast	Error	% Error	Actual	Forecast	Error	% Error	Actual	Forecast	Error	% Error
1961	77	165	88	53 %	80	3	4 %	70	-7	-10 %	52	NR	NR	NR	19	NR	NR	NR
1962	298	195	-103	-53 %	310	12	4 %	300	2	1 %	203	204	1	0 %	111	NR	NR	NR
1963	325	150	-175	-117 %	125	-200	-160 %	155	-170	-110 %	262	175	-87	-29 %	140	NR	NR	NR
1964	163	200	37	19 %	130	-33	-25 %	145	-18	-12 %	124	100	-24	- 24 %	55	NR	NR	NR
1965	313	350	37	11 %	280	-33	-12 %	250	-63	-25 %	247	234	-13	- 6 %	147	NR	NR	NR
1966	149	250	101	40 %	215	66	31 %	150	1	1 %	90	51	-39	-76 %	28	NR	NR	NR
1967	610	385	-225	-58 %	330	-280	-85 %	400	-210	-52 %	515	515	0	0 %	329	NR	NR	NR
1968	131	200	69	35 %	155	24	15 %	140	9	6 %	93	70	-23	-33 %	35	NR	NR	NR
1969	799	550	-249	-45 %	700	-99	-14 %	800	1	0 %	651	750	99	13 %	369	370	1	0 %
1970	145	220	75	34 %	180	35	19 %	170	25	15 %	104	110	6	5 %	68	NR	NR	NR
1971	195	270	75	28 %	220	25	11 %	190	-5	-3 %	154	130	-24	-18 %	87	NR	NR	NR
1972	92	230	138	60 %	160	68	43 %	80	-12	-15 %	65	38	-27	-71 %	25	NR	NR	NR
1973	451	340	-111	-33 %	400	-51	-13 %	470	19	4 %	378	365	-13	-4 %	180	NR	NR	NR
1974	332	290	-42	-14 %	240	-92	-38 %	300	-32	-11 %	258	246	-12	-5 %	125	NR	NR	NR
1975	297	170	-127	-75 %	190	-107	-56 %	265	-32	-12 %	265	260	-5	-2 %	140	NR	NR	NR
1976	75	120	45	38 %	95	20	21 %	85	10	12 %	53	58	5	9 %	13	NR	NR	NR
1977	61	115	54	47 %	60	-1	-2 %	50	-11	-22 %	44	22	-22	-100 %	22	NR	NR	NR
1978	542	340	-202	-59 %	435	-107	-25 %	550	8	1 %	447	505	58	11 %	275	NR	NR	NR
1979	288	210	-78	-37 %	245	-43	-18 %	295	7	2 %	227	190	-37	-19 %	91	NR	NR	NR
1980	475	340	-135	-40 %	470	-5	-1 %	520	45	9 %	380	400	20	5 %	253	NR	NR	NR
1981	172	195	23	12 %	170	-2	-1 %	210	38	18 %	119	155	36	23 %	99	NR	NR	NR
1982	548	345	-203	-59 %	260	-288	-111 %	360	-188	-52 %	357	300	-57	-19 %	184	NR	NR	NR
1983	749	510	-239	-47 %	570	-179	-31 %	700	-49	-7 %	649	620	-29	-5 %	447	NR	NR	NR
1984	240	290	50	17 %	280	40	14 %	235	-5	-2 %	187	165	-22	-13 %	76	NR	NR	NR
1985	218	230	12	5 %	200	-18	-9 %	240	22	9 %	144	145	1	1 %	54	NR	NR	NR
1986	427	250	-177	-71 %	420	-7	-2 %	500	73	15 %	322	385	63	16 %	169	NR	NR	NR
1987	117	125	8	6 %	120	3	3 %	140	23	16 %	71	65	-6	-9 %	23	NR	NR	NR
1988	108	215	107	50 %	160	52	33 %	110	2	2 %	75	76	1	1 %	28	NR	NR	NR
1989	142	180	38	21 %	170	28	16 %	175	33	19 %	81	90	9	10 %	28	NR	NR	NR
1990	94	135	41	30 %	140	46	33 %	105	11	10 %	62	65	3	5 %	25	NR	NR	NR

TABLE 4-7
FORECASTED AND ACTUAL SNOWMELT RUNOFF INTO LAKE KAWEAH
(Flow in 1,000 Acre-Feet)

Water Year	1 APRIL THROUGH 31 JULY										GIVEN DATE THROUGH 31 JULY							
	Actual	1 FEBRUARY			1 MARCH			1 APRIL			1 MAY				1 JUNE			
		Forecast	Error	% Error	Forecast	Error	% Error	Forecast	Error	% Error	Actual	Forecast	Error	% Error	Actual	Forecast	Error	% Error
1991	193	95	-98	-103 %	65	-128	-197 %	230	37	16 %	153	170	17	10 %	83	80	-3	-4 %
1992	97	135	38	28 %	160	63	39 %	155	58	37 %	55	83	28	34 %	14	27	13	48 %
1993	379	340	-39	-11 %	400	21	5 %	390	11	3 %	297	280	-17	-6 %	148	NR	NR	NR
1994	132	150	18	12 %	190	58	31 %	135	3	2 %	95	100	5	5 %	34	NR	NR	NR
1995	602	360	-242	-67 %	330	-272	-82 %	490	-112	-23 %	518	415	-103	-25 %	356	NR	NR	NR
1996	337	220	-117	-53 %	290	-47	-16 %	310	-27	-9 %	243	225	-18	-8 %	102	NR	NR	NR
1997	283	520	237	46 %	470	187	40 %	360	77	21 %	209	255	46	18 %	85	NR	NR	NR
1998	670	260	-410	-158 %	460	-210	-46 %	480	-190	-40 %	555	425	-130	-31 %	422	NR	NR	NR
1999	162	200	38	19 %	180	18	10 %	155	-7	-5 %	123	120	-3	-3 %	45	NR	NR	NR
2000	245	170	-75	-44 %	280	35	13 %	250	5	2 %	179	174	-5	-3 %	66	NR	NR	NR
2001	188	160	-28	-18 %	190	2	1 %	150	-38	-25 %	136	138	2	1 %	34	NR	NR	NR
2002	196	265	69	26 %	210	14	7 %	215	19	9 %	133	133	0	0 %	58	NR	NR	NR
2003	268	220	-48	-22 %	180	-88	-49 %	185	-83	-45 %	217	174	-43	-25 %	100	79	-21	-27 %
2004	133	240	107	45 %	250	117	47 %	180	47	26 %	86	113	27	24 %	32	NR	NR	NR
MEAN (+)	287	247	67	30 %	251	44	21 %	267	25	11 %	218	208	23	10 %	113	NR	NR	NR
MEAN (-)	--	--	-137	-52 %	--	-109	-48 %	--	-61	-28 %	--	--	-34	-10 %	--	NR	NR	NR
EXTREME (+)	799	550	237	60 %	700	187	55 %	800	77	37 %	651	750	99	34 %	447	NR	NR	NR
EXTREME (-)	61	95	-410	-158 %	60	-288	-197 %	50	-210	-110 %	37	22	-130	-100 %	13	NR	NR	NR

NOTES:

1. NR = No Record
2. Forecasts prepared and published by State of California, Department of Water Resources, Snow Surveys.
3. Forecasts and actual flow from 1933-1961 are from Kaweah River near Three Rivers.
4. Computed error based on past performance is not necessarily indicative of the accuracy that may be achieved in the future.

TABLE 4-12
HISTORICAL UNREGULATED MONTHLY INFLOWS TO TERMINUS DAM AND LAKE KAWEAH PROJECT
(1,000 Acre-Feet)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Total
1904	2.7	4.1	3.4	3.7	13.5	48.8	63.8	141.6	70.2	14.1	6.8	7.1	379.8
1905	34.0	6.8	5.7	7.2	14.6	35.2	47.8	88.8	82.1	18.4	4.5	2.6	347.7
1906	2.6	3.3	5.0	51.3	25.1	179.4	118.6	203.8	288.8	215.8	42.6	12.3	1148.6
1907	6.4	6.1	14.4	26.7	36.1	68.3	119.5	122.0	123.6	64.3	16.1	5.6	609.1
1908	7.1	6.5	12.5	13.1	19.2	37.4	48.0	55.5	36.2	11.5	5.4	5.0	257.4
1909	6.2	4.5	5.5	100.5	85.1	55.8	91.2	163.1	217.3	70.6	10.0	6.6	816.4
1910	5.7	13.1	48.6	52.4	26.2	48.9	78.7	86.8	34.9	12.0	3.7	2.9	413.9
1911	4.4	4.2	6.6	56.1	38.5	72.6	75.9	106.3	122.0	51.8	11.4	4.7	554.5
1912	4.8	5.0	5.6	6.3	6.1	12.3	22.6	67.5	61.2	10.6	3.4	2.2	207.6
1913	2.3	3.0	2.9	5.1	7.7	15.7	38.2	68.5	43.2	15.6	10.6	9.0	221.8
1914	3.1	6.6	7.5	75.9	35.2	52.4	67.4	108.5	86.4	38.7	7.5	4.2	493.4
1915	4.3	3.5	5.0	8.5	19.8	28.3	54.1	104.3	105.5	30.8	6.4	3.4	373.9
1916	2.6	3.4	7.6	101.3	67.6	111.9	127.9	145.4	131.1	59.0	16.7	6.1	780.6
1917	19.6	9.0	9.0	18.3	40.5	36.7	71.3	102.1	119.9	30.6	7.9	3.4	468.3
1918	3.0	3.3	3.4	3.5	8.0	34.1	45.2	57.0	55.0	10.0	3.0	3.2	228.7
1919	11.0	7.8	8.8	6.4	14.4	27.4	56.2	88.0	30.0	7.0	2.0	1.3	260.3
1920	2.5	3.3	8.7	6.2	7.7	33.4	68.3	110.2	84.0	21.0	5.0	2.8	353.1
1921	6.6	7.4	9.7	15.5	20.9	40.1	49.4	89.3	85.1	20.0	4.1	2.6	350.7
1922	2.5	2.5	13.2	17.8	28.1	32.7	51.9	155.9	118.7	31.1	9.0	4.6	468.0
1923	4.1	7.9	20.7	16.0	15.7	23.0	67.7	110.7	62.3	27.4	5.4	5.4	366.3
1924	5.3	3.9	3.9	4.3	5.4	7.4	26.5	36.2	5.4	1.6	0.9	0.7	101.5
1925	2.7	11.0	10.5	11.4	21.8	28.2	55.3	92.9	64.5	20.9	5.9	3.2	328.3
1926	5.2	4.9	6.4	4.8	12.5	19.5	64.1	71.2	22.9	4.8	2.1	1.3	219.7
1927	1.5	23.5	13.3	13.2	61.9	51.3	79.8	121.3	88.4	27.3	5.9	3.2	490.6
1928	3.3	19.6	9.0	8.9	11.0	33.1	39.1	52.5	20.1	4.3	2.0	0.9	203.8
1929	1.3	4.9	7.3	7.2	8.3	19.7	30.9	79.1	49.2	10.8	2.9	1.8	223.4
1930	1.6	1.6	2.2	5.4	13.0	23.6	45.1	64.0	55.5	7.8	2.1	1.3	223.2
1931	1.4	3.7	3.1	5.8	7.3	11.3	23.6	40.6	12.6	2.4	1.3	1.1	114.2
1932	1.0	1.7	23.0	15.7	57.1	46.1	75.4	139.9	125.6	41.0	7.2	2.8	536.5
1933	2.6	2.2	3.3	8.3	9.7	23.2	44.1	61.2	103.5	21.2	3.7	2.0	285.0
1934	2.1	2.6	11.5	12.7	10.2	20.6	31.5	21.8	12.3	3.2	1.5	0.8	130.8
1935	1.3	5.1	8.2	9.5	15.0	24.4	85.6	104.6	84.6	16.2	4.2	2.4	361.1
1936	3.0	3.5	4.4	8.6	68.4	49.7	105.2	137.0	78.0	25.8	6.4	2.9	492.9
1937	3.4	3.8	13.4	11.7	116.7	72.8	101.4	192.2	121.1	40.2	8.4	4.1	689.2
1938	4.0	4.4	66.6	22.4	63.7	143.9	124.8	199.2	175.3	65.3	17.5	6.6	893.7
1939	10.5	9.6	8.5	9.8	14.1	31.1	66.5	59.9	25.3	7.1	3.1	2.6	248.1
1940	6.4	2.9	3.4	42.4	65.5	68.9	92.8	141.0	74.4	14.8	4.0	2.6	519.1
1941	5.0	6.0	28.8	30.0	60.2	58.1	73.5	173.8	143.7	55.8	12.9	4.8	652.6
1942	5.2	7.3	16.9	28.8	24.1	40.4	74.8	120.7	130.7	37.0	7.5	3.7	497.1
1943	3.2	7.3	12.6	60.3	38.5	152.1	116.1	152.0	84.3	35.5	8.4	3.6	673.9
1944	3.7	4.4	6.4	9.6	15.7	34.9	39.3	107.1	69.1	20.5	4.4	2.5	317.6
1945	2.4	12.6	11.9	10.2	71.6	53.8	86.3	133.1	120.7	42.2	9.3	4.3	558.4

TABLE 4-12
HISTORICAL UNREGULATED
MONTHLY INFLOWS TO
TERMINUS DAM AND LAKE KAWEAH PROJECT
(1,000 Acre-Feet)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Total
1946	13.7	14.9	27.4	22.6	16.5	34.8	77.4	93.9	42.4	10.8	3.2	2.0	359.6
1947	5.8	24.3	26.8	15.4	16.7	25.4	42.7	73.8	26.4	5.5	2.3	1.5	266.6
1948	3.3	3.9	4.1	3.6	4.9	11.0	50.4	99.1	64.7	12.6	3.1	1.9	262.6
1949	1.9	2.0	3.5	4.8	6.6	15.4	58.8	83.1	34.0	5.6	2.5	1.4	219.6
1950	1.4	4.7	4.8	10.1	29.2	25.9	73.8	86.7	51.0	10.5	2.7	2.1	302.9
1951	3.3	93.2	77.4	28.0	23.6	33.5	46.5	72.0	41.0	12.0	3.4	2.2	436.1
1952	2.8	4.4	32.1	66.2	44.2	74.8	108.2	235.1	176.6	76.8	21.7	6.9	849.8
1953	4.4	6.9	14.1	26.4	16.1	21.4	51.7	57.2	79.5	24.9	5.0	2.7	310.3
1954	2.7	3.9	5.3	10.5	17.5	31.4	74.9	104.9	40.8	11.1	3.2	2.0	308.2
1955	1.8	5.0	8.3	13.4	26.6	22.2	35.7	80.3	65.4	12.5	3.5	1.8	276.5
1956	1.4	3.7	189.4	95.4	45.6	44.9	69.7	135.1	98.5	37.6	10.2	3.8	735.3
1957	4.4	4.2	4.4	6.9	15.7	21.6	31.3	88.4	99.1	16.4	4.2	3.0	299.6
1958	4.5	7.0	12.4	12.5	26.4	55.5	112.0	197.7	146.0	53.4	15.2	6.6	649.2
1959	4.3	3.7	4.5	6.9	16.5	26.2	36.4	33.7	16.3	3.4	1.6	2.5	156.0
1960	1.8	1.7	2.2	4.3	15.9	22.7	43.4	57.6	24.8	4.8	2.3	1.5	183.0
1961	1.9	5.2	6.4	4.3	5.6	10.8	25.5	33.5	16.4	3.0	4.0	1.7	118.3
1962	0.5	2.0	4.8	6.8	48.5	28.3	95.5	92.1	85.4	25.4	5.2	2.3	396.8
1963	3.5	2.6	2.6	29.3	83.8	47.6	62.7	122.0	99.4	40.8	10.0	6.0	510.3
1964	5.7	14.0	9.9	7.4	7.8	15.0	38.7	68.7	45.3	9.9	3.2	2.3	227.9
1965	2.1	9.1	40.9	44.5	26.5	27.9	66.1	100.3	104.9	41.6	17.0	5.6	486.5
1966	4.1	16.0	16.3	15.8	13.1	28.0	58.7	62.5	22.6	5.1	2.4	1.5	246.1
1967	1.5	9.4	211.2	35.7	37.6	67.2	94.3	185.9	190.7	138.6	36.2	14.8	1023.1
1968	6.2	7.6	12.6	12.9	19.2	24.7	38.2	58.4	28.8	5.9	2.5	1.5	218.5
1969	3.9	7.6	11.0	183.8	120.3	97.5	148.1	282.6	238.9	129.6	36.4	10.4	1270.1
1970	8.1	17.6	12.7	55.3	21.9	42.2	40.9	36.2	53.4	14.4	2.7	2.4	307.8
1971	2.5	8.5	14.6	19.5	18.0	27.6	40.9	67.0	68.0	18.7	5.6	2.1	293.0
1972	3.2	6.3	10.0	10.5	12.6	29.3	26.9	40.0	20.5	4.2	1.3	3.2	168.0
1973	2.9	6.9	12.0	36.0	37.0	56.3	72.4	198.1	146.4	33.7	10.1	3.7	615.5
1974	6.4	12.2	17.3	36.7	18.9	55.0	74.6	132.9	100.3	24.5	8.7	2.5	490.0
1975	4.2	6.5	8.0	9.7	15.2	35.1	32.3	125.1	115.7	24.0	5.0	3.9	384.7
1976	11.2	7.5	8.2	5.0	8.3	17.6	22.3	39.9	9.2	3.8	2.3	11.7	147.0
1977	6.7	3.5	3.0	4.9	4.8	6.8	17.9	21.7	19.5	2.3	1.6	0.6	93.3
1978	1.1	2.6	19.9	35.4	72.9	106.4	95.2	172.1	191.8	82.8	21.3	31.4	832.9
1979	8.3	7.3	10.1	18.3	25.7	46.4	61.3	135.2	68.2	23.1	9.6	3.6	417.1
1980	6.4	7.3	7.2	143.3	130.2	92.7	95.4	126.6	157.6	95.3	27.6	8.5	898.1
1981	5.7	5.5	8.8	9.0	16.8	25.5	51.0	71.6	38.9	10.5	3.5	1.8	248.6
1982	4.6	11.7	14.7	32.6	40.3	63.1	190.8	173.1	118.8	65.5	22.8	33.3	771.3
1983	34.7	51.5	86.7	95.1	119.0	172.7	99.7	202.6	284.4	162.2	68.5	24.6	1401.7
1984	16.4	43.6	68.7	45.3	38.5	47.6	53.9	110.3	48.3	27.8	11.4	4.9	516.7
1985	7.8	15.4	15.0	17.8	21.3	28.9	73.5	90.4	43.9	10.0	3.2	5.2	332.4
1986	5.8	10.6	22.7	33.6	144.1	151.5	106.0	152.3	124.8	44.4	13.8	5.5	815.1
1987	9.4	5.9	6.6	7.6	13.9	20.8	45.4	48.7	19.5	3.2	1.5	1.4	183.9
1988	2.4	6.5	8.4	20.3	12.4	22.8	33.3	47.0	22.8	4.9	1.7	2.1	184.6
1989	1.5	5.1	7.2	7.8	11.9	34.3	61.3	52.2	23.7	4.8	1.7	2.9	214.4
1990	3.3	3.5	3.4	5.8	7.5	20.2	32.6	36.9	19.6	5.5	1.8	1.2	141.3

TABLE 4-12
HISTORICAL UNREGULATED
MONTHLY INFLOWS TO
TERMINUS DAM AND LAKE KAWEAH PROJECT
(1,000 Acre-Feet)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Total
1991	1.2	1.7	2.2	3.3	2.5	42.3	40.1	70.4	67.9	14.6	4.1	2.1	252.4
1992	3.0	5.9	4.0	6.0	13.0	18.3	42.3	40.4	8.8	5.1	1.7	0.7	149.2
1993	5.4	5.6	6.7	42.0	32.9	66.9	82.2	149.1	109.4	38.4	7.5	3.9	550.0
1994	3.4	4.2	6.0	6.0	12.8	24.0	37.2	61.0	30.1	4.0	1.2	1.7	191.6
1995	6.0	5.5	7.7	43.3	31.6	120.6	84.8	161.5	209.8	146.5	37.0	12.7	867.0
1996	5.6	4.5	11.1	19.7	72.0	65.0	93.6	141.3	79.7	22.7	8.4	4.2	527.8
1997	3.6	29.4	66.4	235.3	71.2	64.7	74.1	123.8	63.2	21.5	8.0	5.5	766.7
1998	4.4	7.9	13.5	29.1	68.3	78.5	114.6	134.0	246.5	175.1	34.0	15.9	921.8
1999	10.3	11.3	12.9	16.7	23.4	22.7	39.4	77.1	35.5	9.5	3.7	3.3	265.8
2000	2.6	4.3	3.8	11.7	41.2	52.3	65.7	113.5	52.0	13.7	5.6	3.2	369.6
2001	6.0	6.6	5.1	7.4	13.3	31.3	52.2	101.6	23.9	9.9	2.8	1.8	261.9
2002	1.8	10.5	24.6	23.1	17.2	29.3	62.5	74.9	46.7	11.5	3.9	2.0	308.0
2003	2.2	49.4	15.3	19.7	20.2	40.4	51.2	117.3	81.7	17.9	7.8	6.2	429.3
2004	2.2	4.9	3.5	14.0	17.5	48.8	47.3	53.3	24.6	7.8	2.5	1.2	431.3
Mean	5.1	9.1	17.6	27.0	32.0	45.8	65.3	103.8	81.5	31.0	8.5	4.6	431.3

TABLE 8-1
ANNUAL MAXIMUM RAINFLOOD FLOWS
KAWEAH RIVER AT TERMINUS DAM
UNREGULATED CONDITIONS
(Flows in cfs)

Water	PEAK		1-DAY		3-DAY		7-DAY		15-DAY		30-DAY	
Year	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow
1905	11 Oct	4600	11 Oct	3219	11 Oct	2593	9 Oct	1516	3 Oct	908	1 Oct	594
1906	15 Mar	12749	15 Mar	8861	15 Mar	7394	12 Mar	5117	12 Mar	3831	12 Mar	3048
1907	25 Mar	4535	25 Mar	3203	24 Mar	2340	20 Mar	1853	20 Mar	1648	6 Mar	1253
1908	17 Mar	1570	17 Mar	978	16 Mar	936	16 Mar	912	14 Mar	831	2 Mar	633
1909	21 Jan	12227	21 Jan	9578	13 Jan	5987	13 Jan	3044	13 Jan	2824	13 Jan	2030
1910	9 Dec	14108	9 Dec	8226	9 Dec	3608	8 Dec	1975	2 Dec	1151	9 Dec	1073
1911	29 Jan	7921	29 Jan	6874	29 Jan	5924	29 Jan	3340	24 Jan	2034	21 Jan	1303
1912	29 Mar	629	29 Mar	286	28 Mar	264	24 Mar	255	18 Mar	233	2 Mar	209
1913	8 Mar	782	8 Mar	369	8 Mar	351	5 Mar	329	5 Mar	270	1 Mar	250
1914	25 Jan	13899	25 Jan	10275	24 Jan	6860	24 Jan	3733	22 Jan	2161	24 Jan	1348
1915	25 Mar	1650	25 Mar	848	23 Mar	822	20 Mar	736	17 Mar	646	2 Mar	461
1916	17 Jan	15362	17 Jan	10540	17 Jan	5782	17 Jan	3135	17 Jan	2743	17 Jan	1924
1917	22 Feb	6552	22 Feb	2943	21 Feb	2496	20 Feb	1845	20 Feb	1189	20 Feb	846
1918	19 Mar	1641	19 Mar	1456	19 Mar	1165	18 Mar	869	17 Mar	767	2 Mar	581
1919	3 Mar	2610	3 Mar	1456	3 Mar	1127	27 Feb	762	27 Feb	553	11 Feb	503
1920	22 Mar	5009	22 Mar	2798	22 Mar	2475	21 Mar	1826	18 Mar	1156	2 Mar	1037
1921	14 Mar	2090	14 Mar	1778	14 Mar	1777	13 Mar	1490	9 Mar	1160	5 Mar	942
1922	11 Feb	3660	11 Feb	2548	9 Feb	1343	9 Feb	915	9 Feb	658	9 Feb	531
1923	6 Apr	6333	6 Apr	4410	6 Apr	2337	6 Apr	1840	26 Mar	912	11 Mar	637
1924	27 Mar	1250	27 Mar	250	27 Mar	198	25 Mar	164	17 Mar	134	28 Feb	124
1925	9 Nov	1801	9 Nov	1248	9 Nov	839	6 Feb	573	5 Feb	457	6 Feb	124
1926	13 Feb	1553	13 Feb	785	12 Feb	586	12 Feb	405	12 Feb	293	13 Feb	288
1927	17 Feb	10555	17 Feb	6188	16 Feb	3682	16 Feb	2527	15 Feb	1826	15 Feb	1325
1928	27 Mar	3281	27 Mar	2527	25 Mar	2194	24 Mar	1567	17 Mar	929	2 Mar	570
1929	22 Mar	1664	22 Mar	848	22 Mar	600	22 Mar	481	17 Mar	413	2 Mar	335
1930	23 Feb	3198	23 Feb	1113	22 Feb	854	22 Feb	546	22 Feb	421	28 Feb	369
1931	17 Nov	884	17 Nov	407	17 Nov	221	19 Feb	162	15 Feb	151	31 Jan	137
1932	28 Feb	9301	28 Feb	4597	7 Feb	2825	6 Feb	2082	1 Feb	1339	6 Feb	965
1933	17 Mar	1558	17 Mar	801	17 Mar	547	17 Mar	480	8 Mar	436	27 Feb	371
1934	13 Dec	2330	13 Dec	1581	13 Dec	770	12 Dec	450	12 Dec	300	12 Dec	290
1935	6 Apr	9301	6 Apr	4410	8 Apr	2630	6 Apr	1745	27 Mar	1132	12 Mar	772
1936	13 Feb	8360	13 Feb	5366	12 Feb	3810	11 Feb	2453	11 Feb	1721	11 Feb	1215
1937	6 Feb	19751	6 Feb	13520	5 Feb	7162	5 Feb	3848	5 Feb	3104	5 Feb	2065
1938	11 Dec	34799	11 Dec	11232	10 Dec	7720	10 Dec	3958	2 Mar	2842	1 Mar	2258
1939	27 Mar	2399	27 Mar	1279	26 Mar	1105	24 Mar	893	17 Mar	779	2 Mar	531
1940	26 Feb	8893	26 Feb	4482	26 Feb	2797	23 Feb	2438	23 Feb	1830	23 Feb	1317
1941	27 Dec	6350	27 Dec	3307	9 Feb	2433	9 Feb	1925	8 Feb	1983	9 Feb	1228
1942	25 Jan	2598	25 Jan	1654	25 Jan	1283	25 Jan	1022	25 Jan	780	25 Jan	582
1943	9 Mar	17765	9 Mar	9714	21 Mar	6185	9 Mar	4454	9 Mar	3677	2 Mar	2618
1944	5 Mar	3240	5 Mar	1175	4 Mar	834	4 Mar	636	1 Mar	575	15 Feb	436
1945	2 Feb	18554	2 Feb	9890	1 Feb	6427	1 Feb	3435	1 Feb	1954	1 Feb	1205

TABLE 8-1
ANNUAL MAXIMUM RAINFLOOD FLOWS
KAWEAH RIVER AT TERMINUS DAM
UNREGULATED CONDITIONS
(Flows in cfs)

Water	PEAK		1-DAY		3-DAY		7-DAY		15-DAY		30-DAY	
Year	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow
1946	22 Dec	3637	22 Dec	2070	22 Dec	1376	22 Dec	1142	22 Dec	812	21 Dec	596
1947	23 Nov	10659	23 Nov	4670	23 Nov	2302	20 Nov	1376	23 Nov	854	20 Nov	653
1948	10 Apr	7450	10 Apr	3970	10 Apr	2174	10 Apr	1323	1 Apr	796	17 Mar	530
1949	11 Mar	873	11 Mar	424	22 Mar	328	19 Mar	311	22 Mar	288	3 Mar	264
1950	6 Feb	4034	6 Feb	2506	5 Feb	1640	5 Feb	1029	5 Feb	690	5 Feb	570
1951	19 Nov	54332	19 Nov	16640	18 Nov	9741	18 Nov	5126	18 Nov	2766	18 Nov	2395
1952	25 Jan	8851	25 Jan	5918	25 Jan	3259	24 Jan	2019	15 Jan	1548	29 Dec	1232
1953	14 Jan	2414	14 Jan	1217	13 Jan	870	9 Jan	653	8 Jan	560	7 Jan	458
1954	25 Jan	4264	25 Jan	1508	9 Mar	984	9 Mar	672	9 Mar	566	2 Mar	520
1955	17 Feb	6772	17 Feb	4254	17 Feb	2193	16 Feb	1236	16 Feb	769	16 Feb	563
1956	23 Dec	84332	23 Dec	44512	23 Dec	22918	22 Dec	12248	22 Dec	6523	22 Dec	3693
1957	25 Feb	1780	25 Feb	771	25 Feb	568	25 Feb	521	25 Feb	465	23 Feb	393
1958	22 Mar	6197	22 Mar	2662	16 Mar	1889	16 Mar	1738	15 Mar	1364	2 Mar	939
1959	16 Feb	3835	16 Feb	1498	16 Feb	1155	16 Feb	712	16 Feb	490	16 Feb	487
1960	2 Feb	3469	2 Feb	1279	27 Mar	770	27 Mar	660	16 Mar	522	2 Mar	385
1961	2 Dec	1400	2 Dec	598	2 Dec	321	1 Dec	200	26 Nov	145	12 Nov	126
1962	10 Feb	8000	10 Feb	3707	10 Feb	3236	9 Feb	2045	9 Feb	1476	9 Feb	976
1963	1 Feb	30900	1 Feb	18405	31 Jan	11544	30 Jan	5834	30 Jan	3196	30 Jan	1861
1964	15 Nov	1050	15 Nov	470	15 Nov	399	15 Nov	350	15 Nov	310	5 Nov	261
1965	24 Dec	7840	24 Dec	3915	23 Dec	2749	23 Dec	2250	23 Dec	1494	23 Dec	1107
1966	24 Nov	1512	24 Nov	1261	23 Nov	973	23 Nov	649	17 Nov	464	15 Nov	365
1967	6 Dec	105000	6 Dec	53280	5 Dec	25736	5 Dec	12461	3 Dec	6445	28 Nov	3569
1968	18 Feb	846	18 Feb	659	17 Feb	514	18 Feb	481	17 Feb	456	17 Feb	421
1969	25 Jan	35200	25 Jan	22437	25 Jan	13425	21 Jan	8519	19 Jan	6057	19 Jan	3773
1970	16 Jan	13940	16 Jan	8793	16 Jan	4598	15 Jan	2460	14 Jan	1537	10 Jan	994
1971	26 Nov	1293	26 Nov	914	19 Jan	630	18 Jan	521	18 Jan	427	18 Jan	377
1972	18 Mar	1047	18 Mar	633	18 Mar	623	16 Mar	607	8 Mar	568	4 Mar	486
1973	18 Jan	11344	18 Jan	4202	17 Jan	2802	16 Jan	1683	17 Mar	1026	28 Feb	931
1974	2 Apr	9633	2 Apr	3893	1 Apr	2406	31 Mar	1723	22 Mar	1241	7 Mar	985
1975	25 Mar	3154	25 Mar	1567	25 Mar	1206	22 Mar	897	17 Mar	689	2 Mar	576
1976	11 Sep	2040	11 Sep	2039	16 Sep	1085	11 Sep	568	11 Sep	320	8 Oct	212
1977	3 Oct	681	3 Oct	329	1 Oct	310	1 Oct	236	1 Oct	164	1 Oct	112
1978	9 Feb	14700	9 Feb	8135	9 Feb	5543	9 Feb	3365	2 Mar	2103	9 Feb	1943
1979	28 Mar	3163	28 Mar	1396	27 Mar	1170	25 Mar	917	7 Mar	792	1 Mar	752
1980	13 Jan	34000	13 Jan	16933	12 Jan	13893	12 Jan	7644	10 Jan	4278	16 Feb	2766
1981	20 Mar	2253	20 Mar	1015	20 Mar	841	20 Mar	718	17 Mar	581	2 Mar	418
1982	11 Apr	28800	11 Apr	18514	11 Apr	10742	9 Apr	6061	1 Apr	3559	17 Mar	2324
1983	22 Dec	11100	22 Dec	8325	22 Dec	5173	27 Feb	3597	29 Dec	2990	29 Dec	2910
1984	25 Dec	5018	25 Dec	4802	25 Dec	3919	25 Dec	2581	24 Dec	1737	10 Dec	1222
1985	27 Mar	1458	27 Mar	1395	27 Mar	1169	25 Mar	826	17 Mar	576	2 Mar	471

TABLE 8-1
ANNUAL MAXIMUM RAINFLOOD FLOWS
KAWEAH RIVER AT TERMINUS DAM
UNREGULATED CONDITIONS
(Flows in cfs)

Water Year	PEAK		1-DAY		3-DAY		7-DAY		15-DAY		30-DAY	
	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow
1986	13 Feb	9852	13 Feb	9428	17 Feb	7427	13 Feb	6150	13 Feb	4259	13 Feb	3554
1987	13 Feb	1655	13 Feb	1584	13 Feb	967	13 Feb	566	12 Feb	356	13 Feb	339
1988	5 Jan	2885	5 Jan	2282	5 Jan	1185	5 Jan	653	5 Jan	455	4 Jan	342
1989	2 Mar	930	2 Mar	890	7 Mar	758	2 Mar	654	2 Mar	593	28 Feb	546
1990	5 Mar	315	5 Mar	301	3 Mar	283	3 Mar	258	28 Feb	244	15 Feb	204
1991	4 Mar	5456	4 Mar	5221	4 Mar	2976	4 Mar	1517	4 Mar	899	4 Mar	696
1992	27 Oct	492	27 Oct	471	13 Feb	377	23 Feb	331	21 Feb	328	12 Feb	304
1993	26 Mar	2783	26 Mar	2663	25 Mar	2015	24 Mar	1684	17 Mar	1459	28 Feb	1063
1994	16 Mar	503	16 Mar	481	15 Mar	454	14 Mar	432	3 Mar	410	2 Mar	393
1995	11 Mar	12741	11 Mar	8369	10 Mar	5901	10 Mar	3582	10 Mar	2909	2 Mar	2009
1996	20 Feb	9644	20 Feb	5077	20 Feb	3246	19 Feb	2158	20 Feb	1482	5 Feb	1316
1997	2 Jan	56595	2 Jan	17948	2 Jan	13515	2 Jan	7478	1 Jan	4461	2 Jan	3890
1998	23 Feb	9612	23 Feb	4120	22 Feb	3244	20 Feb	2288	14 Feb	1773	2 Feb	1402
1999	9 Feb	2245	9 Feb	1060	8 Feb	833	8 Feb	636	8 Feb	501	20 Jan	451
2000	14 Feb	6460	14 Feb	3453	13 Feb	2018	13 Feb	1373	14 Feb	1039	13 Feb	973
2001	25 Feb	462	25 Feb	431	25 Feb	350	21 Feb	300	14 Feb	268	30 Jan	232
2002	29 Dec	5737	29 Dec	2941	29 Dec	1915	29 Dec	1222	29 Dec	805	29 Dec	544
2003	8 Nov	30273	8 Nov	9436	8 Nov	5715	8 Nov	2834	8 Nov	1505	8 Nov	866
2004	26 Feb	2852	25 Dec	1499	26 Feb	908	26 Feb	620	26 Feb	558	9 Feb	364

COMPUTED STATISTICS

YEARS	100	100	100	100	100	100
LOG MEAN	3.661	3.419	3.261	3.104	2.970	2.854
STANDARD DEV	0.533	0.517	0.480	0.428	0.391	0.369
SKEW COEFF	0.21	0.13	0.15	0.12	0.10	0.05

ADOPTED STATISTICS

YEARS	100	100	100	100	100	100
LOG MEAN	3.661	3.419	3.261	3.104	2.970	2.854
STANDARD DEV	0.533	0.517	0.480	0.428	0.391	0.369
SKEW COEFF	0.20	0.10	0.10	0.10	0.10	0.00

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TABLE 8-2
ANNUAL MAXIMUM RAINFLOOD FLOWS
DRY CREEK NEAR LEMONCOVE
UNREGULATED CONDITIONS
(Flows in cfs)

Water Year	PEAK		1-DAY		3-DAY		7-DAY		15-DAY		30-DAY	
	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow
1960	21 Feb	156	2 Feb	63	9 Feb	52	9 Feb	29	2 Feb	20	2 Feb	13
1961	28 Mar	11	28 Mar	7	28 Mar	6	24 Mar	4	15 Mar	3	1 Mar	2
1962	11 Feb	732	11 Feb	604	10 Feb	492	10 Feb	291	9 Feb	208	9 Feb	136
1963	1 Feb	1600	1 Feb	647	31 Jan	397	31 Jan	179	31 Jan	102	6 Apr	56
1964	2 Apr	202	2 Apr	120	1 Apr	83	31 Mar	50	23 Mar	36	22 Mar	25
1965	7 Jan	770	5 Jan	402	5 Jan	321	5 Jan	185	27 Dec	124	27 Dec	80
1966	30 Dec	112	30 Dec	75	30 Dec	56	29 Dec	32	28 Dec	18	24 Dec	11
1967	6 Dec	14500	6 Dec	6370	5 Dec	2530	5 Dec	1121	5 Dec	534	3 Dec	272
1968	17 Feb	42	18 Feb	34	17 Feb	25	17 Feb	21	12 Feb	15	27 Jan	13
1969	25 Jan	6070	25 Jan	3150	24 Jan	1850	19 Jan	1292	19 Jan	808	18 Feb	510
1970	16 Jan	1990	16 Jan	928	16 Jan	480	15 Jan	245	14 Jan	135	10 Jan	78
1971	29 Nov	102	21 Dec	56	21 Dec	45	17 Dec	36	17 Dec	27	16 Dec	22
1972	26 Dec	81	26 Dec	48	26 Dec	37	23 Dec	30	21 Dec	18	12 Dec	11
1973	18 Jan	2350	18 Jan	817	17 Jan	520	16 Jan	281	10 Feb	157	6 Mar	136
1974	2 Apr	2030	2 Apr	800	1 Apr	412	31 Mar	238	28 Mar	152	27 Mar	99
1975	25 Mar	420	25 Mar	199	25 Mar	148	22 Mar	112	15 Mar	78	8 Mar	63
1976	1 Mar	62	1 Mar	44	1 Mar	32	1 Mar	22	29 Feb	15	4 Feb	11
1977	3 Jan	9	4 Jan	5	3 Jan	3	31 Dec	2	21 Dec	1	30 Dec	1
1978	9 Feb	2860	9 Feb	1800	9 Feb	1189	9 Feb	738	7 Feb	384	9 Feb	308
1979	28 Mar	507	28 Mar	322	27 Mar	212	27 Mar	143	25 Mar	93	8 Mar	70
1980	20 Feb	2800	20 Feb	1290	19 Feb	919	17 Feb	693	16 Feb	409	10 Feb	278
1981	20 Mar	307	20 Mar	178	20 Mar	127	20 Mar	84	19 Mar	58	13 Mar	38
1982	11 Apr	3890	11 Apr	1920	11 Apr	1020	11 Apr	574	1 Apr	388	17 Mar	263
1983	22 Dec	3870	22 Dec	1710	27 Jan	1081	23 Jan	826	22 Jan	563	22 Jan	471
1984	24 Nov	1100	26 Dec	491	25 Dec	448	25 Dec	263	25 Dec	152	21 Dec	94
1985	27 Mar	691	27 Mar	264	27 Mar	196	27 Mar	111	26 Mar	65	12 Mar	39
1986	13 Feb	3270	13 Feb	1260	16 Feb	957	13 Feb	801	12 Feb	467	13 Feb	345
1987	13 Feb	458	13 Feb	180	13 Feb	94	12 Feb	47	10 Feb	26	13 Feb	19
1988	5 Jan	474	5 Jan	290	5 Jan	133	3 Jan	64	5 Jan	40	27 Dec	25
1989	2 Mar	235	31 Mar	97	9 Feb	41	2 Mar	21	1 Feb	14	6 Feb	13
1990	17 Jan	50	17 Jan	49	15 Jan	45	14 Jan	28	12 Jan	17	9 Jan	10
1991	4 Mar	1090	19 Mar	240	19 Mar	169	19 Mar	118	18 Mar	90	2 Mar	64
1992	15 Feb	167	15 Feb	85	15 Feb	62	11 Feb	47	10 Feb	29	6 Feb	18
1993	14 Jan	2370	14 Jan	612	23 Feb	376	20 Feb	336	19 Feb	230	19 Feb	150
1994	8 Feb	101	8 Feb	67	8 Feb	34	7 Feb	20	23 Feb	13	24 Feb	13
1995	23 Mar	2648	11 Mar	1532	10 Mar	873	21 Mar	605	10 Mar	495	10 Mar	334
1996	20 Feb	816	20 Feb	442	20 Feb	326	20 Feb	203	20 Feb	140	20 Feb	109
1997	2 Jan	4071	26 Jan	1698	25 Jan	1105	23 Jan	791	20 Jan	489	2 Jan	407
1998	23 Feb	1496	28 Mar	803	22 Feb	639	28 Mar	578	25 Mar	503	25 Mar	377
1999	9 Feb	366	9 Feb	156	9 Feb	124	20 Jan	81	20 Jan	65	19 Jan	60
2000	14 Feb	1798	14 Feb	724	14 Feb	376	13 Feb	290	27 Feb	189	13 Feb	176

TABLE 8-2
ANNUAL MAXIMUM RAINFLOOD FLOWS
DRY CREEK NEAR LEMONCOVE
UNREGULATED CONDITIONS
(Flows in cfs)

Water Year	PEAK		1-DAY		3-DAY		7-DAY		15-DAY		30-DAY	
	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow
2001	21 Apr	161	21 Apr	101	20 Apr	71	19 Apr	46	24 Feb	35	11 Feb	31
2002	29 Dec	996	29 Dec	400	29 Dec	214	29 Dec	117	29 Dec	63	19 Dec	36
2003	10 Feb	196	15 Mar	161	15 Mar	120	9 Nov	81	14 Apr	41	14 Apr	24
2004	26 Feb	525	26 Feb	261	26 Feb	125	26 Feb	66	26 Feb	25	26 Feb	21

COMPUTED STATISTICS

YEARS	45	45	45	45	45	45
LOG MEAN	2.739	2.442	2.259	2.065	1.870	1.719
STANDARD DEV	0.721	0.665	0.639	0.639	0.639	0.631
SKEW COEFF	-0.48	-0.44	-0.53	-0.47	-0.53	-0.41

ADOPTED STATISTICS

YEARS	44	44	44	44	44	44
LOG MEAN	2.779	2.482	2.300	2.105	1.913	1.7658
STANDARD DEV	0.675	0.616	.585	0.583	0.581	0.580
SKEW COEFF	-0.30	-0.30	-0.30	-0.30	-0.30	-0.30

TABLE 8-3
ANNUAL MAXIMUM SNOWMELT FLOWS
KAWEAH RIVER AT TERMINUS DAM
UNREGULATED CONDITIONS
(Flows in cfs)

Water	1-DAY		15-DAY		30-DAY		60-DAY		90-DAY		120-DAY	
Year	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow
1904	11 May	3280	11 May	2847	7 May	2491	15 Apr	1847	1 Apr	1531	1 Apr	1208
1905	25 May	2190	15 May	1857	16 May	1738	26 Apr	1451	3 Apr	1221	1 Apr	995
1906	28 May	7260	11 Jun	5881	9 Jun	5338	18 May	4553	30 Apr	3913	1 Apr	3397
1907	2 Jun	3480	29 May	2529	15 May	2301	12 Apr	2144	9 Apr	2025	1 Apr	1787
1908	1 May	1630	24 Apr	1138	11 Apr	1006	12 Apr	888	1 Apr	778	1 Apr	633
1909	4 Jun	6000	31 May	4527	27 May	3712	1 May	3150	14 Apr	2700	1 Apr	2260
1910	25 Apr	1990	17 Apr	1652	17 Apr	1564	4 Apr	1390	1 Apr	1119	1 Apr	890
1911	13 Jun	3030	5 Jun	2506	21 May	2177	2 May	1896	1 Apr	1685	1 Apr	1486
1912	29 May	2360	25 May	1859	14 May	1539	24 May	1081	3 Apr	844	1 Apr	678
1913	23 May	1470	16 May	1272	6 May	1183	23 May	981	1 Apr	832	1 Apr	690
1914	30 May	2420	18 May	1988	7 May	1935	4 May	1634	5 Apr	1474	1 Apr	1258
1915	31 May	3280	27 May	2427	13 May	2116	29 Apr	1746	8 Apr	1478	1 Apr	1228
1916	5 May	3440	25 Apr	2952	20 Apr	2653	20 Apr	2440	1 Apr	2244	1 Apr	1935
1917	9 Jun	2830	4 Jun	2406	27 May	2076	24 Apr	1890	4 Apr	1636	1 Apr	1354
1918	9 May	2085	1 May	1744	1 May	1432	17 Apr	1203	1 Apr	1003	1 Apr	795
1919	29 May	2690	1 May	1671	1 May	1614	5 Apr	1378	1 Apr	1085	1 Apr	844
1920	23 May	2980	21 May	2549	17 May	2214	15 Apr	1761	6 Apr	1558	1 Apr	1248
1921	10 Jun	2450	1 Jun	1838	14 May	1651	27 Apr	1492	1 Apr	1244	1 Apr	1021
1922	30 May	3520	23 May	3141	14 May	2743	25 Apr	2306	13 Apr	1824	1 Apr	1491
1923	9 May	2450	6 May	2103	2 May	1827	14 Apr	1454	10 Apr	1299	9 Apr	1050
1924	1 May	940	29 Apr	804	20 Apr	682	4 Apr	525	1 Apr	381	1 Apr	292
1925	6 May	1990	17 May	1593	3 May	1534	26 Apr	1328	1 Apr	1182	1 Apr	977
1926	5 May	1990	22 Apr	1457	23 Apr	1340	5 Apr	1152	1 Apr	883	1 Apr	683
1927	17 May	2900	24 Apor	2167	23 Apr	2098	23 Apr	1866	1 Apr	1609	1 Apr	1325
1928	1 May	1160	29 Apr	931	28 Apr	878	6 Apr	764	1 Apr	624	1 Apr	487
1929	16 Jun	3780	5 May	1473	1 May	1302	28 Apr	1074	3 Apr	886	1 Apr	712
1930	28 May	1720	19 May	1384	18 May	1290	20 Apr	1041	1 Apr	890	1 Apr	702
1931	6 May	1120	30 Apr	851	20 Apr	707	11 Apr	541	1 Apr	429	1 Apr	332
1932	21 May	3200	15 May	2662	15 May	2377	7 May	2135	7 Apr	1848	1 Apr	1553
1933	14 Dec	2750	1 Jun	2163	25 May	2026	8 May	1384	2 Apr	1159	1 Apr	961
1934	15 Apr	748	9 Apr	622	9 Apr	541	1 Apr	444	1 Apr	367	1 Apr	289
1935	4 Jun	2480	23 May	2095	10 May	1903	19 Apr	1716	9 Apr	1444	9 Apr	1133
1936	13 May	2840	5 May	2479	26 Apr	2293	4 Apr	2025	1 Apr	1779	1 Apr	1444
1937	14 May	4760	11 May	3619	4 May	3190	25 Apr	2641	1 Apr	2302	1 Apr	1902
1938	3 Jun	5130	26 May	4206	12 May	3940	19 Apr	3264	5 Apr	2783	1 Apr	2553
1939	9 Apr	1410	8 Apr	1206	7 Apr	1142	2 Apr	1049	1 Apr	847	1 Apr	665
1940	15 May	2840	10 May	3089	2 May	2313	13 Apr	1995	1 Apr	1716	1 Apr	1354
1941	11 May	3810	10 May	3089	8 May	3003	29 Apr	2645	4 Apr	2185	1 Apr	1865
1942	22 May	3220	4 Jun	2645	20 May	2600	4 May	2093	4 Apr	1817	1 Apr	1517
1943	26 May	3260	28 Apr	2706	30 Apr	2480	5 Apr	2250	1 Apr	1963	1 Apr	1625
1944	14 May	2170	2 May	1884	4 May	1776	1 May	1465	1 Apr	1195	1 Apr	987
1945	3 May	2980	29 Apr	2693	20 Apr	2428	21 Apr	2187	8 Apr	1915	1 Apr	1597

TABLE 8-3
ANNUAL MAXIMUM SNOWMELT FLOWS
KAWEAH RIVER AT TERMINUS DAM
UNREGULATED CONDITIONS
(Flows in cfs)

Water	1-DAY		15-DAY		30-DAY		60-DAY		90-DAY		120-DAY	
Year	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow
1946	10 May	2310	25 Apr	2103	17 Apr	1837	12 Apr	1482	1 Apr	1193	1 Apr	944
1947	6 May	1830	1 May	1313	1 May	1216	12 Apr	966	1 Apr	798	1 Apr	622
1948	16 May	2610	14 May	1927	5 May	1687	26 Apr	1384	1 Apr	1124	1 Apr	871
1949	26 May	1860	22 Apr	1496	28 Apr	1391	12 Apr	1265	1 Apr	981	1 Apr	760
1950	31 May	2060	19 May	1841	11 May	1537	9 Apr	1407	1 Apr	1178	1 Apr	930
1951	26 May	1870	17 Mar	1429	3 May	1187	11 Apr	1030	1 Apr	890	1 Apr	719
1952	27 May	5170	19 May	4632	11 May	4235	25 Apr	3406	5 Apr	2851	1 Apr	2455
1953	27 Apr	3340	8 Jun	1568	31 May	1340	24 Apr	1213	3 Apr	1051	1 Apr	893
1954	19 May	2350	7 May	2055	22 Apr	1803	7 Apr	1523	1 Apr	1228	1 Apr	970
1955	7 Jun	2160	28 May	1663	13 May	1562	24 Apr	1236	1 Apr	1010	1 Apr	813
1956	23 May	3420	18 May	2653	16 May	2301	23 Apr	1954	2 Apr	1663	1 Apr	1405
1957	19 May	6840	31 May	2183	18 May	2094	1 May	1540	5 Apr	1211	1 Apr	971
1958	20 May	4370	17 May	3780	6 May	3328	1 May	2819	1 Apr	2498	1 Apr	2101
1959	13 May	871	30 Apr	653	20 Apr	626	2 Apr	574	1 Apr	476	1 Apr	371
1960	12 May	1560	8 May	1175	7 May	972	5 Apr	843	1 Apr	693	1 Apr	540
1961	25 May	692	15 Apr	614	30 Apr	544	3 Apr	485	1 Apr	415	1 Apr	324
1962	5 May	2652	26 Apr	2006	11 Apr	1947	12 Apr	1653	1 Apr	1520	1 Apr	1249
1963	21 May	2664	19 May	2355	7 May	2079	30 Apr	1850	7 Apr	1615	1 Apr	1363
1964	20 May	1741	13 May	1520	11 May	1300	14 Apr	988	1 Apr	854	1 Apr	684
1965	6 Jun	2695	30 May	2276	16 May	2101	24 Apr	1775	10 Apr	1557	1 Apr	1312
1966	6 May	1429	26 Apr	1219	25 Apr	1090	1 Apr	1012	1 Apr	806	1 Apr	627
1967	23 May	5226	17 May	4227	8 Jun	3532	15 May	3439	18 Apr	2900	3 Apr	2546
1968	28 May	1245	18 May	1032	30 Apr	952	8 Apr	834	1 Apr	703	1 Apr	553
1969	1 Jun	6824	24 May	5985	10 May	5398	6 May	4347	18 Apr	3752	1 Apr	3339
1970	18 May	2292	15 May	2006	11 May	1722	26 Apr	1257	14 Apr	1065	1 Apr	861
1971	16 May	1707	7 Jun	1408	15 May	1264	30 Apr	1125	1 Apr	979	1 Apr	815
1972	3 May	900	27 Apr	766	22 Apr	693	13 Apr	590	1 Apr	488	1 Apr	384
1973	18 May	4430	17 May	3819	11 May	3718	25 Apr	2924	7 Apr	2340	1 Apr	1890
1974	28 May	2994	26 May	2585	9 May	2341	27 Apr	1958	4 Apr	1661	1 Apr	1391
1975	1 Jun	3628	26 May	3127	3 May	2792	2 May	2011	13 Apr	1538	1 Apr	1245
1976	13 May	1096	2 May	804	22 Apr	702	3 Apr	519	1 Apr	400	1 Apr	315
1977	9 Jun	723	29 May	578	16 May	483	15 Apr	395	1 Apr	330	1 Apr	259
1978	8 Jun	4626	30 May	4037	18 May	3552	4 May	3041	1 Apr	2589	1 Apr	2066
1979	21 May	3206	16 May	2720	12 May	2246	15 Apr	1822	1 Apr	1477	1 Apr	1202
1980	19 Jun	3171	9 Jun	2893	4 Jun	2659	4 May	2337	12 Apr	2182	1 Apr	1942
1981	1 May	2383	23 Apr	1373	16 Apr	1237	14 Apr	1112	1 Apr	902	1 Apr	721
1982	26 May	3524	25 Apr	3076	16 Apr	2797	16 Apr	2662	16 Apr	2309	16 Apr	1908
1983	29 May	6671	24 May	5393	23 May	5236	18 May	4474	28 Apr	3606	1 Apr	3120
1984	13 May	2538	11 May	2069	4 May	1852	12 Apr	1432	1 Apr	1186	1 Apr	1006
1985	15 Apr	1845	14 May	1589	30 Apr	1496	2 Apr	1365	1 Apr	1162	1 Apr	915

TABLE 8-3
ANNUAL MAXIMUM SNOWMELT FLOWS
KAWEAH RIVER AT TERMINUS DAM
UNREGULATED CONDITIONS
(Flows in cfs)

Water Year	1-DAY		15-DAY		30-DAY		60-DAY		90-DAY		120-DAY	
	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow	Date	Flow
1986	28 May	3712	24 May	3215	16 May	2869	21 Apr	2414	1 Apr	2134	1 Apr	1790
1987	29 Apr	1188	3 May	1035	17 Apr	990	9 Apr	796	1 Apr	635	1 Apr	490
1988	16 May	1212	11 May	958	7 May	785	6 Apr	683	1 Apr	572	1 Apr	449
1989	11 Apr	1416	7 Apr	1299	9 Apr	1061	1 Apr	946	1 Apr	767	1 Apr	596
1990	28 May	984	27 Apr	747	12 Apr	672	11 Apr	603	1 Apr	498	1 Apr	396
1991	25 May	1876	24 May	1611	10 May	1470	25 Apr	1170	1 Apr	994	1 Apr	810
1992	30 Apr	1114	26 Apr	957	17 Apr	870	1 Apr	689	1 Apr	511	1 Apr	405
1993	19 May	2931	11 May	2653	28 Apr	2459	27 Apr	2184	1 Apr	1895	1 Apr	1589
1994	15 May	1576	4 May	1078	5 May	1032	15 Apr	898	1 Apr	718	1 Apr	556
1995	30 Apr	4475	24 Jun	3973	11 Jun	3612	19 May	3211	26 Apr	2920	1 Apr	2509
1996	16 May	4882	3 May	2747	24 Apr	2523	16 Apr	2094	1 Apr	1756	1 Apr	1414
1997	15 May	2663	6 May	2236	3 May	2028	15 Apr	1741	1 Apr	1456	1 Apr	1183
1998	16 Jun	5332	15 Jun	4644	11 Jun	4376	24 May	3646	22 Apr	3147	1 Apr	2797
1999	13 May	1704	13 May	1451	6 May	1310	15 Apr	1047	1 Apr	849	1 Apr	678
2000	24 May	2527	20 May	1973	1 May	1851	7 Apr	1527	1 Apr	1291	1 Apr	1026
2001	11 May	2247	7 May	1902	26 Apr	1746	1 Apr	1276	1 Apr	994	1 Apr	786
2002	15 Apr	1839	18 May	1363	9 May	1334	9 Apr	1180	1 Apr	1028	1 Apr	820
2003	28 May	3519	22 May	2928	14 May	2374	22 Apr	1693	1 Apr	1395	1 Apr	1122
2004	4 May	1449	26 Apr	1130	22 Apr	943	1 Apr	839	1 Apr	708	1 Apr	564

COMPUTED STATISTICS

YEARS	101	101	101	101	101	101
LOG MEAN	3.383	3.286	3.239	3.164	3.088	2.999
STANDARD DEV	0.228	0.228	0.231	0.232	0.242	0.255
SKEW COEFF	-0.23	-0.18	-0.20	-0.20	-0.22	-0.16

ADOPTED STATISTICS

YEARS	101	101	101	101	101	101
LOG MEAN	3.383	3.286	3.239	3.164	3.088	2.999
STANDARD DEV	0.228	0.228	0.231	0.232	0.242	0.255
SKEW COEFF	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20

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TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

U.S. Army Corps of Engineers
Sacramento District
Revised July 2005

PLATES

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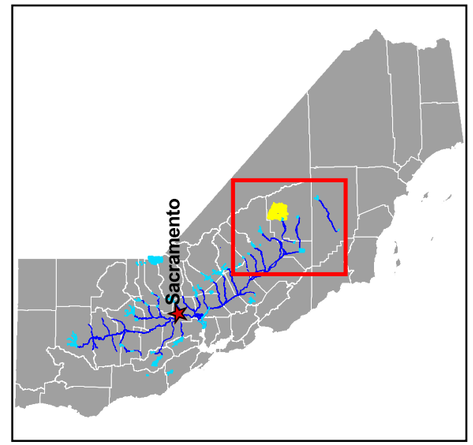


MAP SCALE
20 Miles
10
0
10

MAP LEGEND

- Project Watershed
- Related Watershed
- Lake or Reservoir
- Intermittent Water
- Major River
- Stream
- Canal
- Interstate or Highway
- State Route
- Railroad
- County Boundary
- City

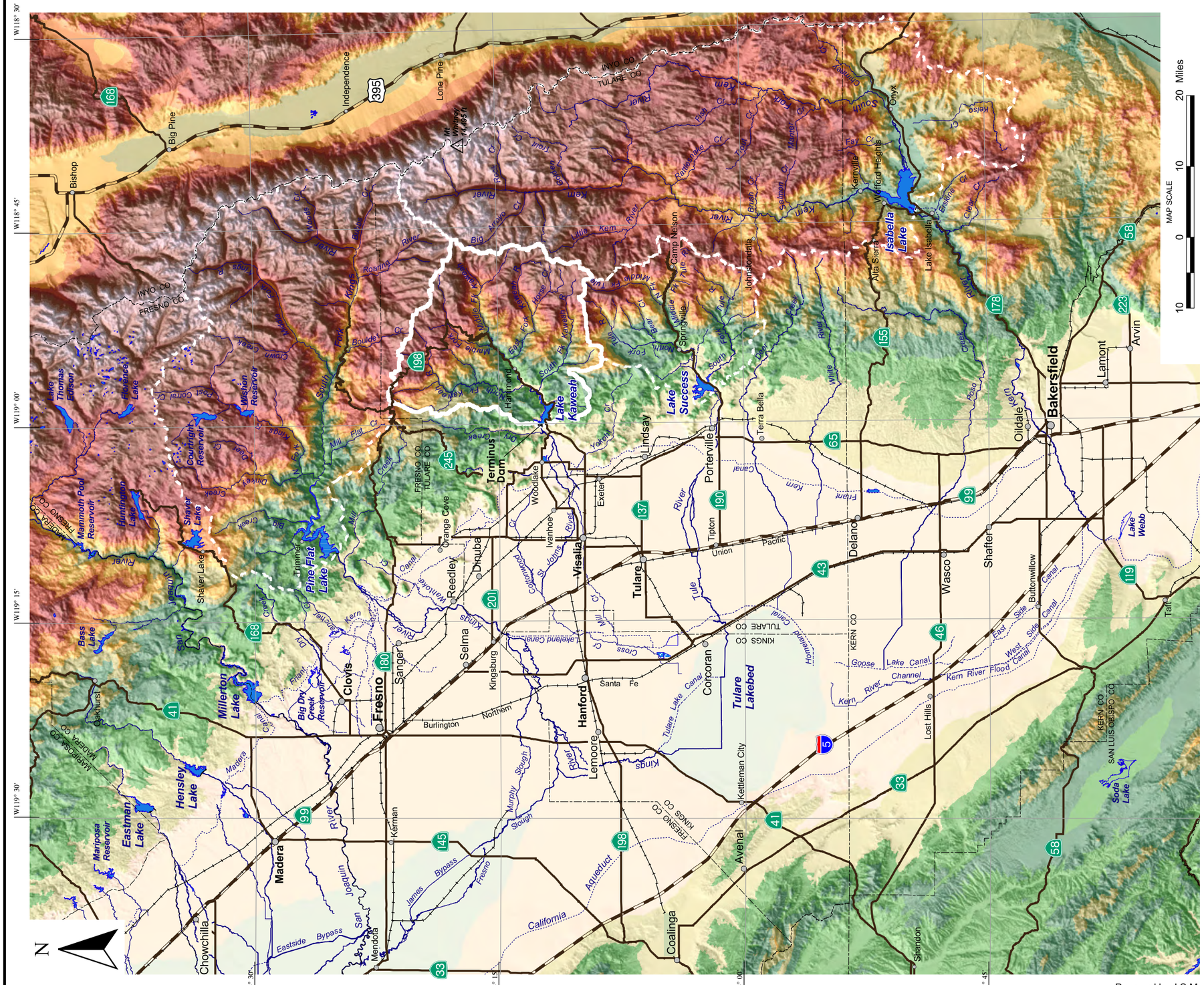
TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

GENERAL MAP

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by J.S.M.

Revised Jul 2005 SHEET 1 OF 2 PLATE 2-1



MAP LEGEND

- Interstate or Highway
- State Route
- Railroad
- County Boundary
- City
- Project Watershed
- Related Watershed
- Lake or Reservoir
- Intermittent Water
- Major River
- Stream
- Canal

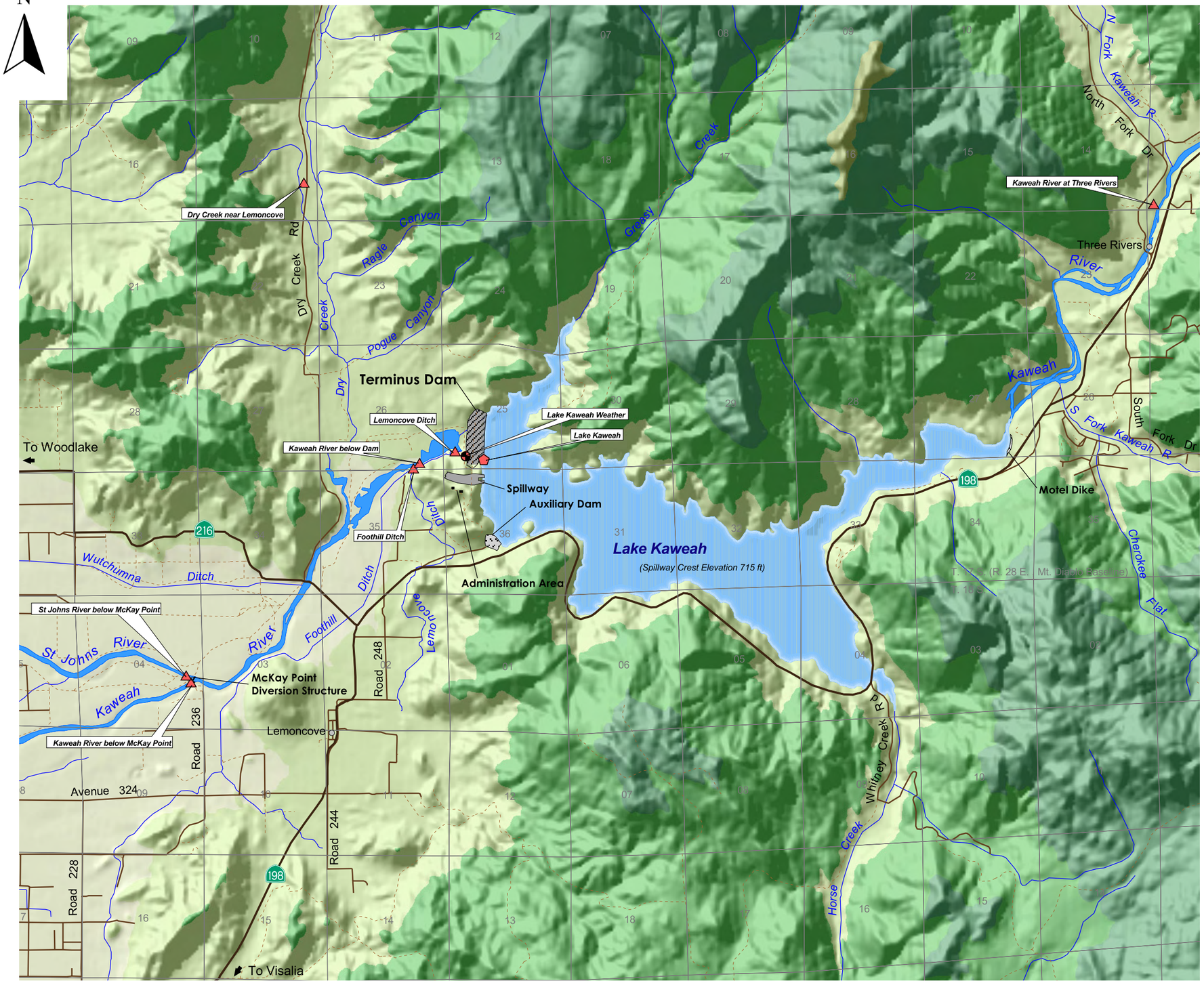
Prepared by J.S.M.

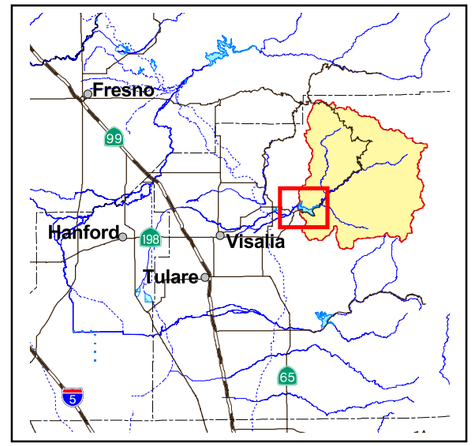
TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

GENERAL MAP
(TOPOGRAPHIC RELIEF)

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

N





MAP LEGEND

- Lake
- Major River
- Stream or Canal
- State Route
- County Road
- Unpaved Road
- Town

Gaging Station Types:

- Reservoir Pool Elevation and Storage Recorder
- Stream Stage Recorder
- Complete Climatological Station

MAP SCALE

0.5 0 0.5 1 Miles

Prepared by J.S.M.

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

AREA MAP

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE 2-2

N

Terminus Dam

Spillway

Auxiliary Dam

Administration Area

Lake Kaweah

(Spillway Crest Elevation 715 ft)

Lemon Hill

Kaweah

Slick Rock

Cobble Knoll

Motel Dike

Horse Creek

McKay Point
Diversion Structure

Three Rivers

Lemoncove

To Woodlake

To Visalia

Greasy Creek

Ragle Canyon

Pogue Canyon

Dry Creek

N Fork Kaweah R.

S Fork Kaweah R.

Kaweah River

St Johns River

Foothill Ditch

Wutchumna Ditch

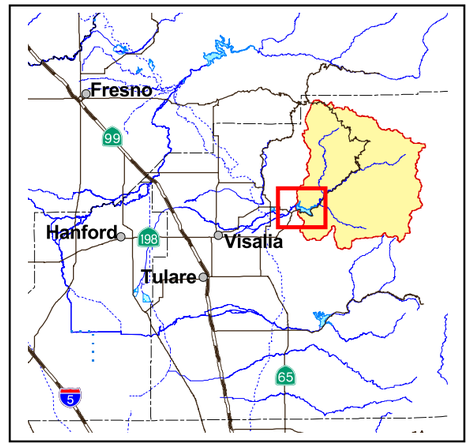
Lemon Cove Ditch

Cherokee Flat

Horse Creek

T. 17 S. (R. 28 E., Mt. Diablo Baseline)

T. 18 S.



MAP LEGEND

- Project Boundary
- Lake
- Major River
- Stream or Canal
- Bouy Line - 5 mph zone
- State Route
- County Road
- Unpaved Road
- Town

Recreation Symbols:

- Camping
- Tent Camping
- Picnic Area
- Hiking
- Boat Launch
- Fishing Access
- Swimming Beach
- Information Center

MAP SCALE

0.5 0 0.5 1 Miles

Prepared by J.S.M.

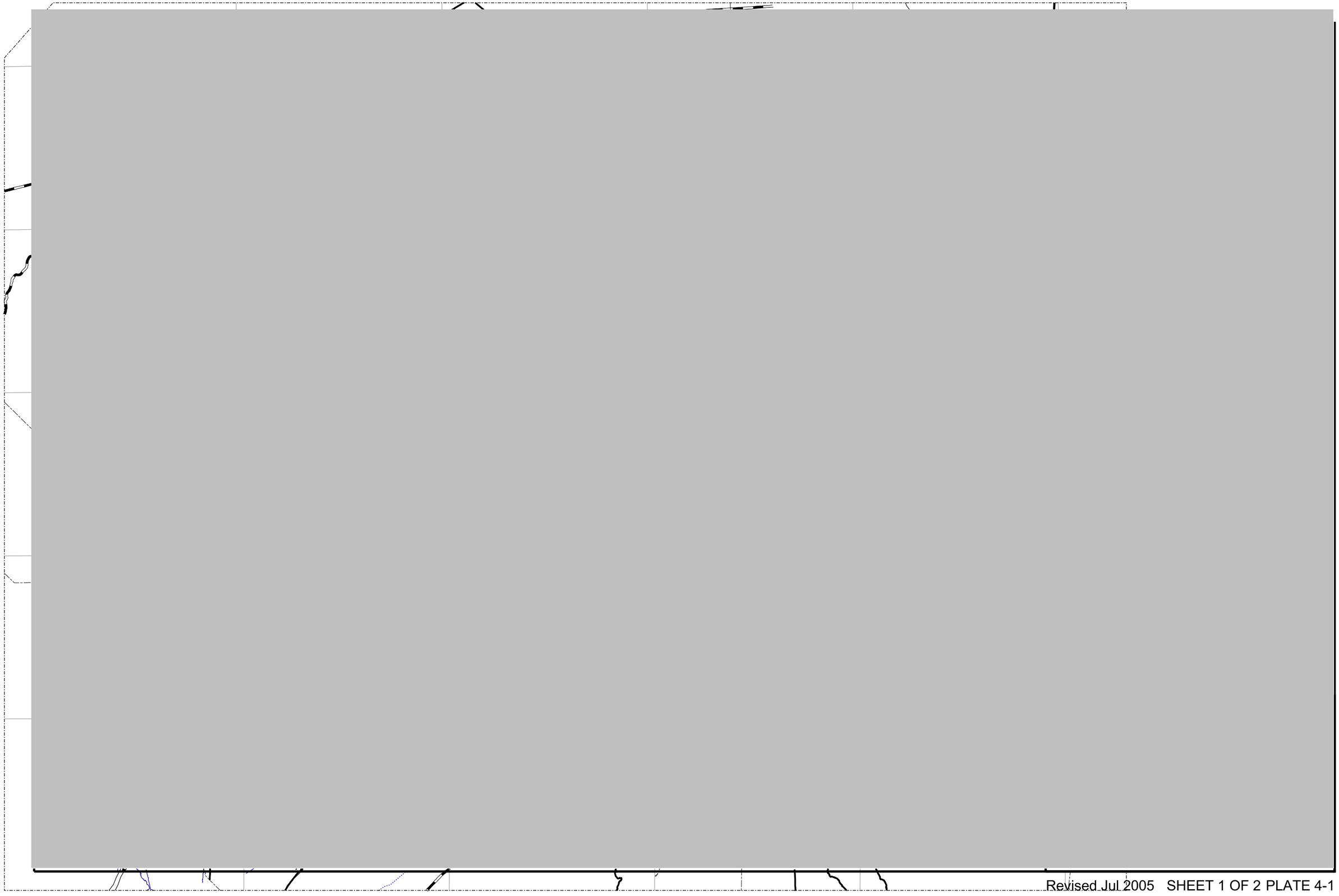
TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

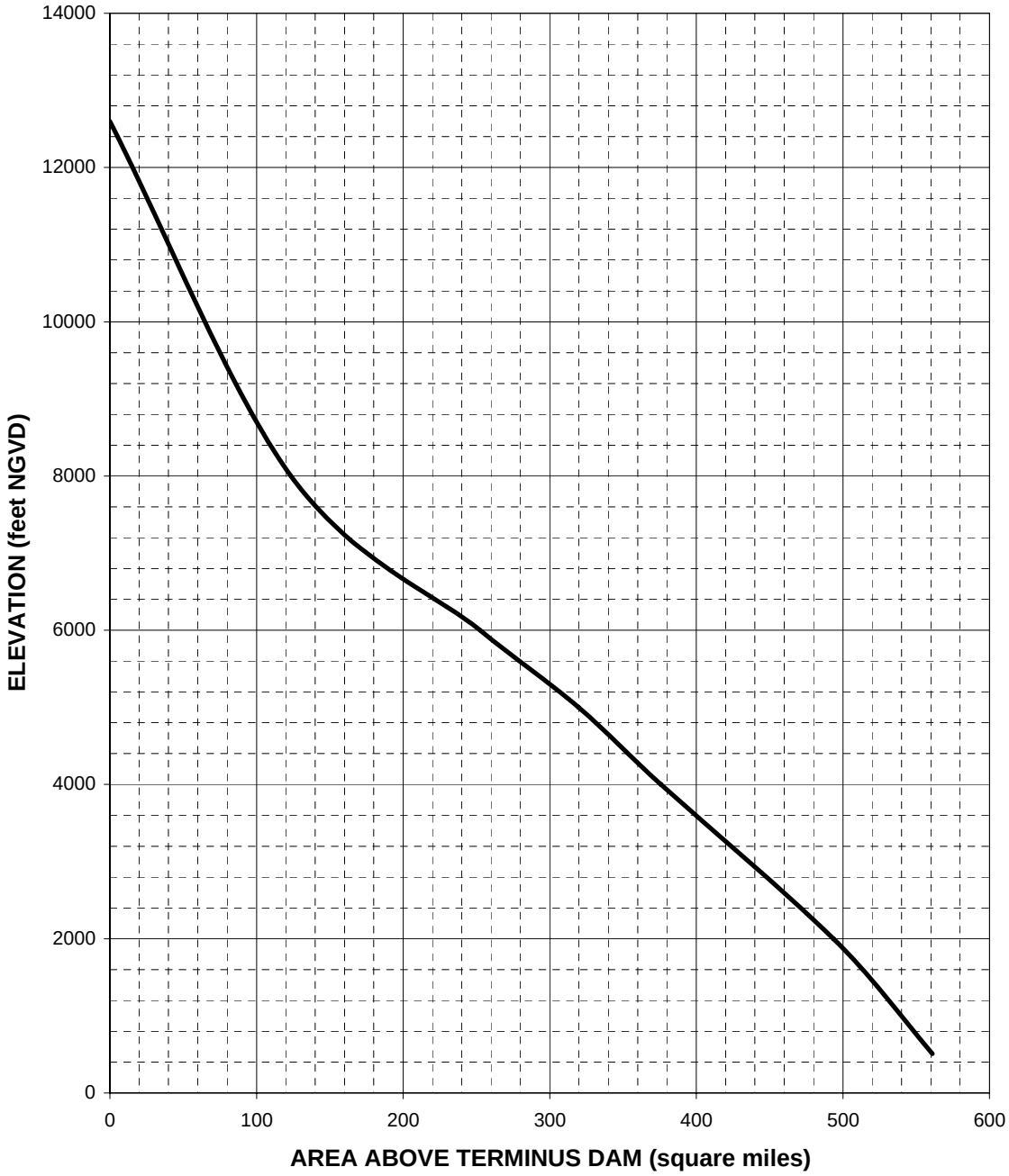
REAL ESTATE AND RECREATION FACILITIES

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE 2-9





NOTES: 1. Area: 561 square miles

2. Dam site elevation: 510 feet

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

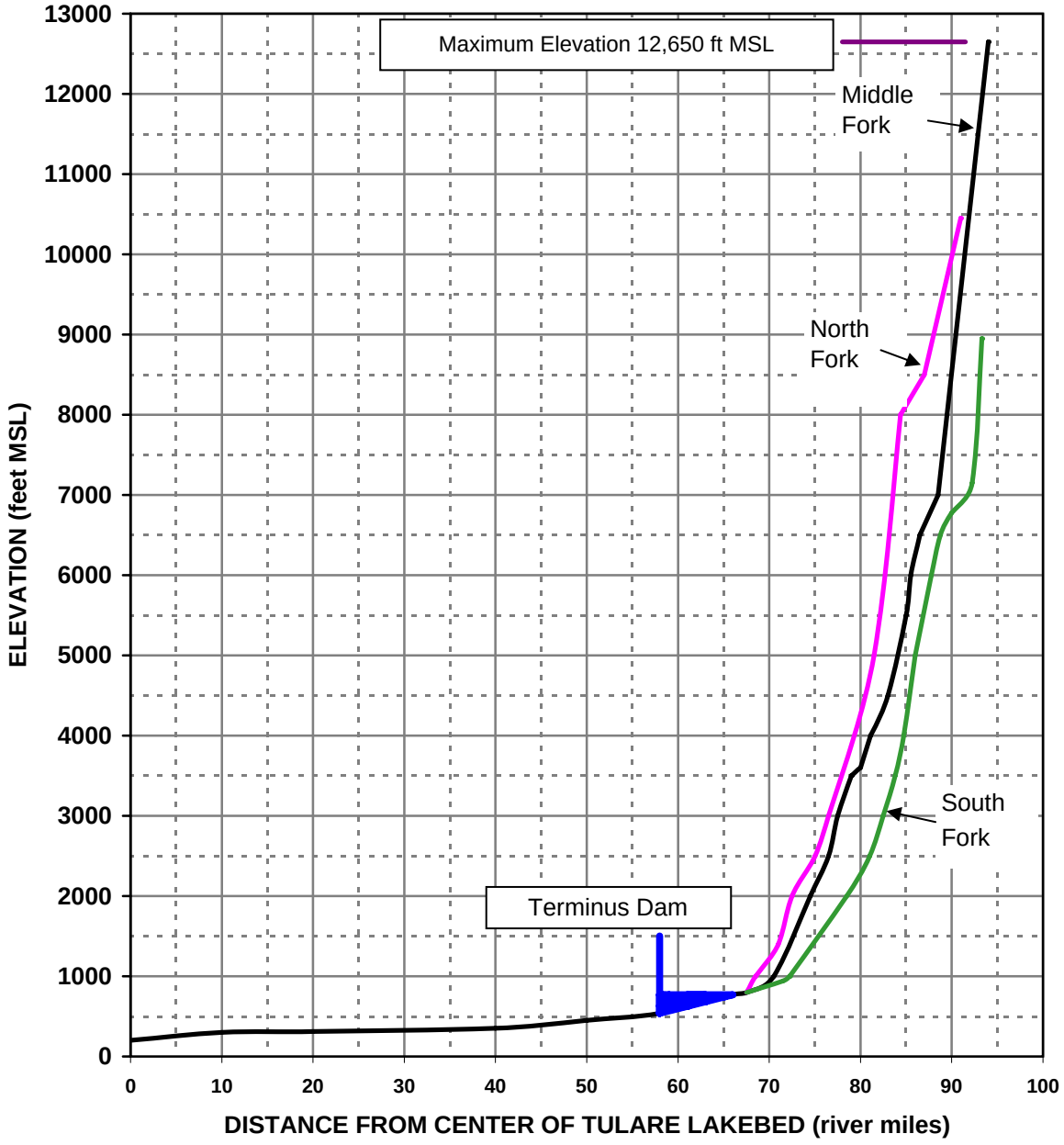
AREA-ELEVATION CURVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE 4-2



TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

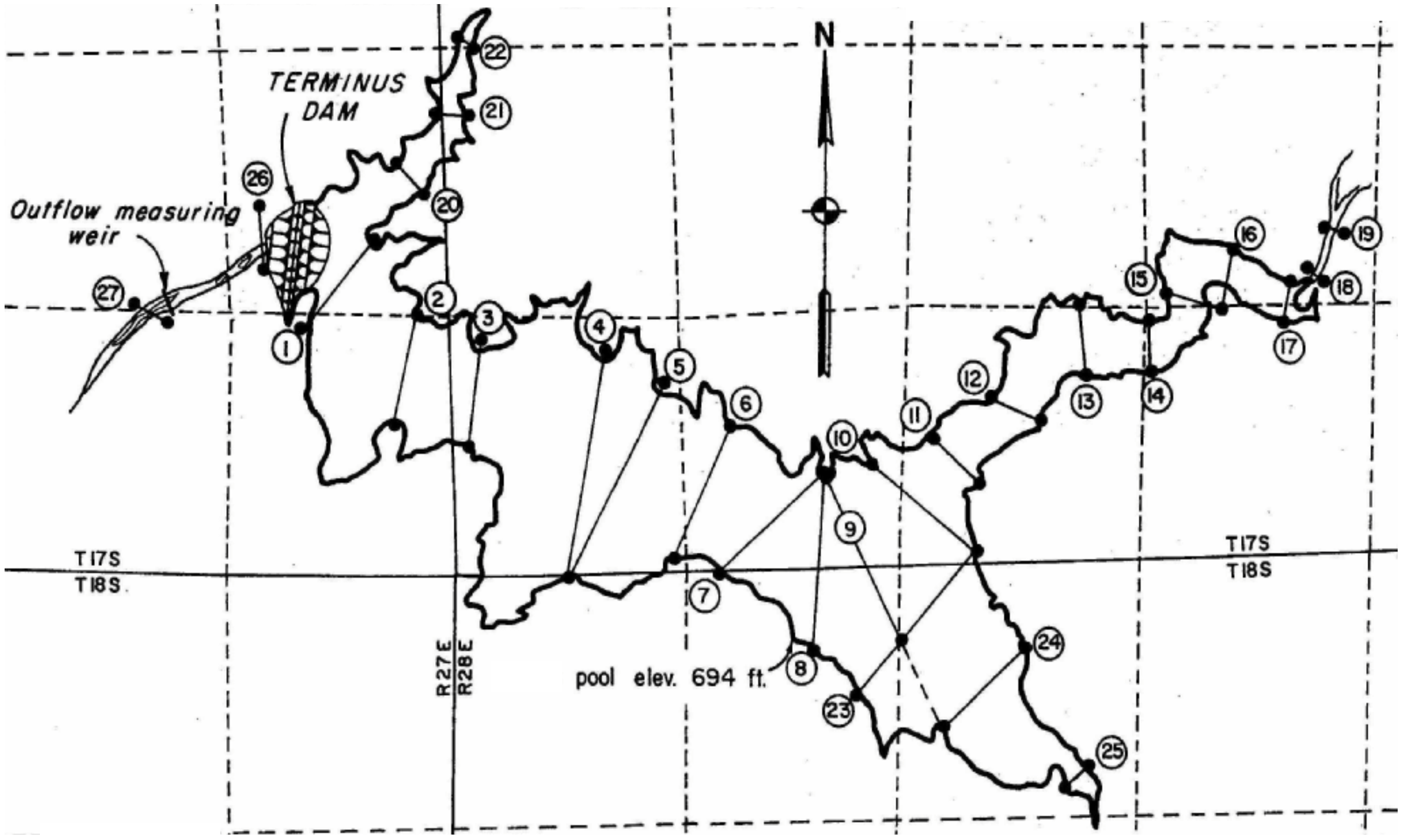
KAWEAH RIVER STREAM PROFILES

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE 4-3



TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

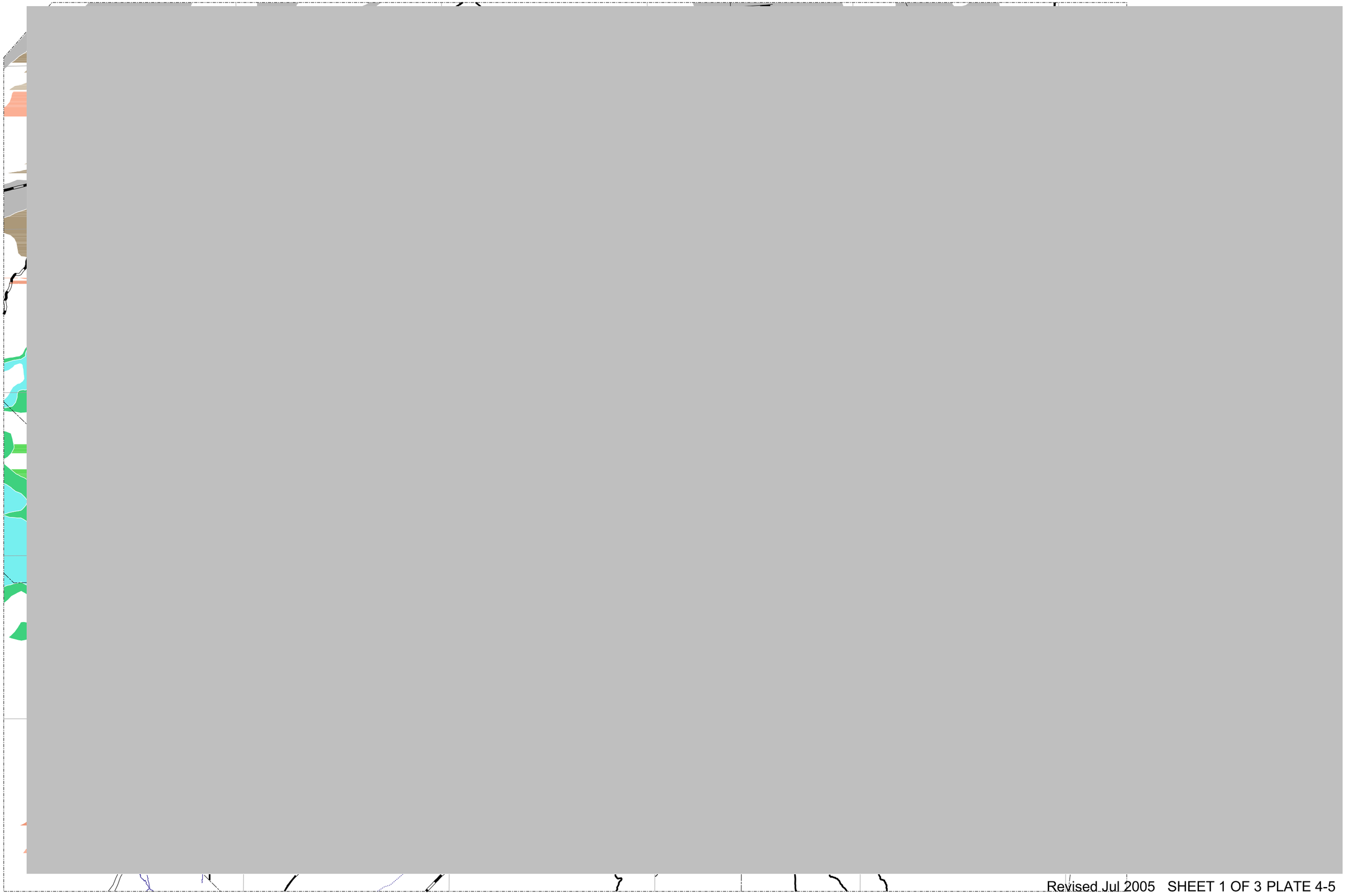
SEDIMENTATION RANGES

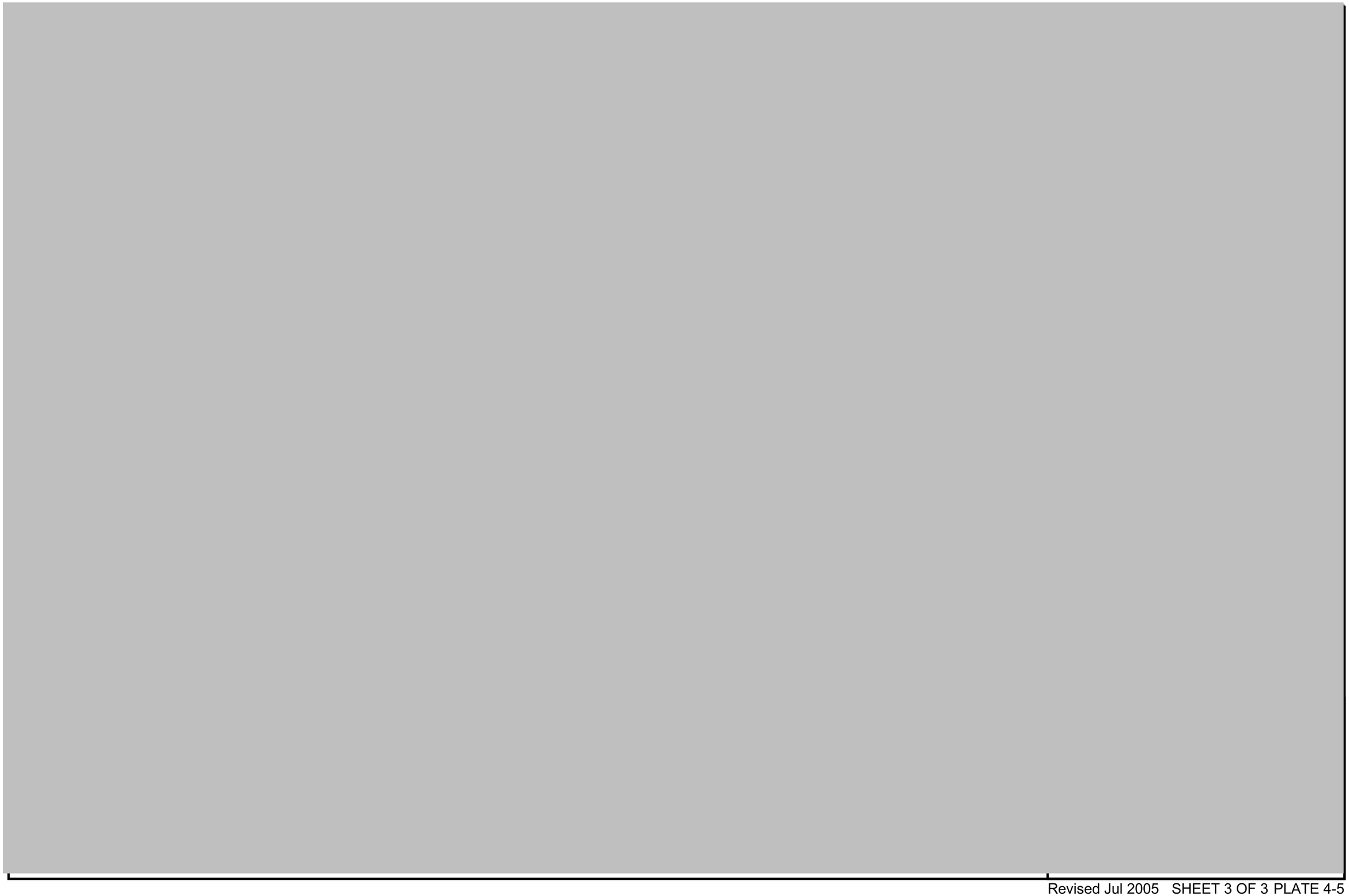
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

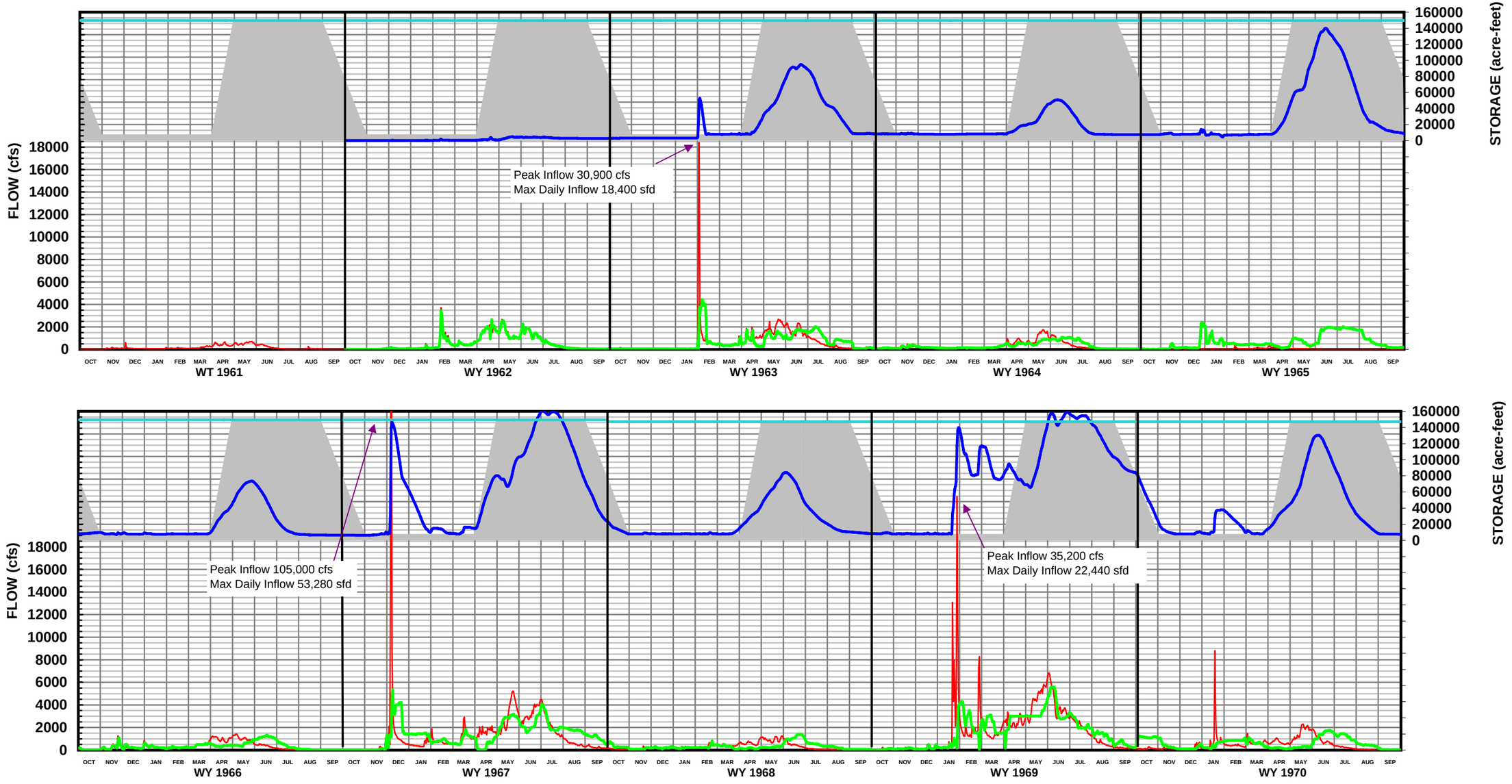
Prepared by WLJ

Revised Dec 2003

PLATE 4-4





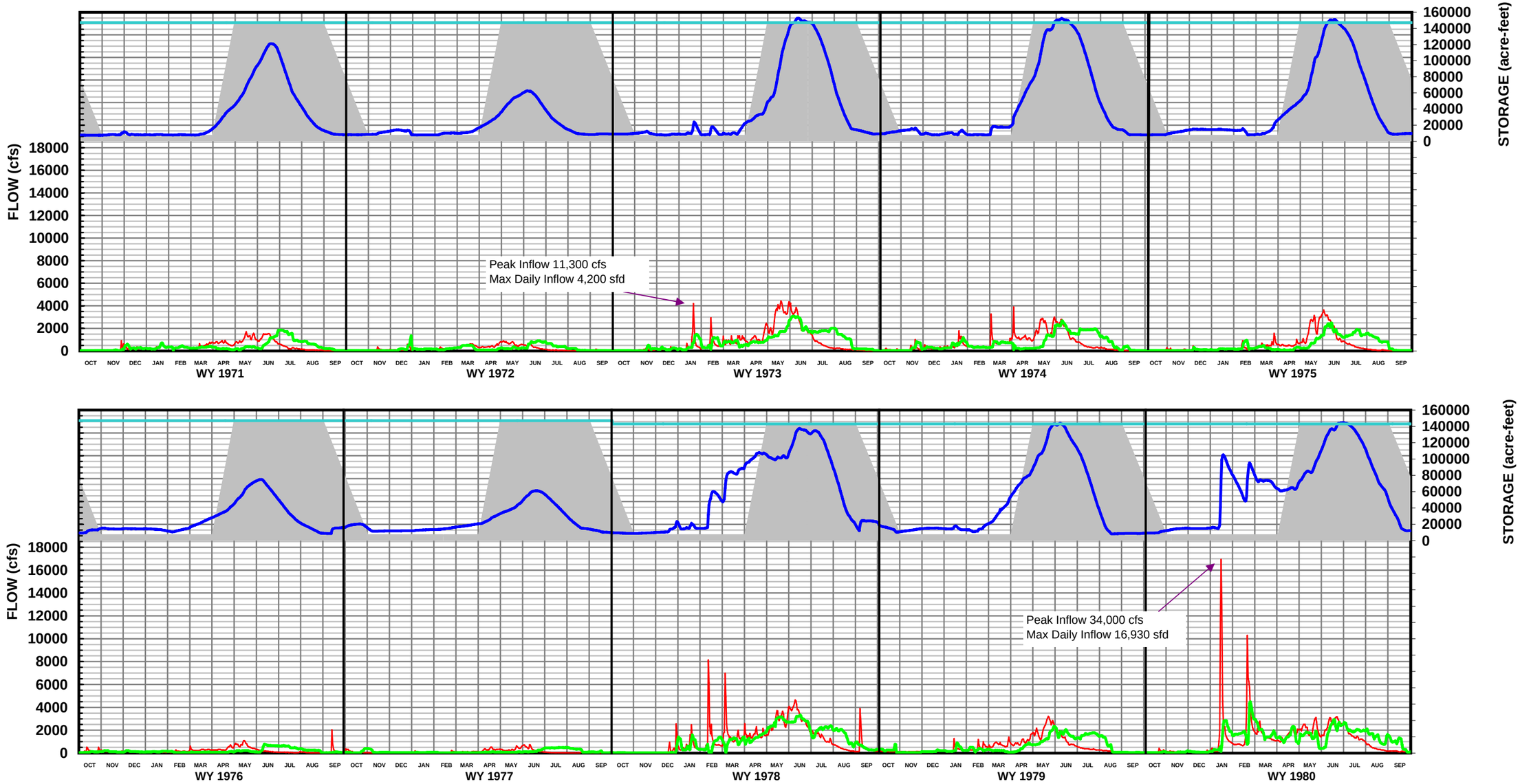


TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by TLT

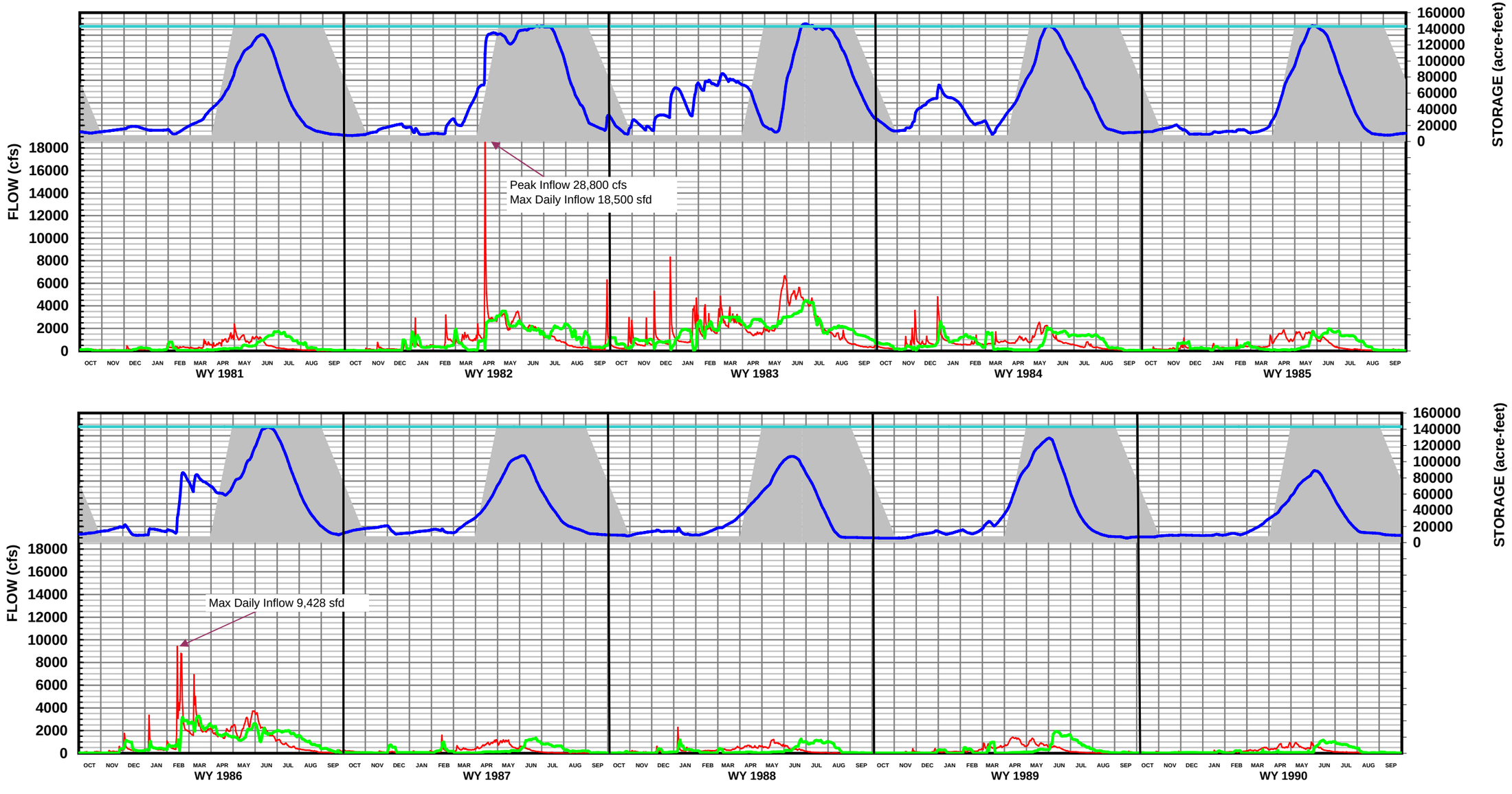


TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by TLT

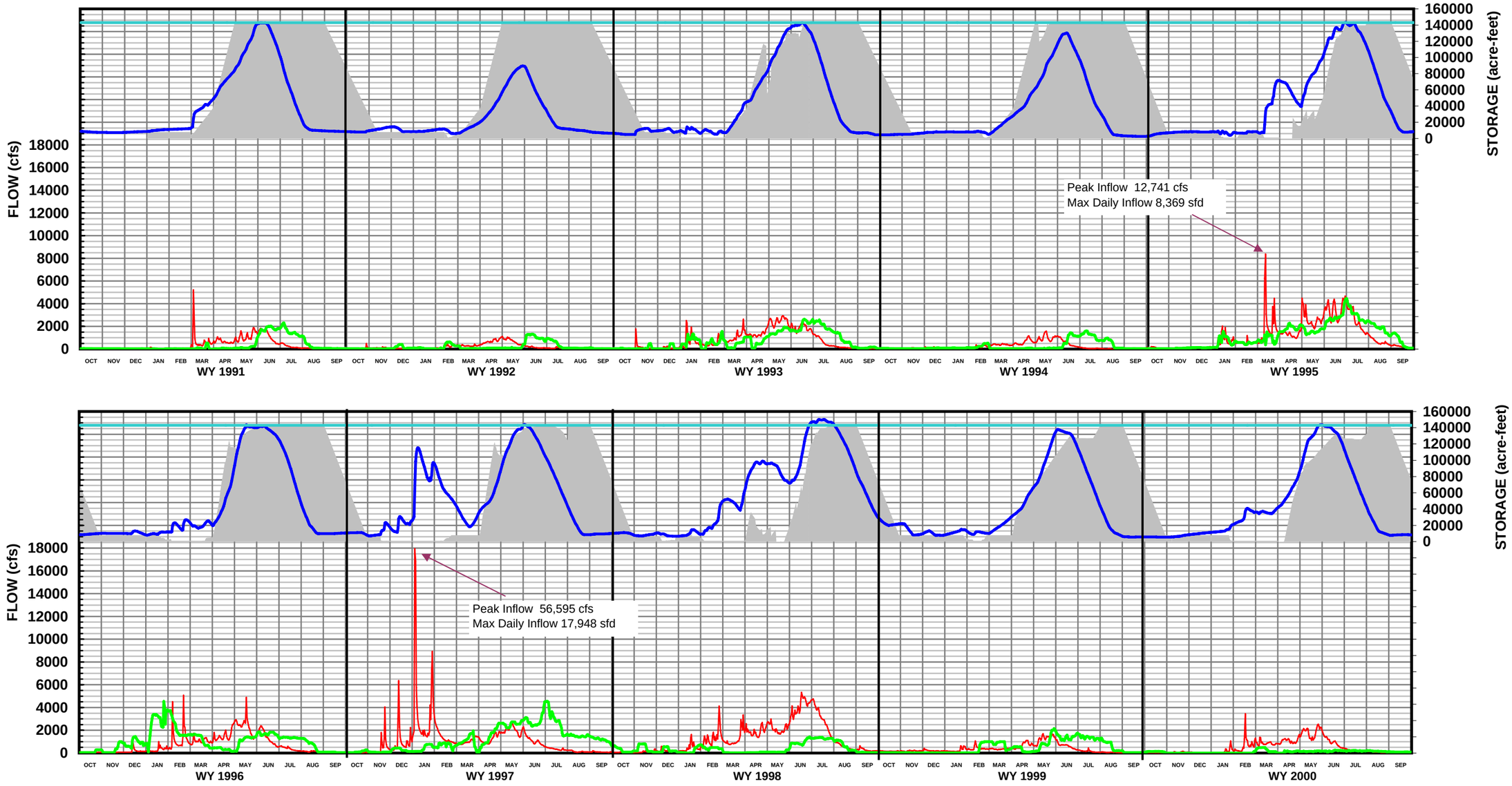


TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by TLT

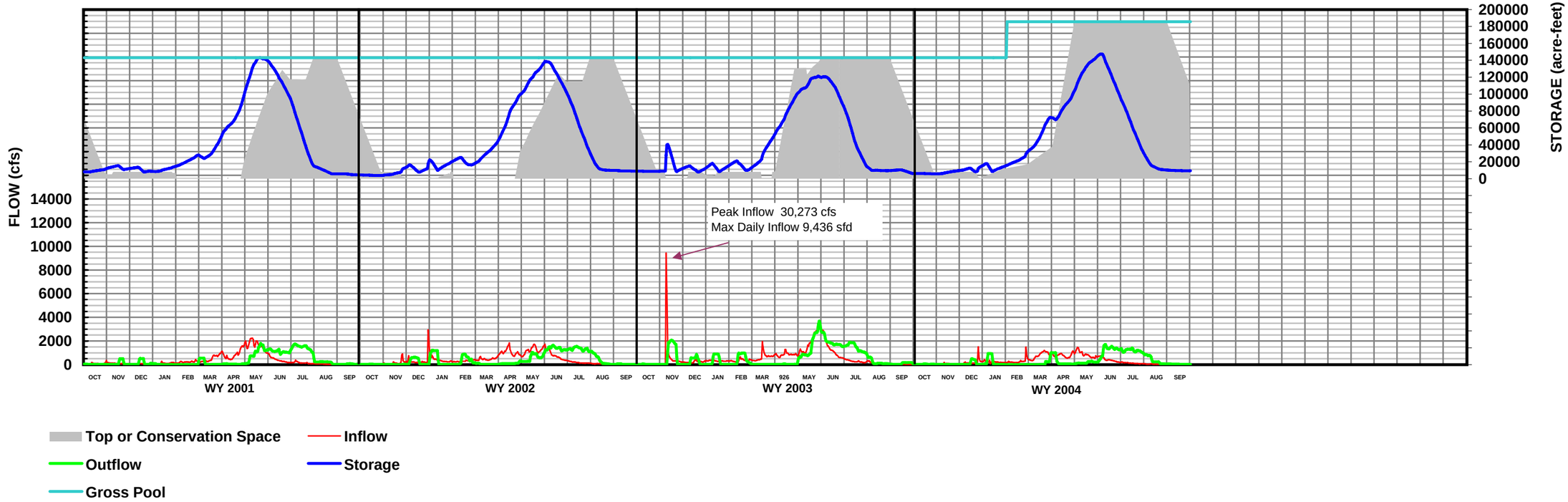


TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by TLT

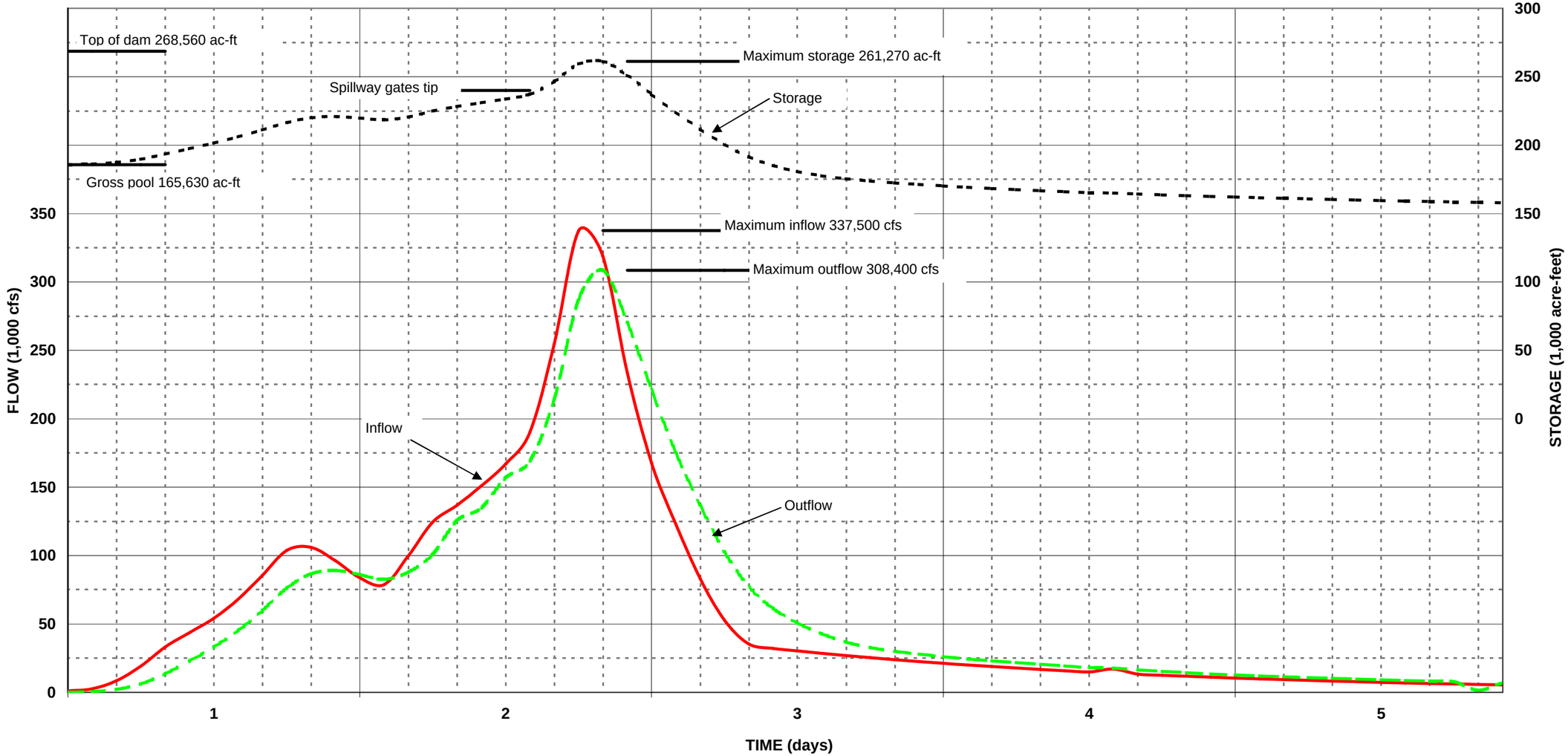


TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

HISTORICAL OPERATION

Prepared by TLT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



NOTES

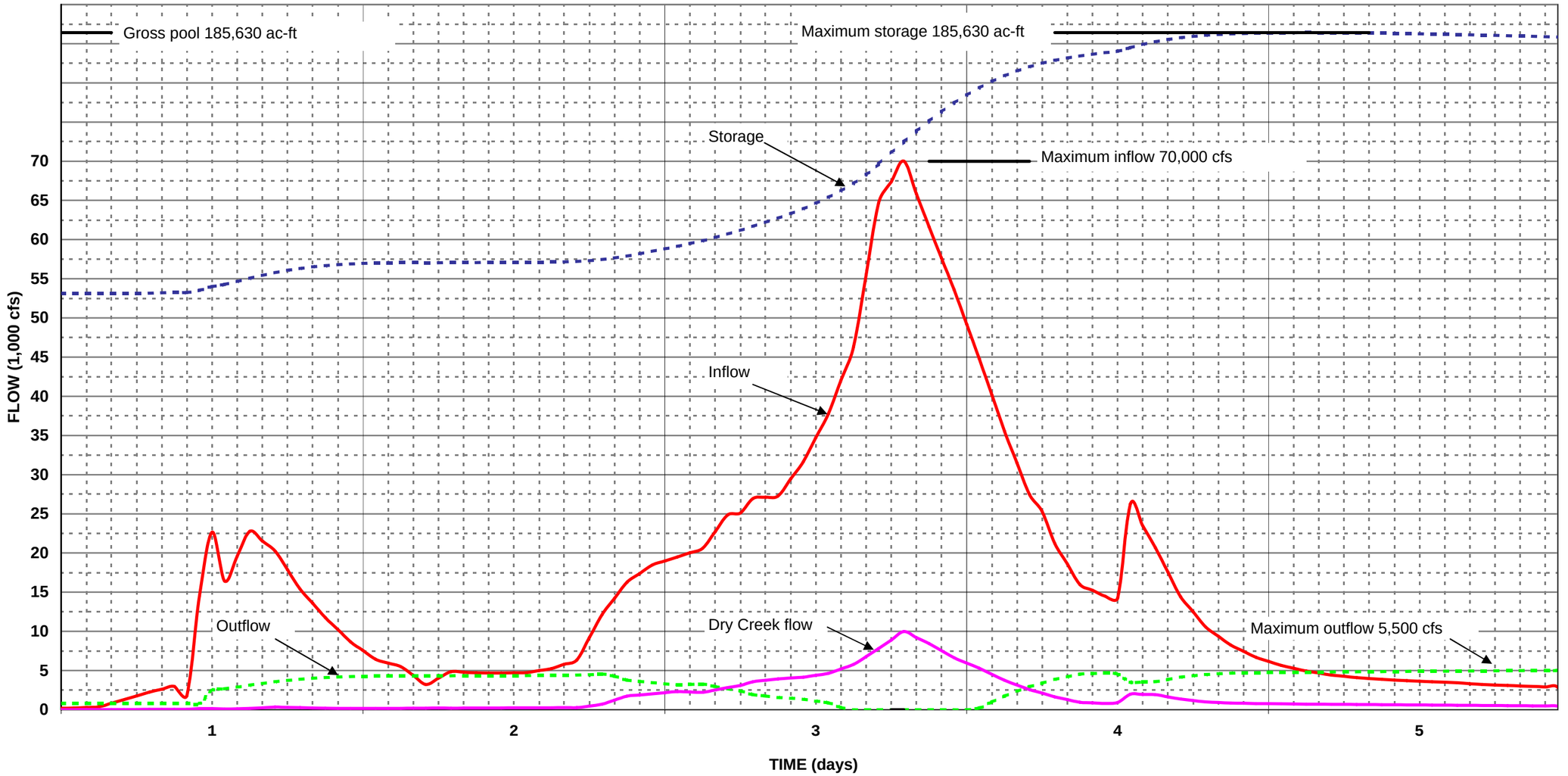
1. At the beginning of the Spillway Design Flood routing it was assumed that the lake was at gross pool level, elevation 715.0 feet
2. Inflow based on 1998 PMF Study using HMR 58

Prepared by WLJ

TERMINUS DAM AND LAKE KAWEAH KAWEAH RIVER, CALIFORNIA
SPILLWAY DESIGN **FLOOD ROUTING**
U.S. ARMY CORPS OF ENGINEERS SACRAMENTO DISTRICT

Revised Jul 2005

PLATE 8-1



NOTE

Routing through Lake Kaweah is made in conformity with the Water Control Diagram using maximum objective flow rate in Kaweah River at McKay Point of 5,500 cfs.
Local flow is estimated to be 13.4 percent of Lake Kaweah inflow.
Flood routing is based on a 30-day series. Only the main wave (4th wave in a 6 wave 5-day series) is shown on this plate.

Prepared by WLJ

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

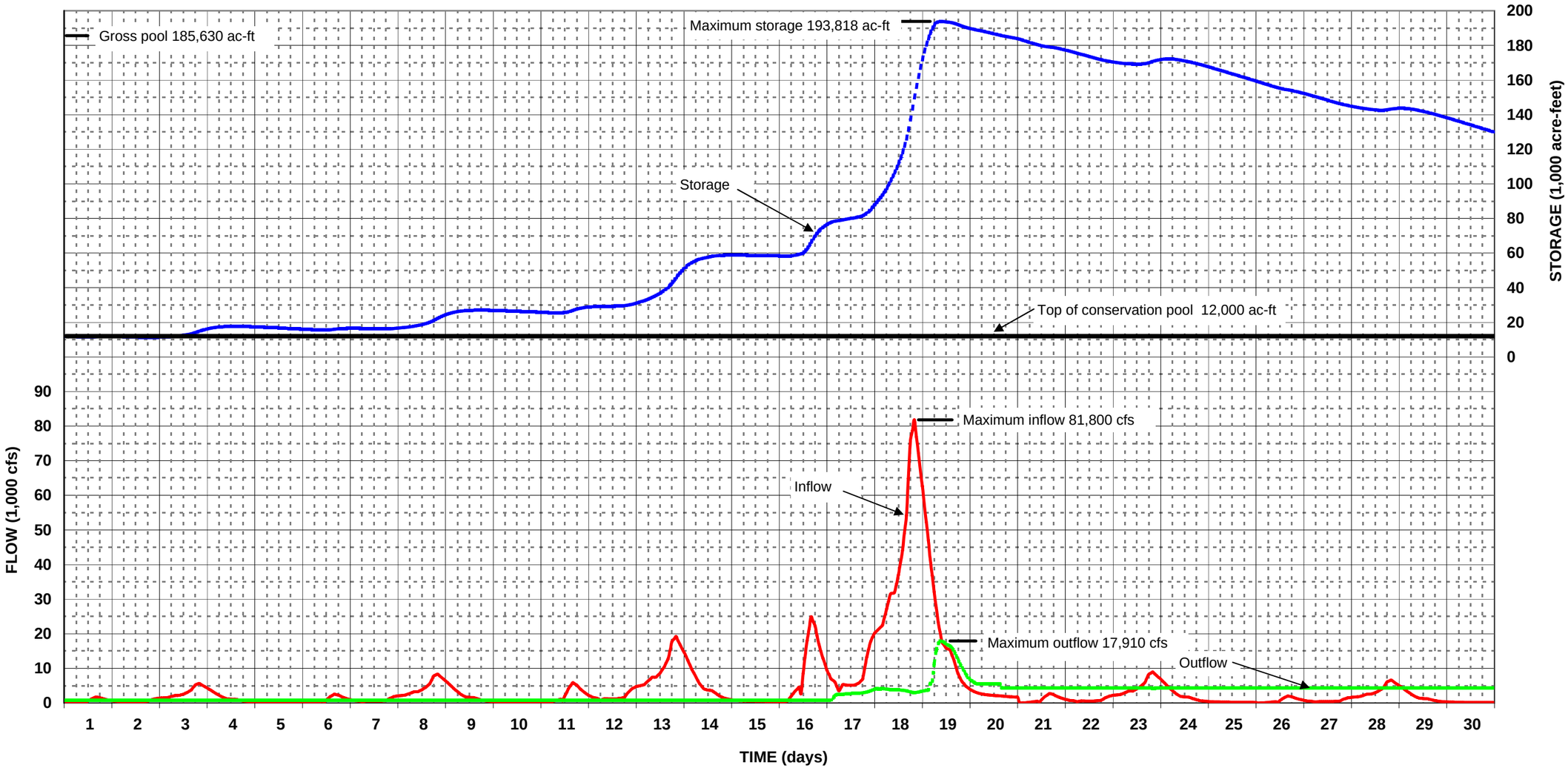
RESERVOIR DESIGN

FLOOD ROUTING

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE 8-2



TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

1 PERCENT

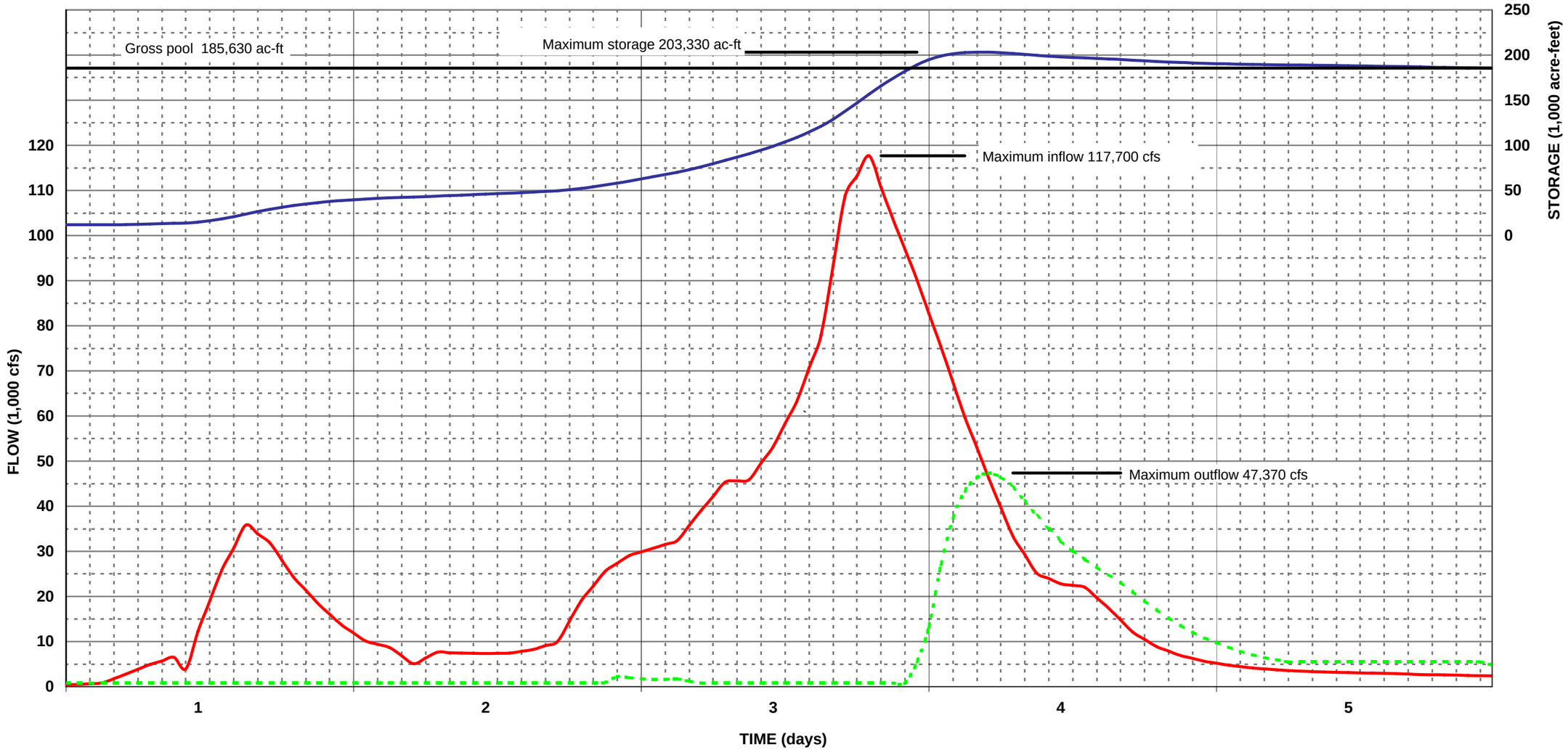
FLOOD ROUTING

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE 8-3



NOTE

Routing through Lake Kaweah is made in conformity with the Water Control Diagram using maximum objective flow rate in Kaweah River at McKay Point of 5,500 cfs.

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

STANDARD PROJECT

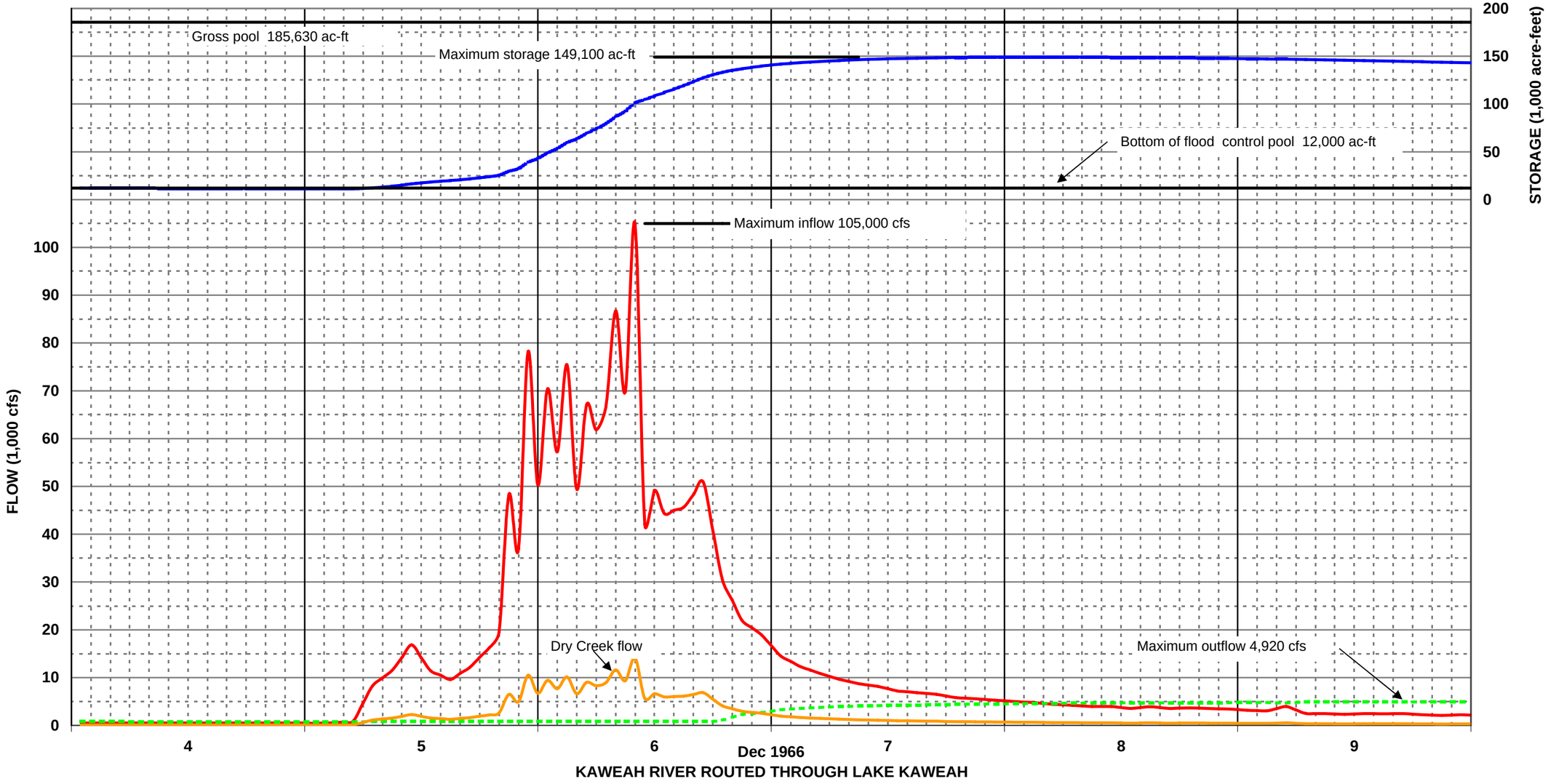
FLOOD ROUTING

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE 8-4



NOTE:
Routing through Lake Kaweah is made in conformity with the Water Control Diagram.
Local flow was estimated to be 13.4 percent of the inflow into Lake Kaweah.

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

HYPOTHETICAL 1966

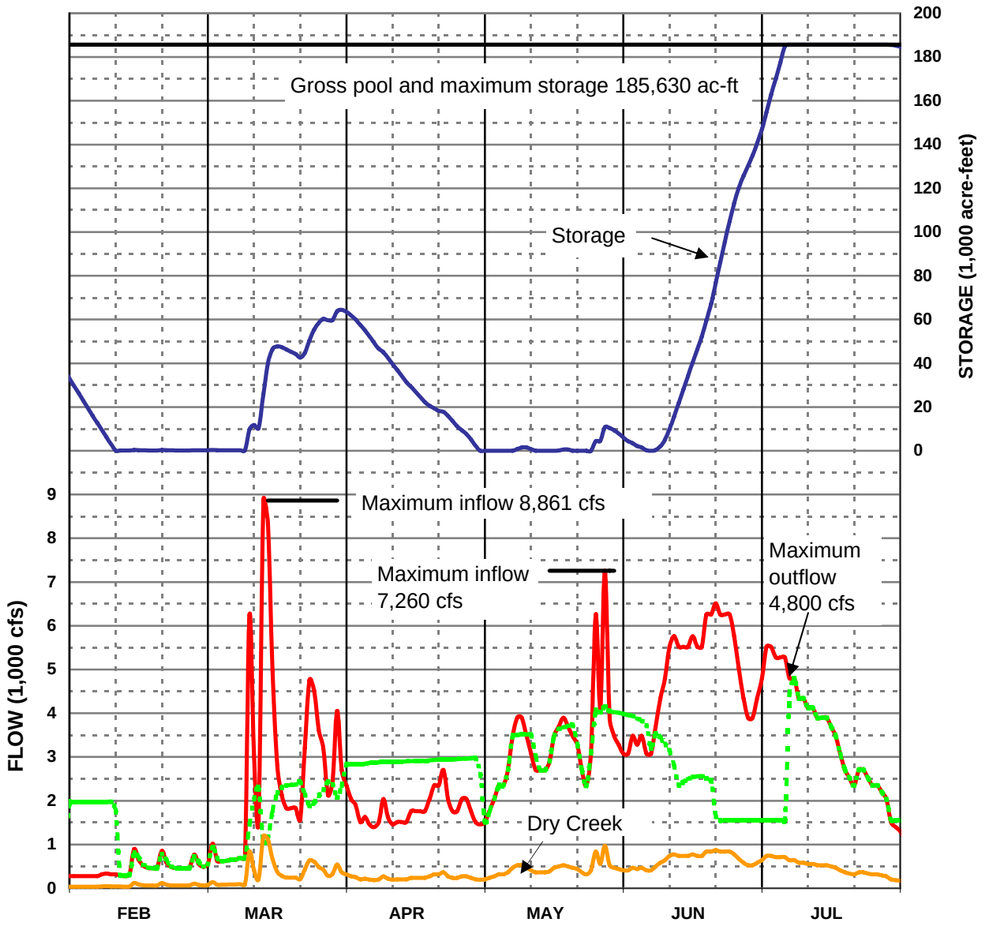
RAINFLOOD ROUTING

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

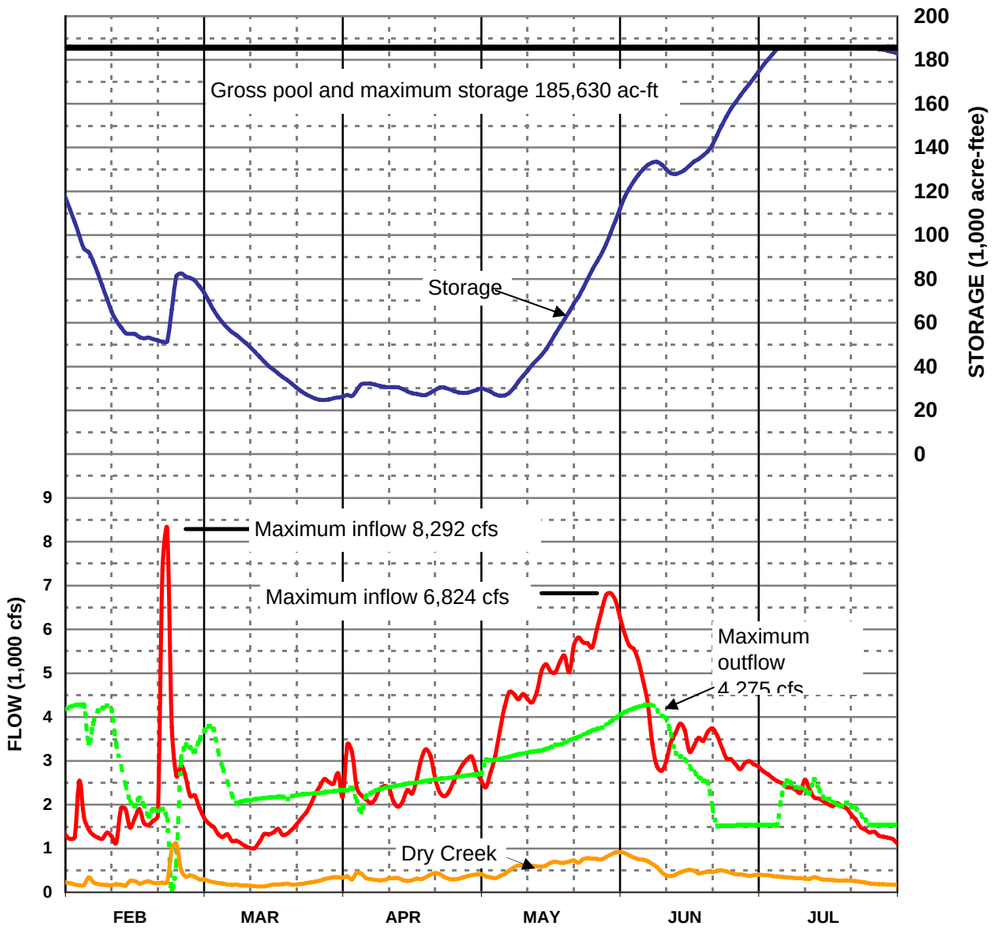
Revised Jul 2005

PLATE 8-5



1906

KAWEAH RIVER ROUTED THROUGH LAKE KAWEAH



1969

KAWEAH RIVER ROUTED THROUGH LAKE KAWEAH

NOTES:

1. Routing through Lake Kaweah is made in conformity with the Water Control Diagram.
2. In 1906, estimated inflows to Lake Kaweah were used. Dry Creek flow was estimated to be 13.4 percent of the inflow into Lake Kaweah.
2. In 1969, published inflows to Lake Kaweah and Dry Creek flows were used.

Prepared by WLJ

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

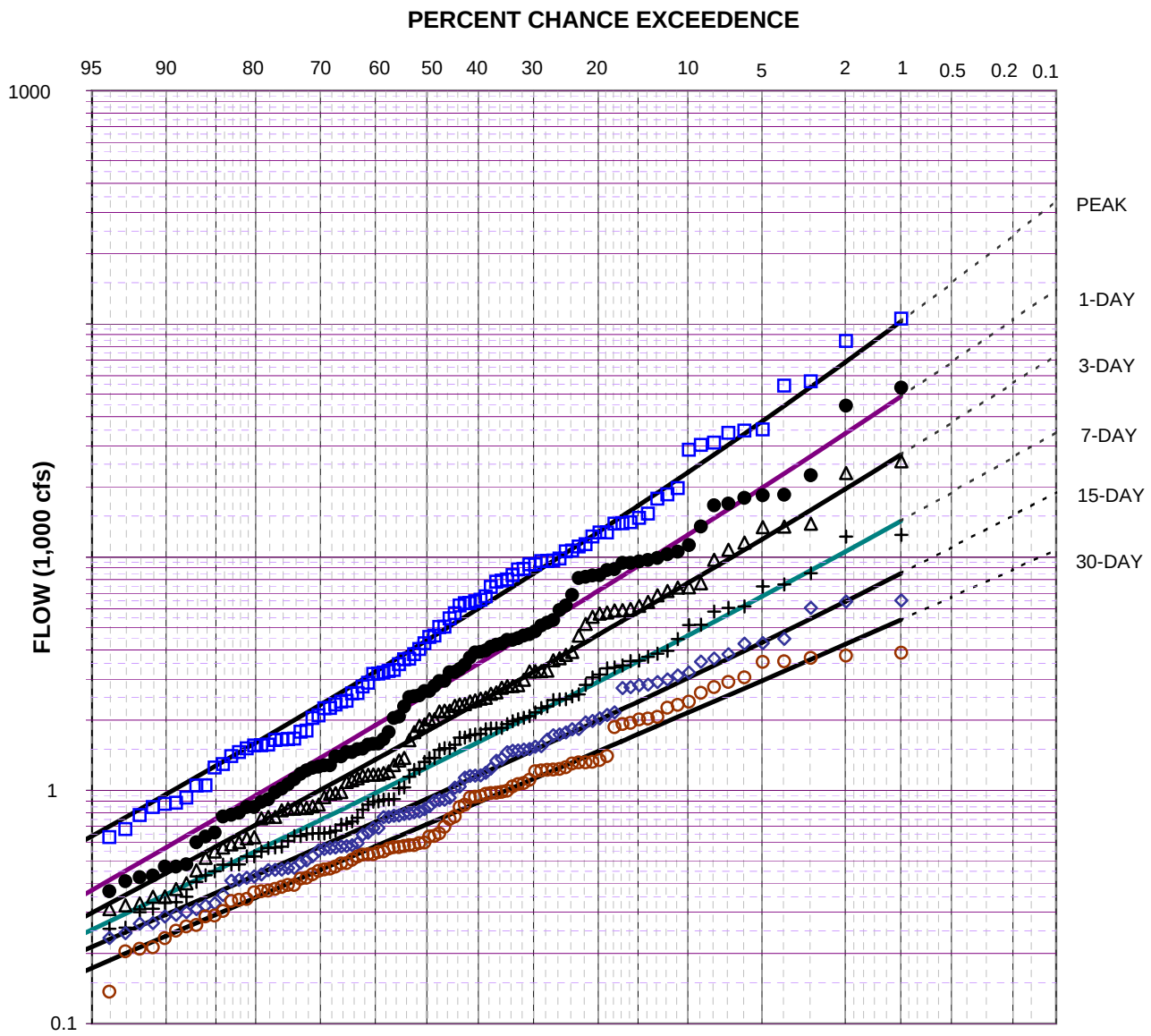
HYPOTHETICAL SNOWMELT

FLOOD ROUTINGS

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE 8-6



CURVE STATISTICS	CURVE	MEAN	STD DEV	ADOPTED SKEW
□	PEAK	3.661	0.533	0.20
●	1-DAY	3.419	0.517	0.10
△	3-DAY	3.261	0.480	0.10
+	7-DAY	3.104	0.428	0.10
◇	15-DAY	2.970	0.391	0.10
○	30-DAY	2.854	0.369	0.00

NOTES:

1. Weibull plotting positions and expected probability adjustment applied based on 100 years of record.
2. Drainage Area: 561 sq. mi.
3. Period of record: WY 1905-2004

Prepared by WLJ

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

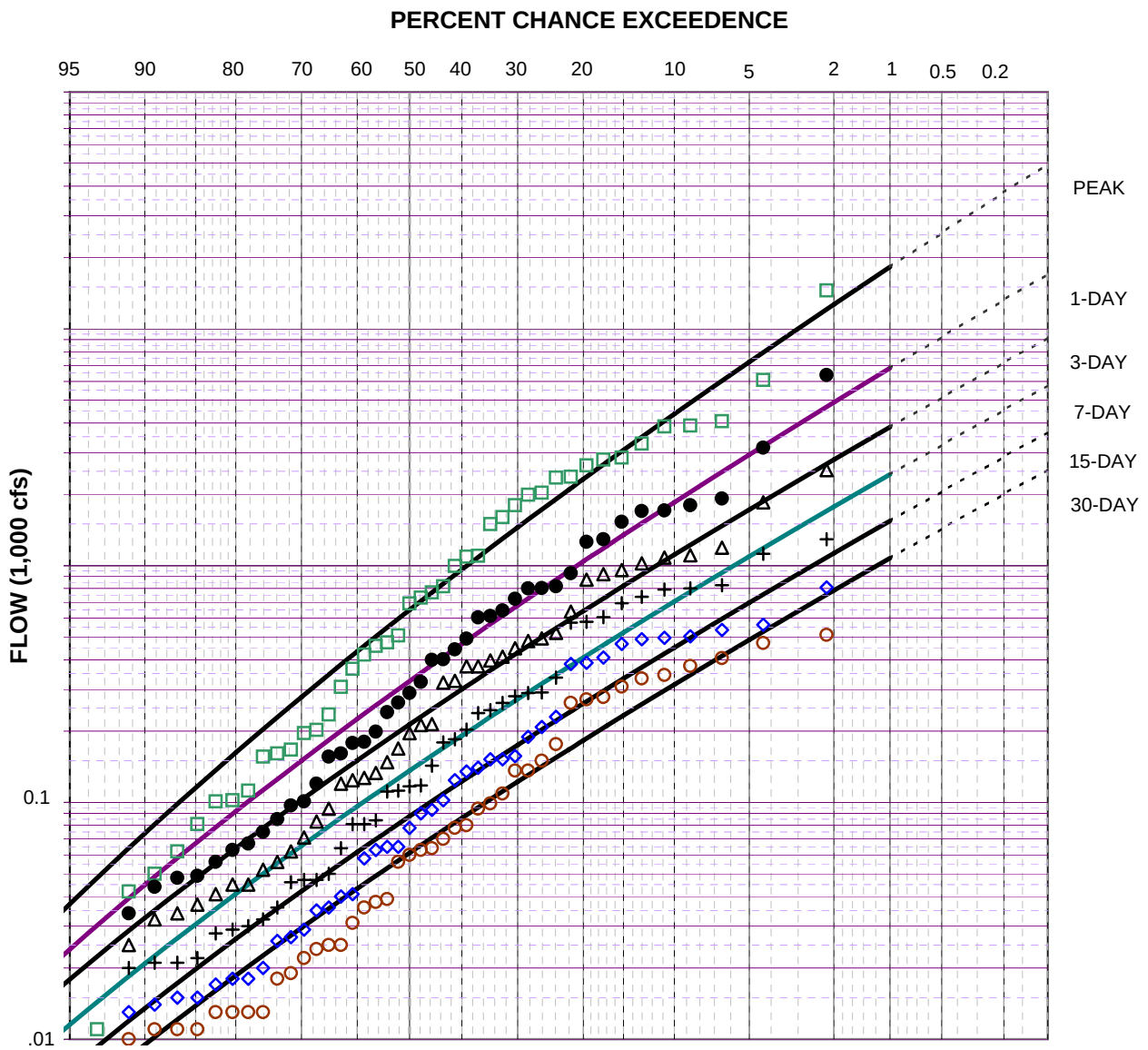
KAWEAH RIVER BELOW TERMINUS DAM
RAINFLOOD FREQUENCY CURVES

(UNREGULATED CONDITION)

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE 8-7



CURVE STATISTICS	CURVE	MEAN	STD DEV	ADOPTED SKEW
	PEAK	2.779	0.675	-0.30
	1-DAY	2.482	0.616	-0.30
	3-DAY	2.300	0.585	-0.30
	7-DAY	2.105	0.583	-0.30
	15-DAY	1.913	0.581	-0.30
	30-DAY	1.758	0.580	-0.30

NOTES:

1. Weibull plotting positions and expected probability adjustment applied based on 45 equivalent years of record.
2. Drainage Area: 80 sq. mi.
3. Period of record: WY 1960-2004

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

DRY CREEK
RAINFLOOD FREQUENCY CURVES

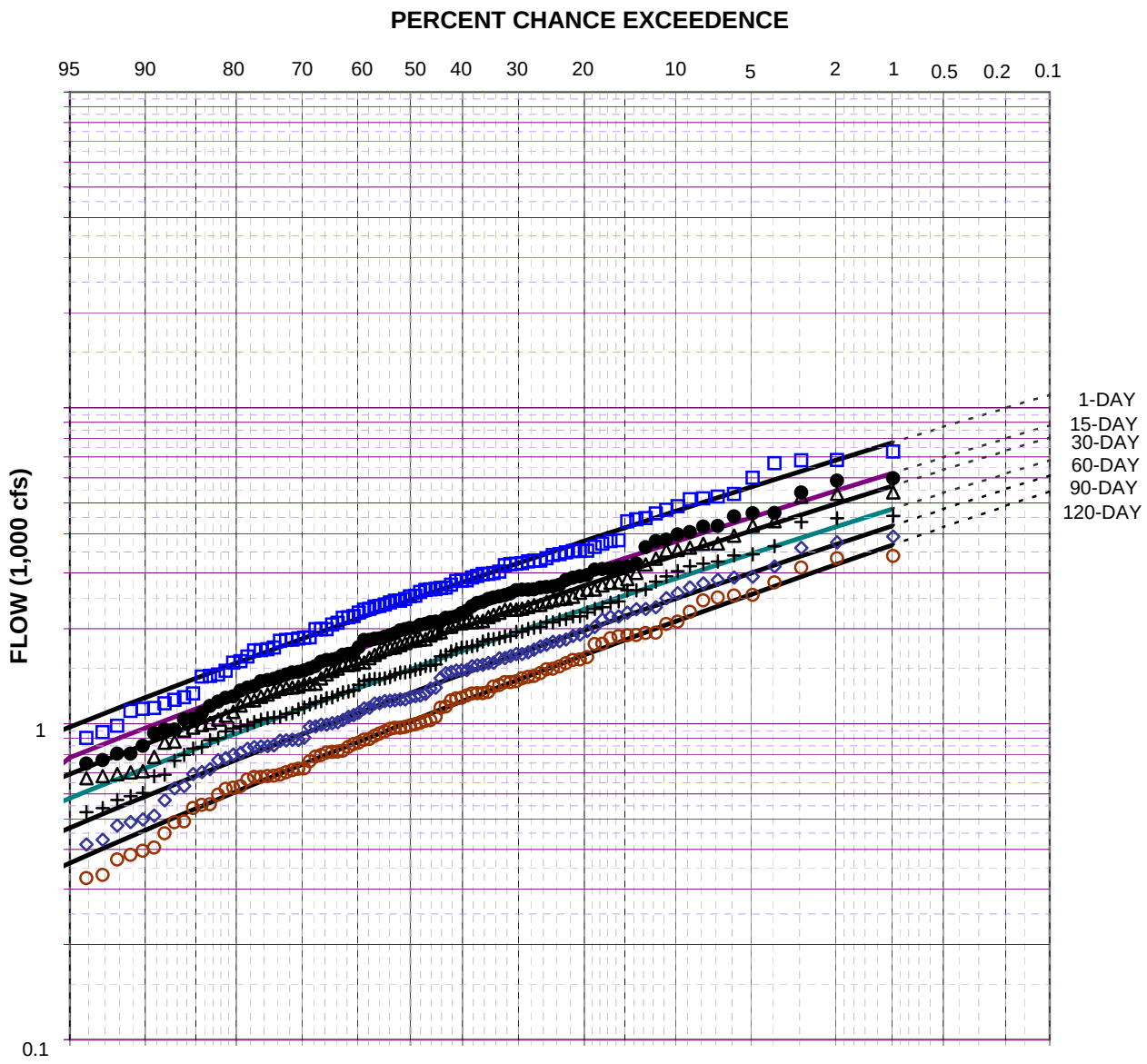
(UNREGULATED CONDITIONS)

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE 8-8



CURVE STATISTICS	CURVE	MEAN	STD DEV	ADOPTED SKEW
□	1-DAY	3.383	0.228	-0.20
●	15-DAY	3.286	0.228	-0.20
△	30-DAY	3.239	0.231	-0.20
+	60-DAY	3.164	0.232	-0.20
◇	90-DAY	3.088	0.242	-0.20
○	120-DAY	2.999	0.255	-0.20

NOTES:

1. Weibull plotting positions and expected probability adjustment applied based on 101 years of record.
2. Drainage Area: 561 sq. mi.
3. Period of record: WY 1904-2004

Prepared by WLJ

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

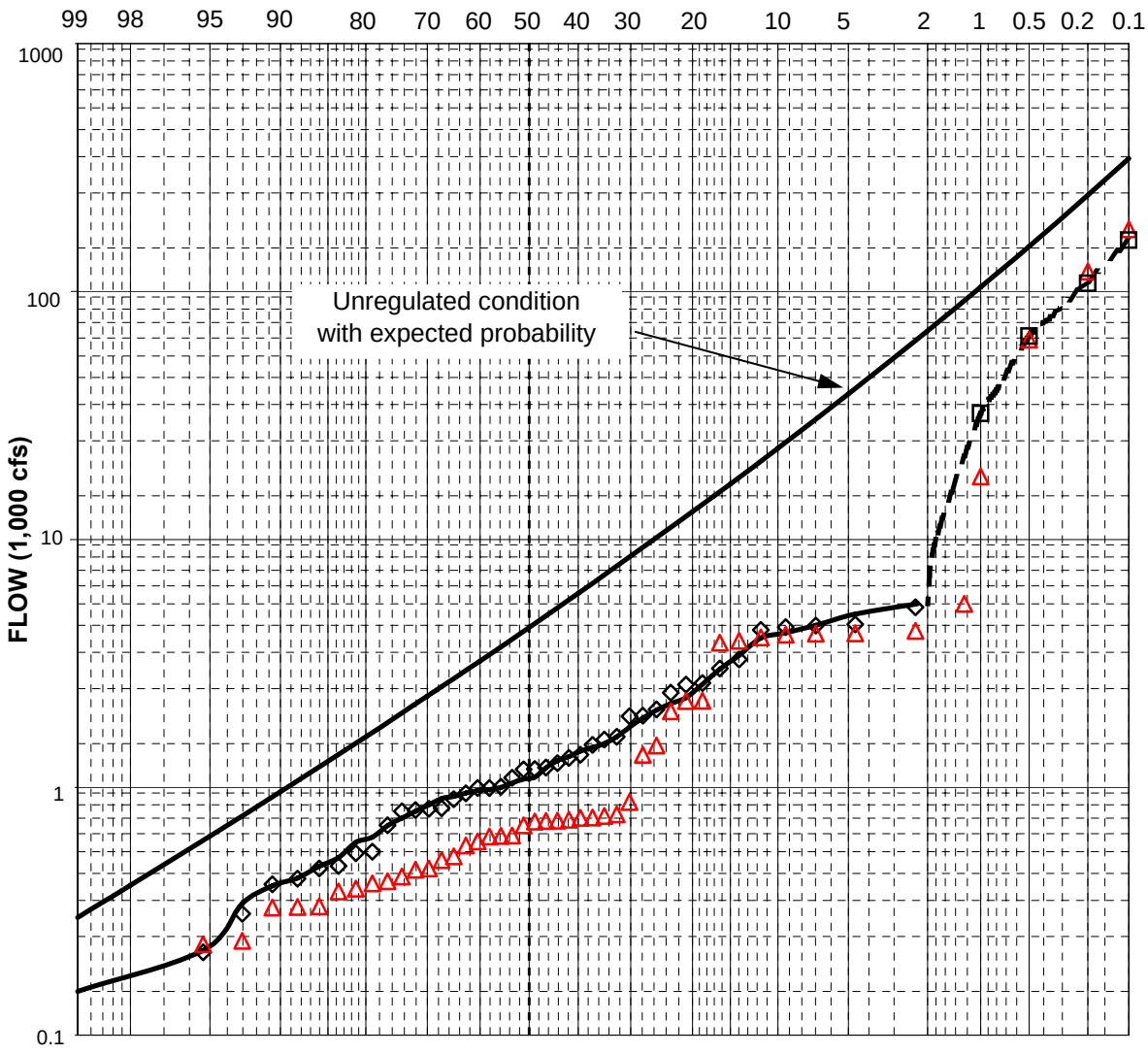
KAWEAH RIVER BELOW TERMINUS DAM
SNOWMELT FLOOD FREQUENCY CURVES

(UNREGULATED CONDITION)

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE 8-9



NOTES: 1. Drainage Area: 561 sq. mi.

2. Period of Record: 1963-2004

3. △ Hypothetical operation with raised spillway

4. ◊ Historical Operation

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

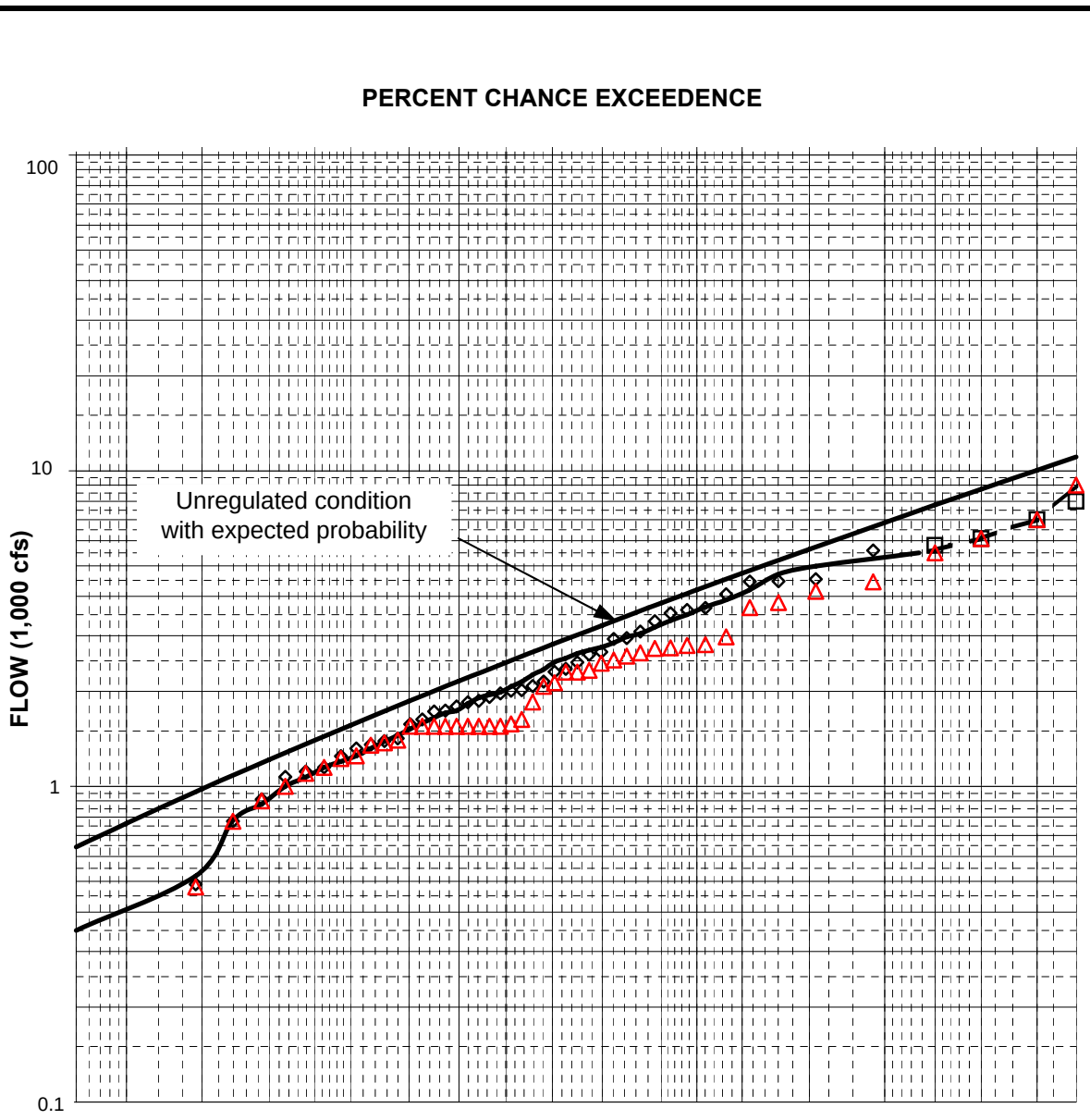
KAWEAH RIVER BELOW TERMINUS DAM
RAINFLOOD FREQUENCY CURVES
(REGULATED CONDITION)

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE 8-10



NOTES: 1. Drainage Area: 561 sq. mi.

2. Period of Record: 1963-2004

3. △ Hypothetical operation with raised spillway

4. ◊ Historical Operation

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

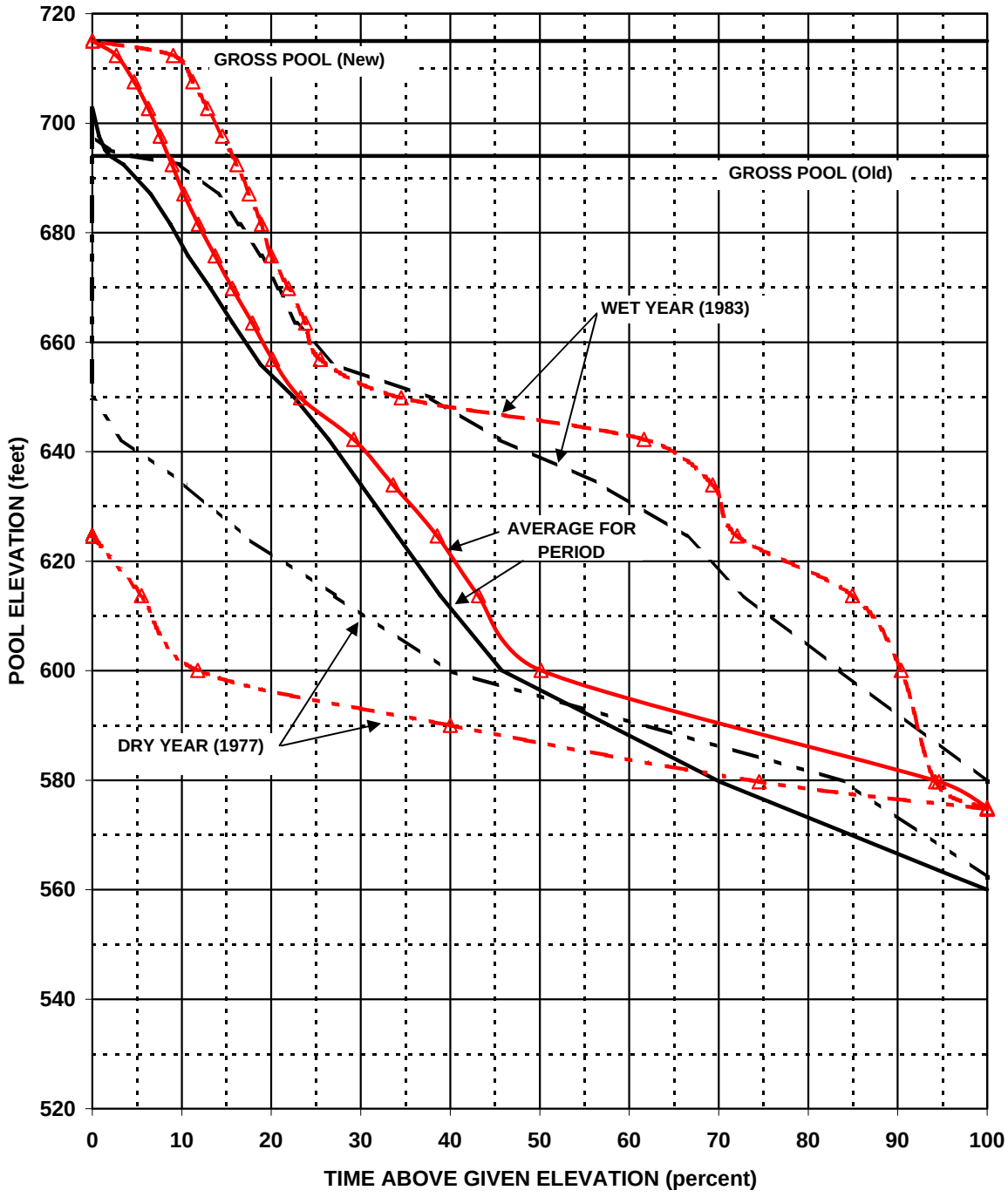
KAWEAH RIVER BELOW TERMINUS DAM
SNOWMELT FLOOD FREQUENCY CURVES
(REGULATED CONDITION)

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE 8-11



NOTES:
1. Drainage area 561 sq. mi.
2. Period of record: 1963-2003
3. △Hypothetical operation with raised spillway shown in red

Prepared by WLJ

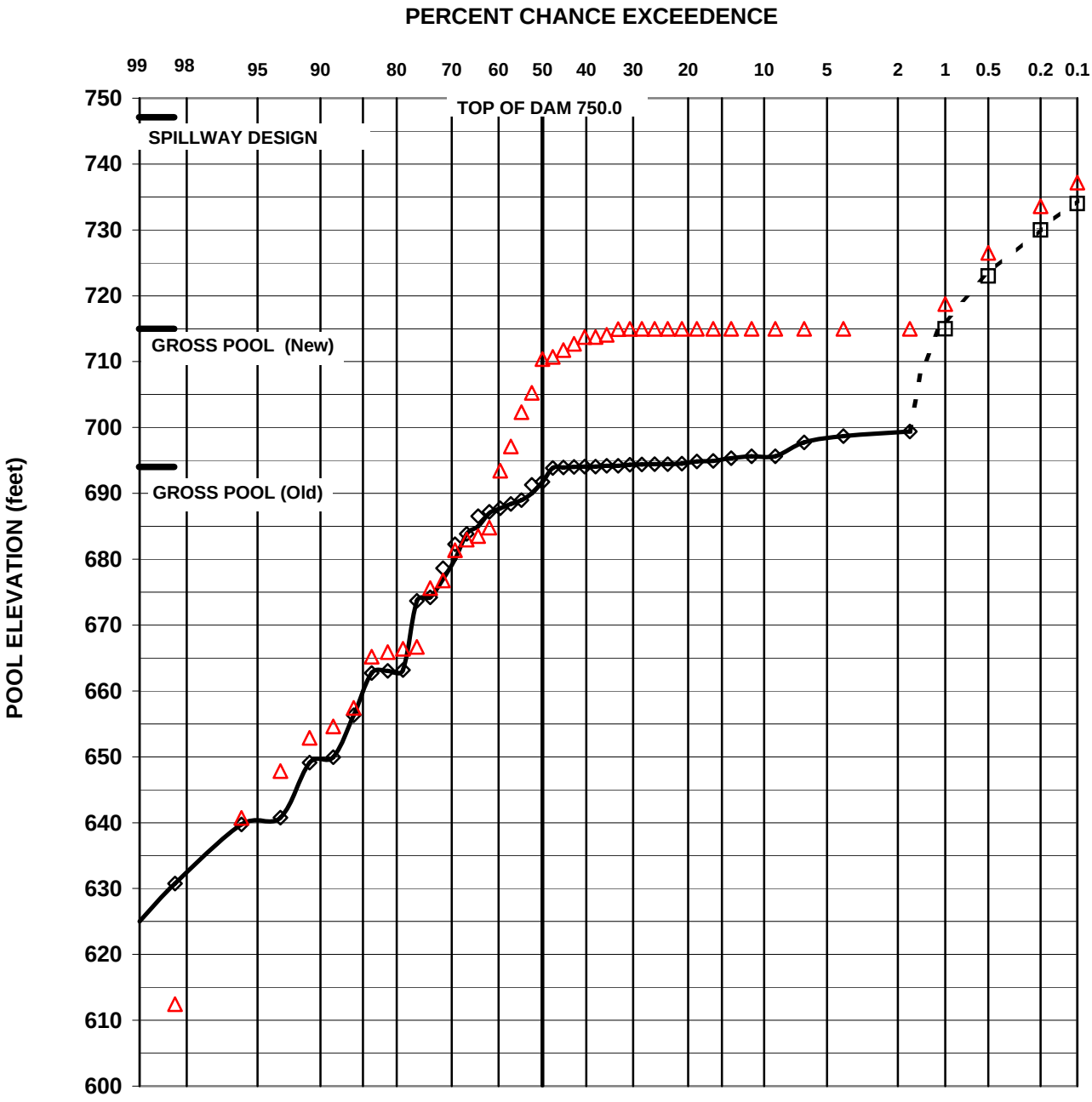
TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

POOL ELEVATION-DURATION CURVES

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE 8-12



NOTES:

1. Drainage area 561 sq. mi.
2. Period of record: 1963-2003
3. △ Hypothetical operation with raised spillway
4. ◊ Historical operation

Prepared by WLJ

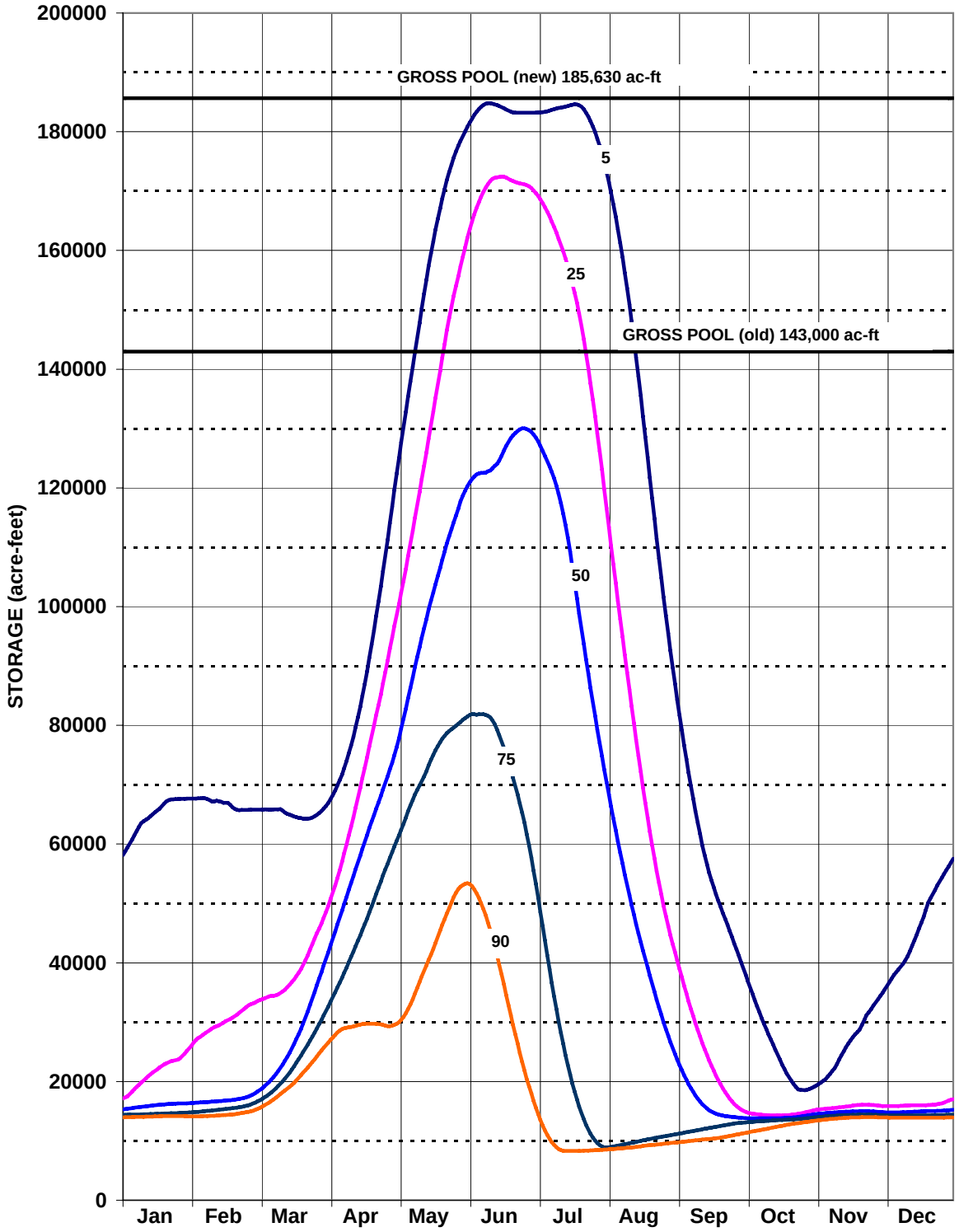
TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

POOL ELEVATION-FREQUENCY CURVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE 8-13



NOTES:

1. Hypothetical operation with raised spillway.
2. Lines represent percent of time storage is exceeded on a given date.
3. Period of Record: 1963-2003

Prepared by WLJ

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

SEASONAL VARIATION OF STORAGE FREQUENCY

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

WATER CONTROL MANUAL

TERMINUS DAM AND LAKE KAWEAH

Kaweah River
California

EXHIBIT A

STANDING INSTRUCTIONS TO PROJECT OPERATORS
FOR
TERMINUS DAM AND LAKE KAWEAH

U.S. Army Corps of Engineers
Sacramento District
Sacramento, California

June 1962
Revised November 1971
Revised July 2005

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EXHIBIT A

STANDING INSTRUCTIONS TO THE PROJECT OPERATORS
FOR
TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

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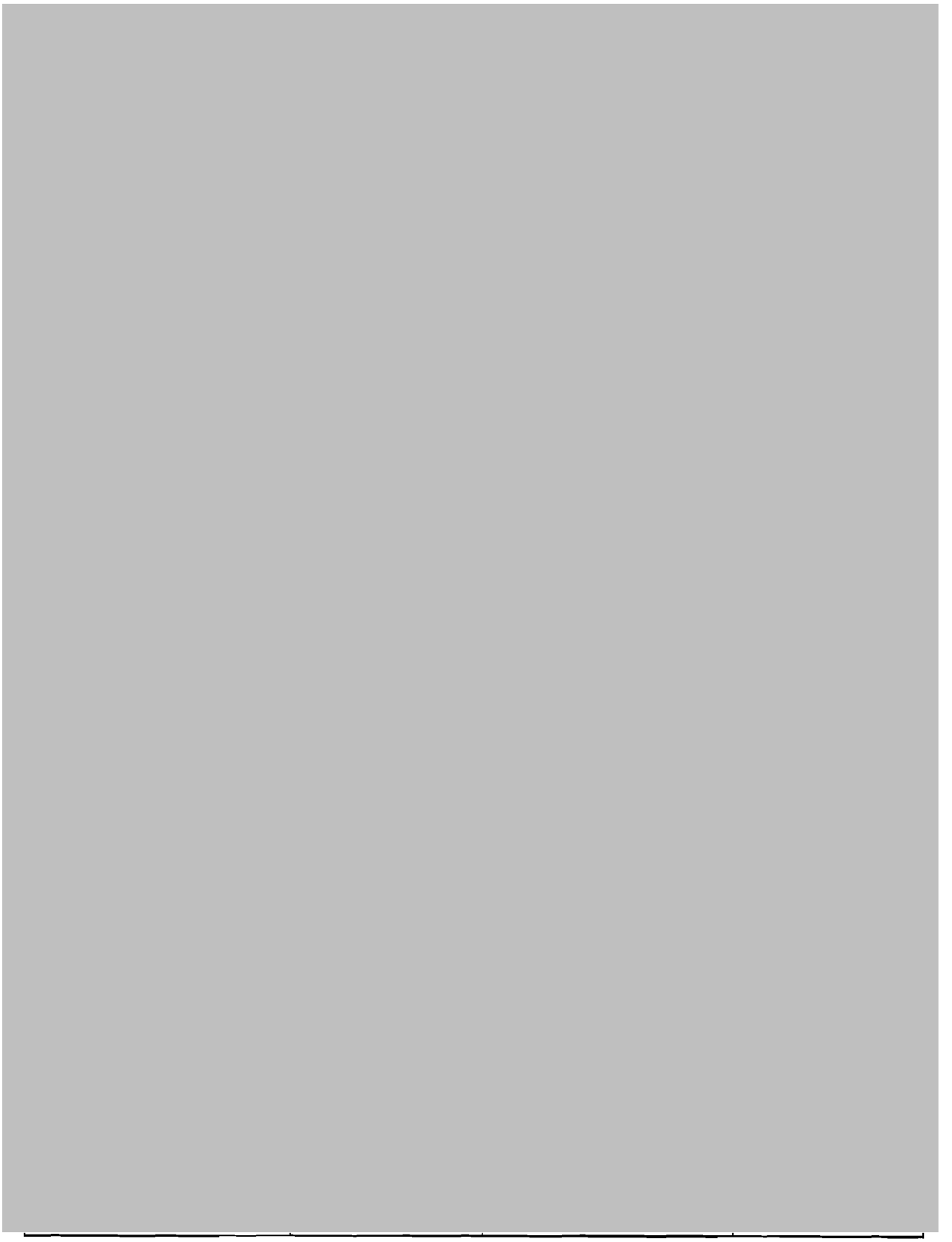

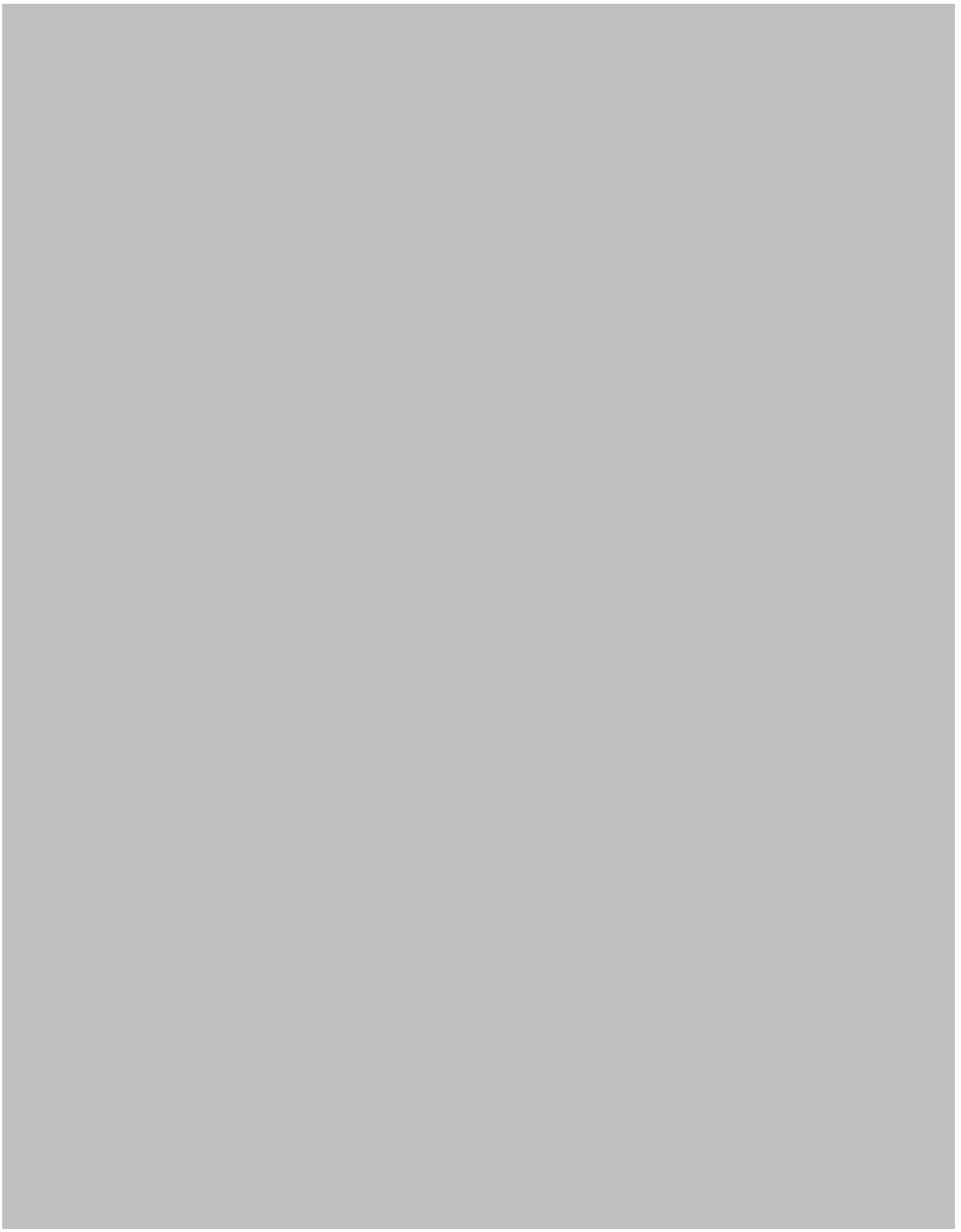

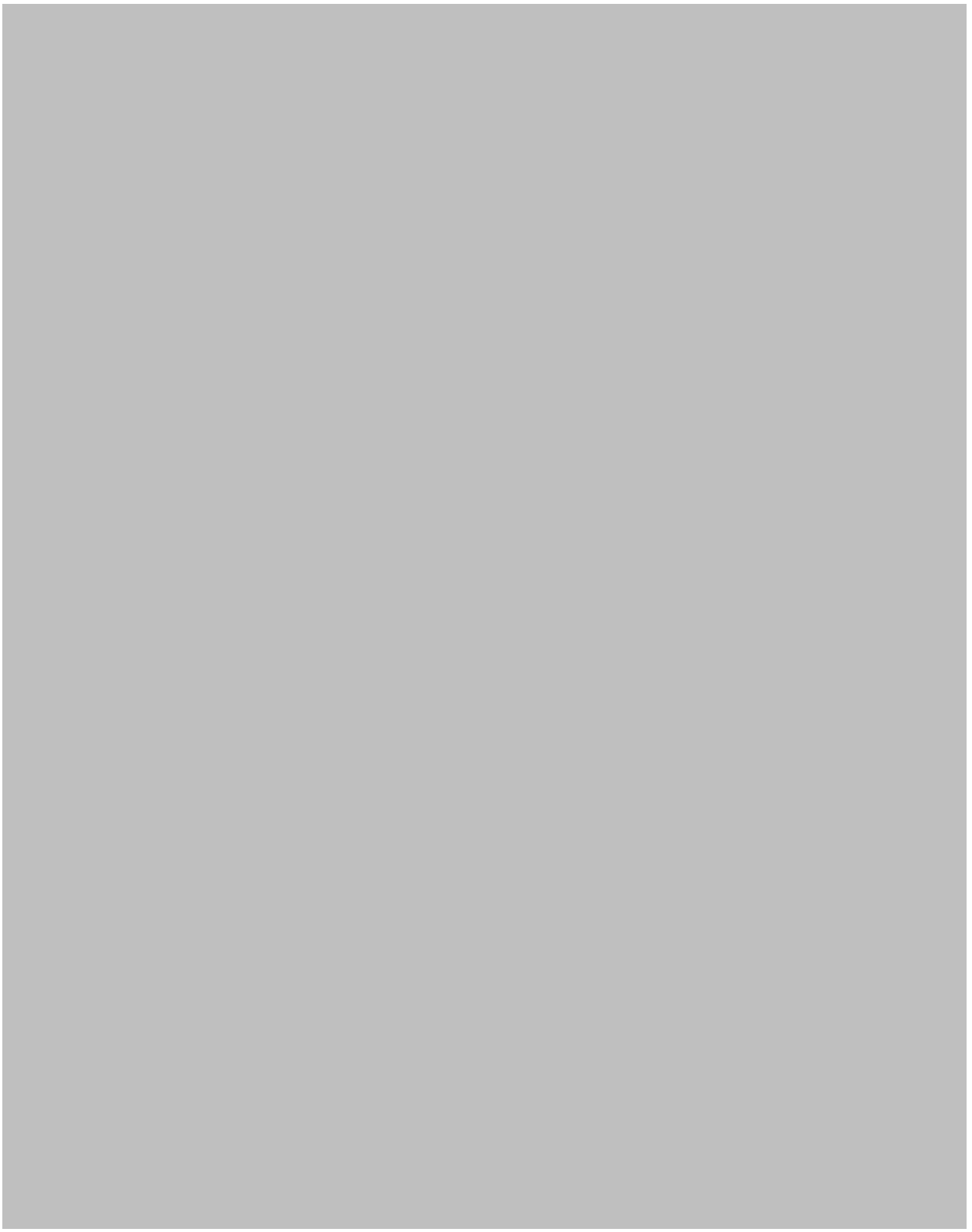

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OPERATIONAL DATA REQUIREMENTS

TERMINUS DAM / LAKE KAWEAH, KAWEAH RIVER, CALIFORNIA

DISTRICT PHASE SPK SUP A to ER 500-1-1 Chapter 4	PROJECT PHASE	PROJECT STATUS CRITERIA	PROJECT BASIN CONDITION	HYDRO-METEOROLOGICAL DATA REQUIREMENTS*
NORMAL OPERATIONS	IV	Daily inflow less than 500 cfs	No flood threat	Daily data obtained from WCDS at 2400 hrs seven days a week
		Daily inflow greater than or equal to 500 cfs and less than 1,500 cfs	Forecast storms with potential flood control space encroachment	Daily data obtained from WCDS at 2400 hrs seven days a week
EMERGENCY OPERATIONS	III	Daily inflow greater than or equal to 500 cfs and less than 1,500 cfs or flood control encroachment of 25% or greater	Forecast storms with flood control space encroachment	Daily data same as for II plus short period data from WCDS at 0600, 1200, 1800, & 2400 hrs
		Inflow greater than or equal to 1,500 cfs and/or flood control encroachment of 25% or greater	Storm in progress with flood control space encroachment, flood control releases are being made from reservoir	Daily data same as for II plus short period data from WCDS every 2 hours at 0200, 0400, 0600 etc.
PARTIAL ACTIVATION	II	Declared Emergency	Severe flood threat, flood flows occurring, emergency declared by District Engineer	Daily data same as for II plus short period data from WCDS every 2 hours at 0200, 0400, 0600 etc.
FULL ACTIVATION	I	Declared Emergency	Emergency declared by District Engineer	Daily data checked hourly

*OPERATION DATA:

(1) All data to be obtained from the Water Control Data System (WCDS) or any of its components.

(2) If the WCDS is inoperative, project personnel are to obtain and furnish data from whatever sources are available, as outlined in the Water Control Manual, Exhibit A, Section A-02a(2).

Revised January 2016

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EXHIBIT A

STANDING INSTRUCTIONS TO PROJECT OPERATORS
FOR
TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

A-01. Background and Responsibilities

a. General Information

(1) "Standing Instructions to Project Operators for Water Control" are essential to ensure efficient and safe operation of the project at all times. Any physical operating constraints should be within design limitations and clearly outlined to ensure that water control features are operated in a safe manner during all phases of the project's life, including the construction phase.

This exhibit to the "Terminus Dam and Lake Kaweah, Kaweah River, California, Water Control Manual" is prepared in accordance with instructions contained in EM 1110-2-3600, Management of Water Control Systems, Paragraph 9-2, (Standing Instructions to Project Operators for Water Control) and ER 1110-2-240, Engineering and Design—Water Control Management. All elevations in this manual are based on the National Geodetic Vertical Datum of 1929 (NGVD29). As directed by EM 1110-1-1004, Geodetic and Control Surveying, the datum has been changed to the North American Vertical Datum of 1988 (NAVD88). However, the elevations in this manual do not reflect NAVD88.

This exhibit pertains to duties and responsibilities of the Project Operator in connection with the functional operation of Terminus Dam and Lake Kaweah, and the reporting of required hydrologic data. A copy of these Standing Instructions must be kept on hand at all times by the Project Operator. Any deviation from the Standing Instructions will require approval of the District Engineer or designee.

Operation and maintenance of the project is performed by the Corps of Engineers. Operational instructions to the Project Operator are briefly outlined with specific emphasis on the Project Operator's duties and responsibilities during extreme flood emergencies. Exhibit A is designed to be a stand-alone document used independently as the flood control regulation guide or as published, in conjunction with the Water Control Manual. To facilitate independent use of this exhibit, all plates required for water control operation of Terminus Dam and Lake Kaweah, Plates A-1 through A-13, are included herein.

(2) Terminus Dam and Lake Kaweah will be operated for flood control in accordance with the Water Control Plan, Plate A-13, which defines the requirements for water control operation of Terminus Dam. Terminus Dam is operated to restrict flood releases and

flows to non-damaging levels to the Kaweah River downstream from the dam, insofar as possible, without endangering the safety of the structure. The flood control objectives in terms of storage and release limitations are as follows:

(a) Provide the maximum practical amount of storage for conservation of irrigation water without impairment of flood control functions of the reservoir. No flood control reservation shall be required during the month of August.

Physical limitations on storage are as follows:

TABLE A-1
STORAGE LIMITATIONS

Storage (acre-feet)	Water Surface Elevation (ft MSL)	Flow Over Spillway (cfs)	Remarks
33	520.0	0	Dead Pool
185,630	715.0	0	Gross Pool
261,262	747.12	308,418	Spillway Design Flood Pool

(b) Restrict flows in the Kaweah River to non-damaging flows of 5,500 cfs at McKay Point. Releases from Terminus Dam must be made with due allowance for the Dry Creek near Lemoncove local flow below Terminus Dam.

(3) The responsibility for operating Terminus Dam and Lake Kaweah is delegated to units of the Engineering Division and Construction-Operations Division of the Sacramento District, Corps of Engineers. The Park Manager is responsible for the physical operation of the reservoir in accordance with the instructions contained in this manual as issued by the Water Management Section, Sacramento District, Corps of Engineers.

(4) The Terminus Dam and Lake Kaweah Project is located on the Kaweah River, approximately 21 miles east of the city of Visalia in the southern half of the Central Valley. The location of the project is shown on Plate 2-1.

(5) The criteria for operation of Terminus Dam and Lake Kaweah are summarized on the Water Control Diagram shown on Plate A-13. The drawdown of the lake for flood control was established from zero space reservation on 1 September to a maximum of 185,630 on 15 November. Beginning on 10 November, the required flood control reservation is a function of the ground wetness index. Beginning 1 March, the required flood control reservation is a function of the ground wetness index and/or the forecasted snowmelt runoff. The

ground wetness index equation and calculation parameters reflect the flood potential of the basin above the project. Strict compliance with the indicated flood control requirements is necessary to assure fulfilling the flood control objectives of the Terminus Dam and Lake Kaweah Project, while simultaneously allowing for conservation storage that must be filled with winter rainfall and snowmelt runoff. No flood control reservation shall be required during the month of August.

b. Role of the U.S. Army Corps of Engineers. The primary responsibility for operating Terminus Dam and Lake Kaweah Project is delegated to the Water Management Section, (Engineering Division) and Operation and Readiness Branch (Construction-Operations Division) of the Sacramento District, U.S. Army Corps of Engineers, as outlined below. The Sacramento District's Public Affairs Office (PAO) coordinates with local press regarding floods and other aspects of the project operation. Names, addresses, and telephone numbers of those individuals whose responsibilities are outlined in the following paragraphs are listed in the front of this manual and in this exhibit.

(1) Water Management Section (Engineering Division). The Water Management Section responsibilities are as follows:

(a) Obtaining current hydrometeorological data and weather forecasts for the region.

(b) Analyzing current reservoir information, hydrometeorologic data, and weather forecasts for the region, making regulation decisions which are in accordance with the approved Water Control Plan, and issuing appropriate operating instructions to the designated damtender.

(c) Providing training to the Project Operators in the Water Control Plan, operations procedures, and instrumentation.

(d) Providing maintenance for hydrometeorological instrumentation and gage control equipment at the project, and supervising its operation.

(e) Preparing monthly operation reports and other reports about the operation of the project as requested by the Office, Chief of Engineers, and as needed for operational purposes.

(f) Making revisions to this Water Control Manual and distributing them.

(g) Advising the District Engineer whenever there has been a departure from operating instructions, or when there is a need for making a temporary modification to those instructions.

(h) Staying informed at all times of downstream channel conditions and

making periodic field inspections.

(i) Arranging with local interests for collection of flow and diversion data.

(j) Obtaining from local interests each month a summary of requested flows and maintaining a record of the instructions issued, data transmitted to other agencies, and requests received from other agencies.

(k) Keeping the Kaweah Delta Water Conservation District and other local interests continuously advised of the operation of the project.

(2) Terminus Dam and Lake Kaweah Park Manager (Construction-Operations Division) has the following responsibilities:

(a) Keeping well informed of the operating rules contained in this Water Control Manual and bringing to the attention of the Water Management Section any feature of the manual that may require clarification or revision.

(b) Keeping familiar with the operation of all recording and communication equipment and keeping informed of current hydrological and meteorological conditions (i.e., pool elevation, river flows, precipitation, etc.). Reporting by radio, telephone, or e-mail to the Water Management Section the data outlined in this exhibit.

(c) Accomplishing the physical operation of the dam in accordance with instructions contained in this manual, or as issued by the Water Management Section. During storms, this may require 24-hour attendance at the dam.

(d) Calculating and maintaining a continuous record of inflow, outflows, storage, Dry Creek flow, weather data, and other data specified by the Water Management Section.

(e) Reporting any unusual conditions of the dam embankment, the reservoir, and the downstream channel of the Kaweah River that might interfere with the planned operation of the reservoir.

(f) Obtaining necessary information on scheduled downstream irrigation and downstream spreading activities, and keeping local interests continually advised of the routine operation of the reservoir.

(g) Maintaining a log of gate operation containing the following information: change in position of gates, date and time when such changes are made, reservoir water level, and initials of the individual accomplishing the change.

(h) Maintaining records of instructions received from Water Management Section and requests from the Kaweah Watermaster.

(i) Making and recording weekly checks on reservoir and flow gage readings to assure proper operation of all recording equipment.

(j) Immediately after the end of each month, transmitting to the Water Management Section the data specified in Exhibit A.

(k) Making emergency operational changes when contact with the Water Management Section is broken and a clearly defined change occurs that warrants immediate action.

(l) Assisting with obtaining samples for water quality and sedimentation analysis, as required.

(3) Operations and Readiness Branch (Construction-Operations Division) has the responsibly of budgeting project operation and maintenance funds.

c. Other Federal Agencies

(1) The Bureau of Reclamation (BOR) acts as the agent for the United States in the execution of the repayment contract , wherein water users are repaying a percentage of the capital for the construction of Terminus Dam with annual operational and maintenance costs. BOR is also responsible for the marketing and administration of project water supply.

(2) The National Oceanic and Atmospheric Administration (NOAA), through its National Weather Service (NWS), maintains year-round surveillance of weather conditions. NOAA weather and storm forecasts, pertinent to the area, are furnished to the NWS office in Sacramento for distribution to agencies responsible for flood protection. The NWS furnishes meteorological data and weather forecasts on a 24-hour basis. When the meteorological situation indicates general area precipitation, NWS furnishes Quantitative Precipitation Forecasts (QPF). (See Paragraph 6-01b.)

(3) Personnel from the NWS office in Sacramento and the California Department of Water Resources are assigned to the Joint Federal-State River Forecast Center (RFC), which monitors weather conditions and river stages on a year-round basis. The RFC forecasts stages and flows on major river systems, including inflow to Lake Kaweah on the Kaweah River.

(4) The Federal-State Flood Operations Center furnishes flood warnings and forecasts of river stages and flows to the local news media, law enforcement agencies, and other responsible agencies for their use and for dissemination to the public.

d. State and County Agencies

(1) The California Department of Fish and Game enforces fish and game laws on the lake and within the wildlife area. They also stock the lake with fish.

(2) The California Division of Forestry is responsible for firefighting on project land.

(3) The County of Tulare provides normal law enforcement at the project and patrol of the lake by boat. During periods of peak visitation, additional law enforcement is provided under a contract with the Corps.

(4) The Kaweah Delta Water Conservation District directs the use of conservation storage in Lake Kaweah and manages the mitigation areas that are not located on the U.S. Army Corps of Engineers property.

e. Private Organizations. None.

A-02. Data Collection and Reporting

a. Normal Conditions

(1) During normal operation, a daily operation report is produced by the Water Management Section, Sacramento District. The Corps of Engineers Reservoir Report includes the following information on project operation:

(a) Pool elevation as of midnight
(b) Reservoir storage as of midnight
(c) Reservoir storage change from midnight to midnight
(d) Reservoir mean daily outflow as of midnight
(e) Reservoir mean daily inflow as of midnight
(f) Daily precipitation at project as of midnight
(g) Dry Creek near Lemoncove flow as of midnight
(h) Kaweah River at Three Rivers flow as of midnight
(i) Kaweah River at McKay Point flow as of midnight
(j) Cross Creek at Houston flow as of midnight
(k) Yokohl Creek at Garcia Bridge flow as of midnight

(2) All data will be obtained from the HADA (Hydrometeorological Automatic Data Acquisition) System. If the HADA System is inoperative, the reservoir operator shall report the following data by radio or telephone to the Water Management Section each workday prior to 0730 hours. This reporting includes:

(a) Reservoir elevation and storage at midnight
(b) Pan evaporation as of 0700 hours
(c) Mean daily outflow (ending at midnight) of Kaweah River below Terminus Dam
(d) Total inflow to the reservoir
(e) Daily precipitation at the dam as measured at 0700 hours
(f) Flows as of 0700 hours for Dry Creek near Lemoncove, Kaweah River at Three Rivers, Kaweah River at McKay Point, Cross Creek at Houston, and Yokohl Creek at Garcia Bridge
(g) Climatological gage readings for precipitation at Atwell, Beartrap Meadow, Giant Forest, and Hockett Meadow (if possible)
(h) Climatological gage readings for snow at Giant Forest

(3) When conditions do not warrant weekend or holiday reports, complete reports for each day shall be made on the first day following the non-reporting period. More frequent reports of the above information, and reports of other Kaweah River data, will be made in the same manner when requested by the Water Management Section. A summary of Operational Data Requirements is shown at the front of this exhibit.

(4) Immediately after the end of each month, the reservoir operator will send all original forms used for observations and computations to the Water Management Section. These forms include:

(a) Daily Reservoir Computation Sheet
(b) Record of Evaporation and Climatological Observations
(c) Bi-hourly and Mean Daily Flows at Kaweah River below Terminus Dam
(d) Bi-hourly and Mean Daily Flows at Foothill Ditch
(e) Bi-hourly and Mean Daily Flows at Hawkeye Ditch
(f) Bi-hourly and Mean Daily Flows at Lemoncove Ditch
(g) Log of Gate Operations
(h) Log of Messages and Instructions

(5) Mean Daily Release from the reservoir is computed as follows:

(a) Tabulate gage height readings at even hours, starting with 0200 hours.

(b) Enter current rating table using shifts, as applicable, and determine and list flow at each odd hour using the procedure indicated for mean daily flow, step (e) below.

(c) Total the 12 flow readings and divide by 12. This is the mean daily flow.

(d) Mean flow will be listed to the nearest 0.1 cfs for flows up to 10 cfs, and to the nearest 1 cfs for flows above 10 cfs.

(e) When calculating discharge from gage height with a (-) shift correction, enter rating table below the actual height (i.e., if observed gage height is 4.86 and shift is -.02, enter rating table at 4.84 to obtain discharge). For (+) shift, enter rating table above observed gage height.

(f) In order to calculate the gage height for a desired flow under a (-) shift condition, add amount of negative shift to gage height obtained from table for desired discharge (i.e., if the shift is -.03, the desired discharge is 5,000 cfs. If the rating table shows a gage height of 10.20 = 5,000 cfs, the required gage height for 5,000 cfs is 10.20 + .03 = 10.23). For (+) shift, subtract amount of shift from gage height obtained from table for desired discharge.

(6) Evaporation from the Reservoir. Lake evaporation in inches is equal to the pan evaporation in inches multiplied by the evaporation coefficient shown on Plate A-11, divided by 12. For this computation, pan evaporation measured at 12:00 midnight is used to compute lake evaporation for the previous day. Lake evaporation in cfs is computed using the following formula:

$$\text{Pan Evaporation (inches)} \times \frac{\text{Gross Evaporation Coefficient}}{12} \times \text{Avg. Lake Area (acres)} \times 0.50417^{*}$$

$$= \text{mean cfs for 24-hours.}$$

* The coefficient shown is for a 24-hour day. When changing to or from daylight savings time, the coefficients are as follows: for a 23-hour day (change to D.S.T.) use 0.52609, for a 25-hour day (change from D.S.T.) use 0.48400.

Lake area used when computing evaporation will be the average area for the day; this is obtained by averaging the midnight areas at the beginning and ending of the period being computed.

(7) Inflow to the Reservoir. Computed mean daily inflow to the lake will be taken as the algebraic sum of the mean outflow, change in lake storage, and evaporation for the lake water surface, and will represent mean daily inflow to the lake from all sources including rainfall on the lake surface.

$$\text{Mean Daily Outflow (cfs)} + \text{Change in Lake Storage (sfd)} + \text{Evaporation (sfd)} = \text{Mean Daily Inflow (cfs)}$$

(8) Basin Mean Precipitation. The approximate basin mean precipitation is computed by multiplying the sum of the precipitation at representative rain gages by the conversion factor for the basin and gages. The conversion factor is computed by dividing the

basin Normal Annual Precipitation (NAP) by the sum of the NAP's for the rain gages. The computation of the conversion factor for the Kaweah River Basin and the rain gages is shown in Table A-2.

TABLE A-2
BASIN MEAN PRECIPITATION

STATION	GAGE MEAN ANNUAL PRECIPITATION
Atwell	40.68
Bear Trap Meadow	47.45
Giant Forest	41.28
Hockett Meadow	40.56
Terminus Dam	15.10
SUM	185.07
KAWEAH RIVER BASIN NAP = 36.6	
BASIN CONVERSION FACTOR = 36.6/185.07 = 0.20	
Source: U.S. Army Corps of Engineers, Sacramento District, Water Management Section	

(9) Basin Wetness Parameter. The basin wetness parameter (PAR) is the basin mean precipitation (BMP) for that given day plus 97 percent of the previous day's wetness parameter (PAR'). The parameter is reset to zero on 1 September. A sample computation of PAR is shown below.

Given: Station precipitation for 14 December

Terminus Dam	1.69
Atwell	4.40
Bear Trap Meadow	5.00
Giant Forest	4.60
Hockett Meadow	4.00

(computation continued on next page)

Data for BMP, PAR, and PAR' for period 12 Dec through 13 Dec. and computed 14 December data.

Date	BMP (in)	.97 PAR' (in)	PAR (in)
12 Dec	0.10	3.73	3.74
13 Dec	2.45	3.63	6.08
14 Dec	3.94	5.90	9.84

BMP = Basin conversion factor x daily station precipitation
BMP = 0.20 x 19.69 = 3.94
PAR = BMP + 0.97 (PAR')
PAR = 3.94 + 0.97 (6.08) = 3.94 + 5.90 = 9.84

b. Emergency Conditions. For flood events and other emergency conditions, the information in Paragraph A-02a will also apply (see the Operational Data Requirements at the front of this exhibit). The maximum design release (channel capacity) of 5,500 cfs will not be intentionally exceeded. If flows over the spillway occur, gate releases will be curtailed to maintain a flow of 5,500 cfs or less at McKay Point for as long as possible. An emergency notification plan is maintained at the Terminus Dam and Lake Kaweah Project Office. The Emergency Seismic Action Plan for Terminus Dam and Lake Kaweah is shown in Exhibit D.

c. Regional Hydrometeorological Conditions. During the flood season (1 October to 31 July), the reservoir operator shall call the Water Management Section whenever any of the following occurs:

(1) One inch or more of rainfall occurs at the project during any 6-hour period, or 1.5 inches of rainfall during any 24-hour period.

(2) An increase in flow of 1,000 cfs or more at the Kaweah River at Three Rivers gaging station during any 8-hour period. A rating curve for the Kaweah River at Three Rivers gaging station is shown on Plate A-6.

Any special report based on one of the above criteria should include the latest available data concerning the other item. On non-working days or nights, these special reports should be telephoned directly to the Chief of the Water Management Section or his designated alternate. The Project Operator will be informed by a Water Manager of any regional hydrometeorological conditions that could impact the structure.

A-03. Water Control Action and Reporting

a. Normal Conditions. Plate A-13 depicts flood control space and flood management requirements. Flood management operation is under the direction of the Water Management Section, Sacramento District, U.S. Army Corps of Engineers. During flood periods, close contact will be maintained between project and District personnel on a 24-hour basis, or as otherwise required.

(1) During non-flood periods, all inflow in excess of the releases requested by the Kaweah Delta Water Conservation District will be stored, depending on conservation space available.

(2) Releases of water stored for irrigation will be in accordance with the requests of the Kaweah Delta Water Conservation District, conforming to the mutual agreements and stipulations of the water users, unless prior release is required for flood management.

(3) During flood periods, inflows in excess of the release permitted by downstream controlling flow rates will be temporarily stored in the flood management space provided. Water thus stored in the flood control space will be released per the release schedules indicated on the Water Control Diagram (Plate A-13). The seasonal limits of flood control space are shown graphically in the Water Control Diagram.

(4) Outlet Gate Operation. Desired releases will be obtained from the power plant and/or Corps outlet gates. Release through the Corps gates are made by manipulating the gates until the appropriate stages are obtained, as indicated by the current rating curve for Kaweah River below Terminus Dam shown on Plate A-7. The outlet gate rating curves shown on Plate A-3 will be used as a guide in estimating gate openings for river outlet releases. Irrigation releases and flood releases, below the spillway level, will be regulated by the three 5.0-foot x 9.0-foot hydraulically operated slide gates and/or by the power penstock. However, for large releases, it is desirable to maintain approximately equal gate openings at the three gates, whenever feasible, in order to obtain smooth flow through the conduit.

(5) Spillway Surcharge Operation. Controlled surcharging of the reservoir occurs when there is sufficient water to spill at or near irrigation demands. As flows occur over the spillway, releases will be curtailed to maintain the objective flow at McKay Point. The maximum average irrigation release, 2,100 cfs, occurs in July. A spillway surcharge of approximately 1 foot would be required to obtain this flow. This storage could be obtained in about 33 percent of the water years. This operation will provide additional irrigation storage (2,160 acre-feet) and benefits for flood damage reduction for the downstream water users. Any surcharge operation would be coordinated between the Sacramento District, Corps of Engineers, and the Kaweah Delta Water Conservation District.

Minimum surcharging is required to operate the reservoir for gross pool, as diurnal effects, forecasted inflows, wind and wave runup, along with other factors, affect the ability to fill to gross pool without surcharging.

b. Emergency Conditions. During flood and other emergencies (see Section 7-13), the official regulations are subject to temporary modifications by the District Engineer or designee, Sacramento District, Corps of Engineers. The U.S. Army Corps of Engineers, Water Management Section, may direct that releases be increased or decreased from those required by the water management plan depending on conditions prevailing at the time. Permanent revisions of the water management criteria are subject to prior approval of the Chief of Engineers or designee.

c. Inquiries. All significant inquiries received from citizens, constituents, or interest groups regarding water management procedures or actions, must be referred directly to the Water Management Section, Sacramento District. Press inquiries must be referred to the Public Affairs Office (PAO), Sacramento District.

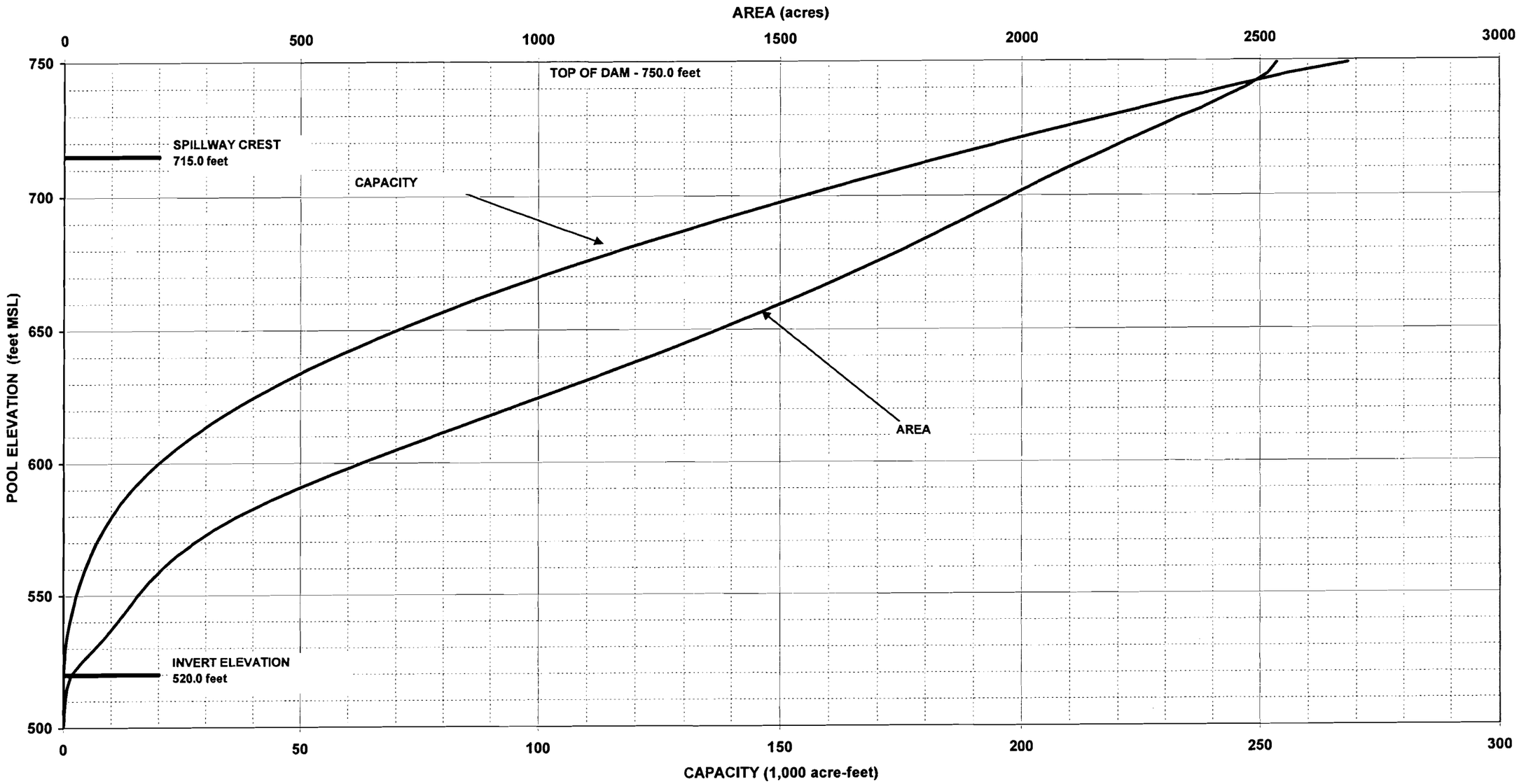
d. Water Management Problems. The Sacramento District, Water Management Section, must be informed immediately, by the most rapid means available, in the event that an operational malfunction, erosion, or an incident occurs that could impact project integrity in general or water management capability, in particular.

e. Communication Outage. During a flood emergency, if communication is broken between the operating personnel and the Water Management staff, continue releases in accordance with the last instructions received from the Water Management staff. However, every attempt should be made to reestablish communications. If communications cannot be reestablished, make releases in accordance with the Water Control Plan and Diagram on Plate A-13.

A-04. Deviation from Normal Regulation. Deviations from approved Water Control Plans occur because every possible circumstance cannot be accounted for in a Water Control Plan. Because of the often competing goals and complex interactions of interested groups/agencies, even seemingly inconsequential deviations from an approved plan can lead to unforeseen environmental and legal complications. The CESPD regulation, CESPD R 1110-2-8 dated 12 September 2002, serves to assist CESPK in preparing their deviation requests. It outlines a minimum set of considerations that need to be addressed when making a recommendation to deviate from an approved Water Control Plan.

Deviations from approved Water Control Plans are intended, therefore, to address unforeseen and unique circumstances. They are not intended as a means for identifying or initiating new opportunities to reoperate or reallocate storage in response to new and changing public needs.

Deviations are discussed in Exhibit B.



Note:
Area and capacity based on Area-Capacity Table dated September 1978.

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

AREA AND CAPACITY CURVES

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE A-1

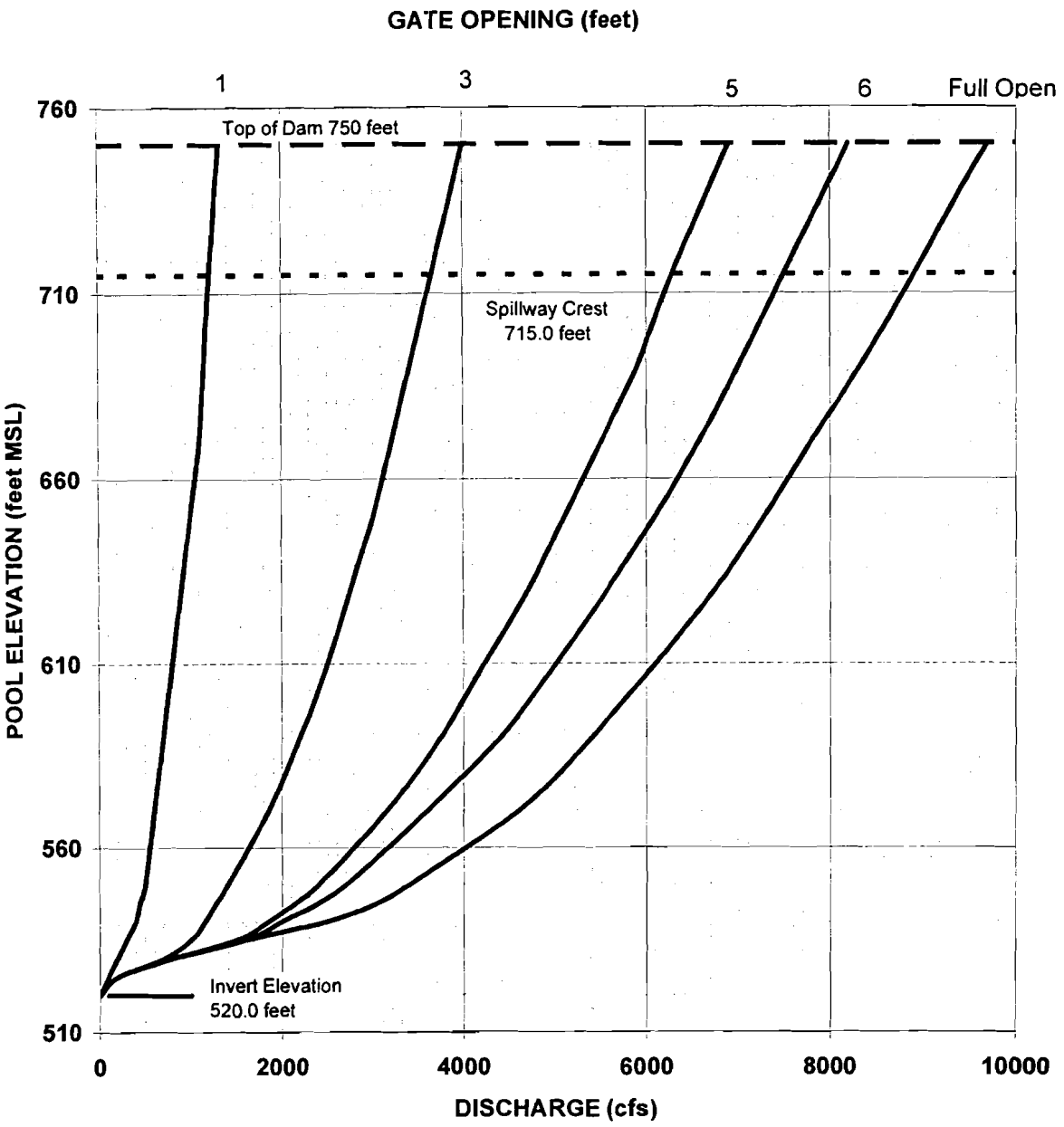
Terminus Dam and Lake Kaweah, Kaweah River, California
Area-Capacity Table
September 1978

ELEV	CAP AREA 0	CAP AREA 1	CAP AREA 2	CAP AREA 3	CAP AREA 4	CAP AREA 5	CAP AREA 6	CAP AREA 7	CAP AREA 8	CAP AREA 9
500	0	2	3	5	7	8	10	12	13	15
	0	1	2	2	2	2	2	3	3	4
510	17	18	20	21	23	25	26	28	30	31
	4	5	6	7	7	8	9	10	12	14
520	33	51	73	100	133	170	213	261	314	372
	16	20	25	30	35	40	45	51	56	61
530	436	505	579	659	743	832	926	1024	1127	1235
	66	72	77	82	87	91	96	101	105	110
540	1347	1463	1584	1709	1839	1972	2110	2252	2398	2548
	114	119	123	127	131	136	140	144	148	153
550	2703	2862	3026	3194	3367	3544	3727	3914	4107	4306
	157	161	166	170	175	180	185	190	196	201
560	4509	4719	4935	5157	5385	5620	5862	6110	6367	6631
	207	213	219	225	232	238	245	253	260	268
570	6903	7183	7471	7768	8074	8389	8714	9048	9393	9747
	276	284	293	301	311	320	329	339	349	360
580	10112	10488	10875	11273	11683	12104	12537	12983	13441	13911
	370	381	392	404	415	427	439	452	464	477
590	14394	14890	15400	15922	16459	17009	17573	18151	18743	19349
	490	503	516	529	543	557	571	585	599	614
600	19970	20605	21255	21920	22599	23294	24003	24728	25468	26223
	628	643	657	672	687	702	717	732	747	763
610	26993	27779	28579	29396	30227	31074	31937	32815	33708	34617
	778	793	809	824	839	855	870	886	901	916
620	35541	36481	37436	38406	39392	40393	41409	42440	43487	44549
	932	947	963	978	993	1009	1024	1039	1054	1069
630	45625	46717	47824	48946	50083	51234	52400	53581	54777	55987
	1084	1099	1114	1129	1144	1159	1174	1188	1203	1217
640	57212	48451	59704	60972	62254	63550	64861	66185	67523	68875
	1232	1246	1261	1275	1289	1303	1317	1331	1345	1359

Terminus Dam and Lake Kaweah, Kaweah River, California
Area-Capacity Table
September 1978

ELEV	CAP AREA 0	CAP AREA 1	CAP AREA 2	CAP AREA 3	CAP AREA 4	CAP AREA 5	CAP AREA 6	CAP AREA 7	CAP AREA 8	CAP AREA 9
650	70241	71621	73014	74421	75841	77275	78722	80183	81657	83144
	1373	1386	1400	1414	1427	1441	1454	1467	1480	1494
660	84644	86157	87683	89222	90774	92338	93915	95505	97107	98722
	1507	1520	1532	1545	1558	1571	1583	1596	1609	1621
670	100349	101989	103640	105304	106981	108669	110369	112081	113805	115541
	1633	1646	1658	1670	1682	1694	1706	1718	1730	1742
680	117289	119048	120819	122602	124396	126202	128019	129847	131687	133539
	1754	1765	1777	1788	1800	1811	1823	1834	1846	1857
690	135401	137275	139160	141057	142964	144883	146813	148754	150706	152670
	1868	1879	1891	1902	1913	1924	1935	1947	1958	1969
700	154644	156630	158627	160635	162655	164686	166728	168782	170847	172924
	1980	1991	2003	2014	2025	2037	2048	2059	2071	2082
710	175012	177112	179224	181347	183483	185630	187790	189962	192146	194343
	2094	2106	2118	2130	2142	2154	2166	2178	2190	2203
720	196552	198774	201008	203255	205516	207789	210075	212374	214687	217012
	2215	2228	2241	2254	2267	2280	2293	2306	2319	2332
730	219351	221703	224068	226447	228838	231242	233658	236087	238528	240981
	2345	2359	2372	2385	2398	2410	2423	2435	2447	2459
740	243445	245920	248405	250900	253404	255916	258435	260959	263489	266022
	2470	2480	2490	2499	2508	2516	2522	2528	2532	2534

Note:
Area = Acres
Capacity = Acre-Feet



NOTE:
Discharges given by the curves are for three 5' 10" x 9' 0" gates (openings identical)

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

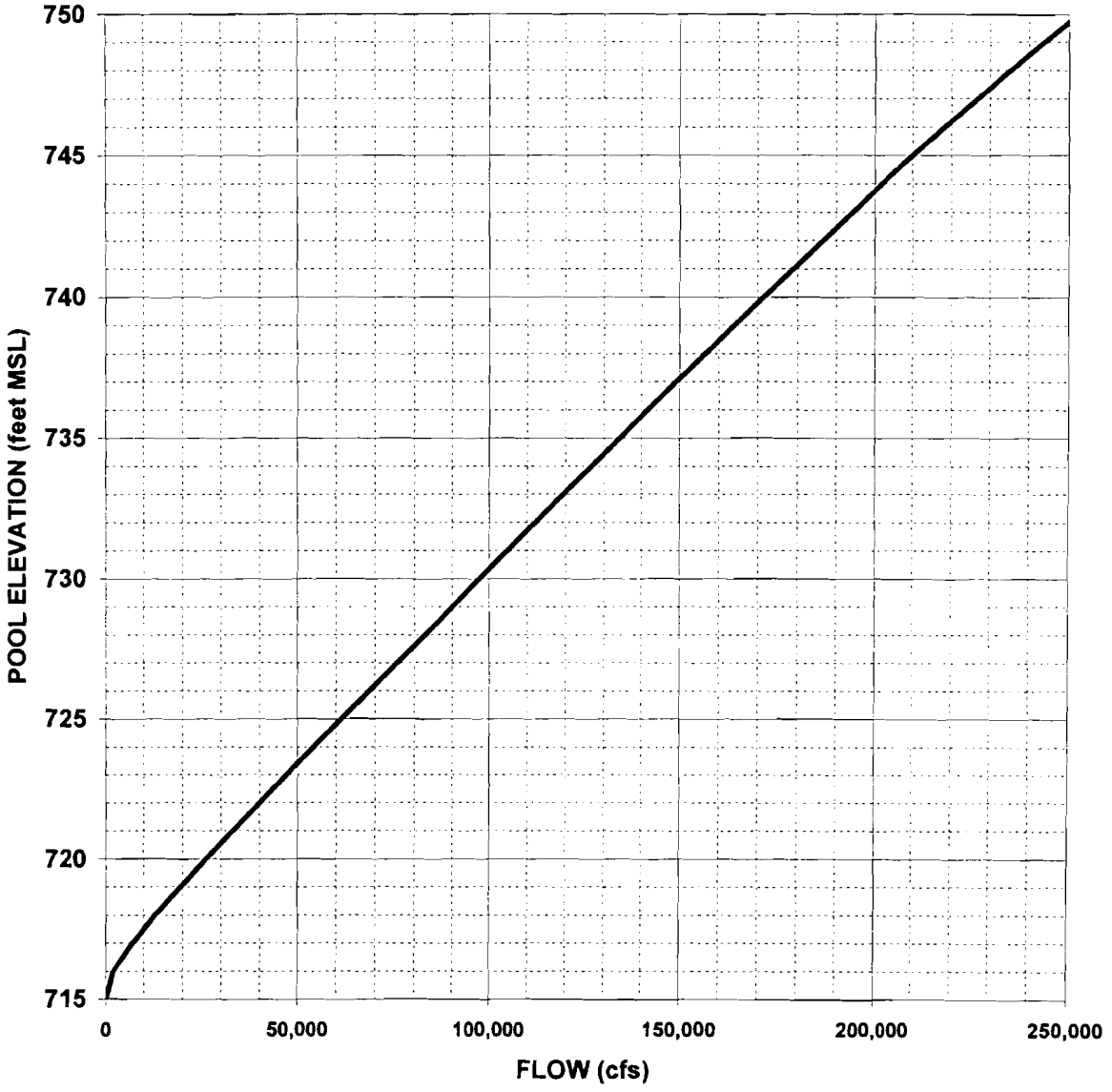
OUTLET RATING CURVES

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE A-3



NOTE:
Curve assumes all fusegates are intact.

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

SPILLWAY RATING CURVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE A-4

Terminus Dam and Lake Kaweah, Kaweah River, California
Spillway Rating Table
All Fusegates Intact

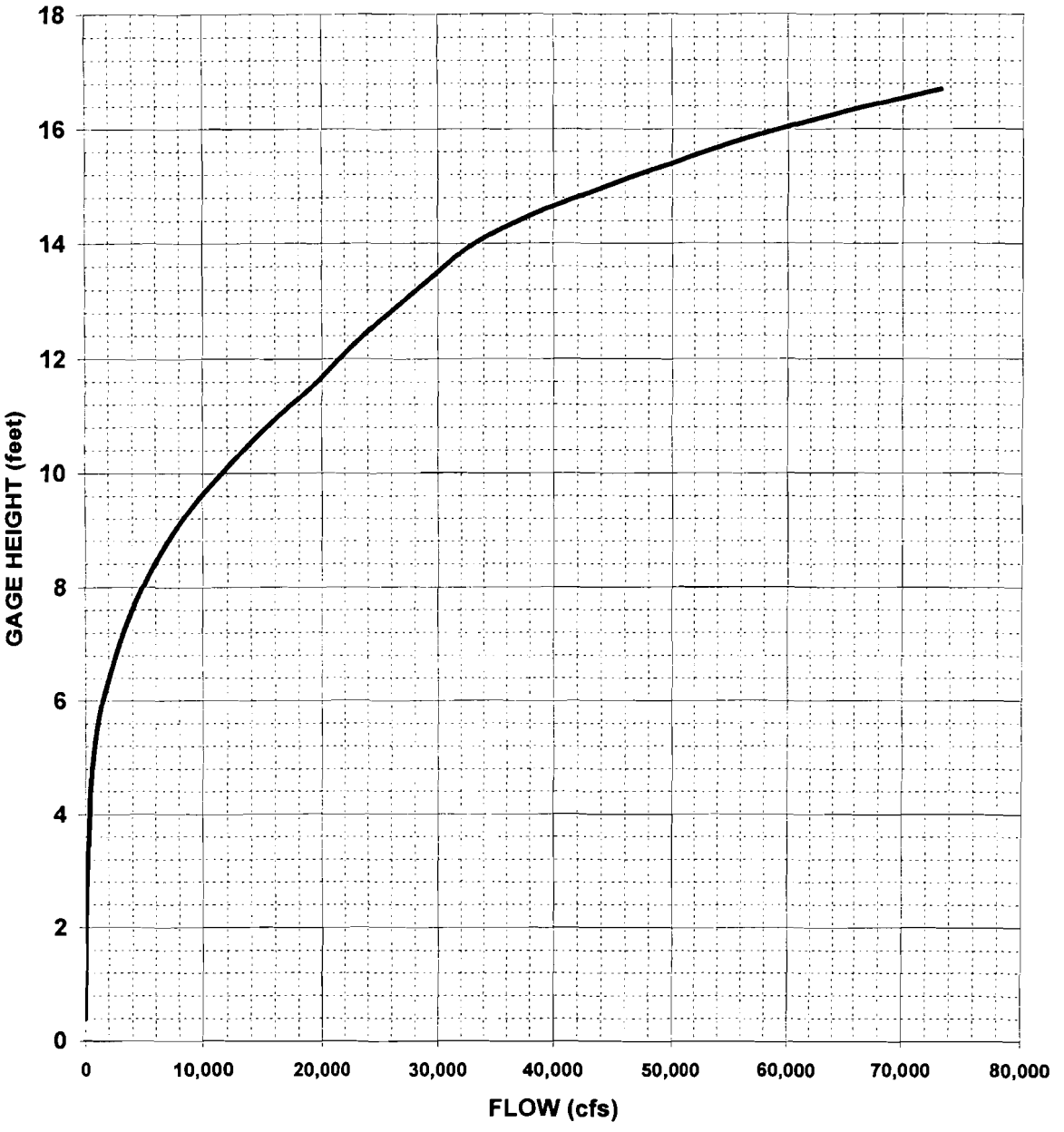
Flow in CFS

Elev	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
715.0	0	201	402	603	804	1006	1207	1408	1609	1810
716.0	2011	2522	3032	3542	4052	4562	5072	5582	6092	6602
717.0	7112	7692	8273	8853	9434	10014	10594	11175	11755	12336
718.0	12916	13567	14226	14885	15544	16203	16862	17522	18181	18840
719.0	19499	20158	20817	21476	22135	22794	23453	24112	24771	25430
720.0	26089	26774	27470	28166	28861	29557	30253	30949	31645	32340
721.0	33036	33732	34428	35124	35819	36515	37211	37907	38603	39298
722.0	39994	40697	41408	42118	42829	43539	44250	44961	45671	46382
723.0	47092	47803	48513	49224	49934	50645	51355	52066	52776	53487
724.0	54198	54910	55628	56346	57064	57782	58500	59218	59936	60654
725.0	61372	62090	62808	63526	64245	64963	65681	66399	67117	67835
726.0	68553	69271	69986	70701	71416	72131	72846	73561	74277	74992
727.0	75707	76422	77137	77852	78567	79282	79997	80712	81427	82142
728.0	82857	83572	84292	85014	85736	86457	87179	87901	88622	89344
729.0	90066	90787	91509	92231	92952	93674	94396	95117	95839	96561
730.0	97282	98004	98732	99465	100198	100931	101664	102397	103130	103863
731.0	104596	105329	106062	106795	107528	108261	108994	109727	110460	111193
732.0	111926	112659	113397	114141	114886	115630	116375	117119	117864	118608
733.0	119353	120097	120842	121586	122331	123075	123820	124564	125309	126053
734.0	126798	127542	128286	129028	129770	130512	131254	131996	132738	133480
735.0	134222	134964	135706	136448	137190	137932	138674	139415	140157	140899
736.0	141641	142.383	143125	143865	144606	145346	146086	146827	147567	148307
737.0	149048	149788	150529	151269	152009	152750	153490	154230	154971	155711
738.0	156451	157192	157932	158678	159424	160171	160917	161663	162409	163156
739.0	163902	164648	165394	166141	166887	167633	168379	169126	169872	170618

Terminus Dam and Lake Kaweah, Kaweah River, California
Spillway Rating Table
All Fusegates Intact

Flow in CFS

Elev	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
740.0	171364	172111	172857	173617	174381	175145	175909	176673	177437	178201
741.0	178964	179728	180492	181256	182020	182784	183548	184312	185076	185840
742.0	186603	187367	188131	188895	189659	190422	191186	191949	192713	193477
743.0	194240	195004	195768	196531	197295	198058	198822	199586	200349	201113
744.0	201877	202640	203404	204215	205048	205880	206712	207544	208376	209208
745.0	210040	210873	211705	212537	213369	214201	215033	215865	216697	217530
746.0	218362	219194	220026	220867	221717	222568	223418	224268	225118	225968
747.0	226819	227669	228519	229367	230214	231061	231907	232754	233600	234447
748.0	235294	236140	236987	237838	238697	239555	240414	241272	242131	242989
749.0	243848	244706	245565	246435	247323	248211	249099	249987	250875	251763
750.0	252651									



NOTE:

Data extracted from
Corps of Engineers Rating Table #18

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

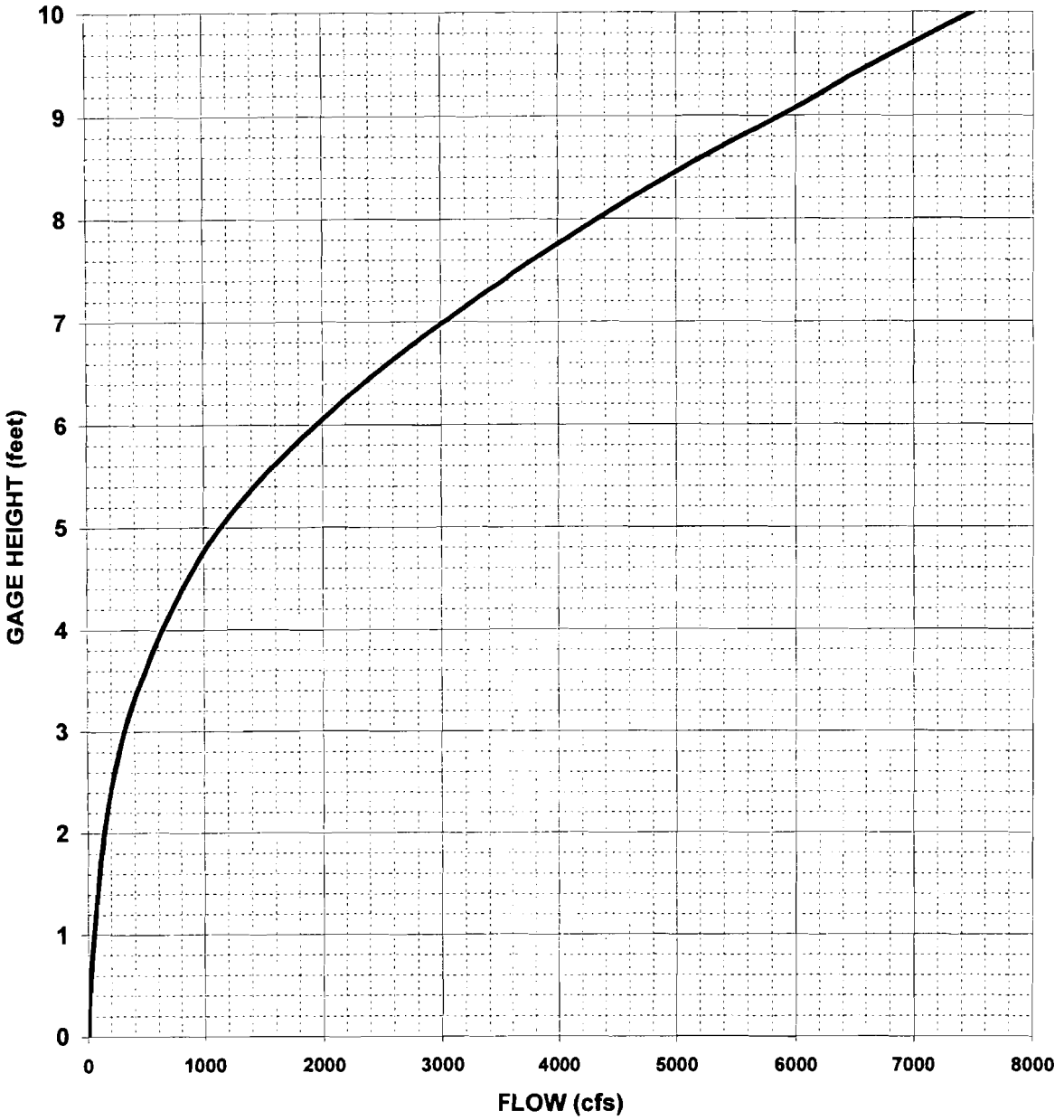
KAWEAH RIVER
AT THREE RIVERS
DISCHARGE RATING CURVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE A-6



NOTE:
Data extracted from
Corps of Engineers Rating Table #15

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

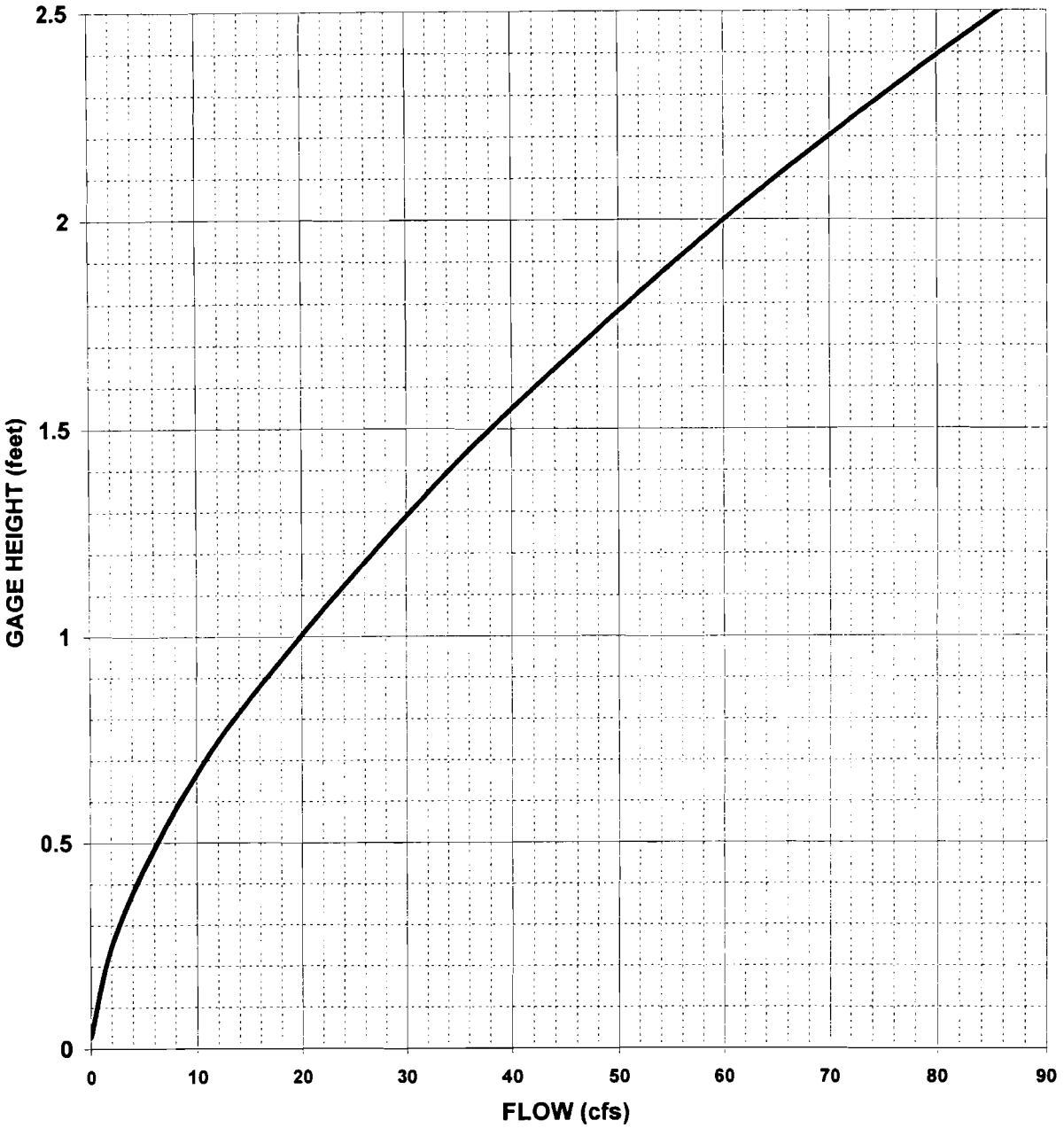
KAWEAH RIVER
BELOW TERMINUS DAM
DISCHARGE RATING CURVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE A-7



NOTE:
Data extracted from
Corps of Engineers Rating Table #3

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

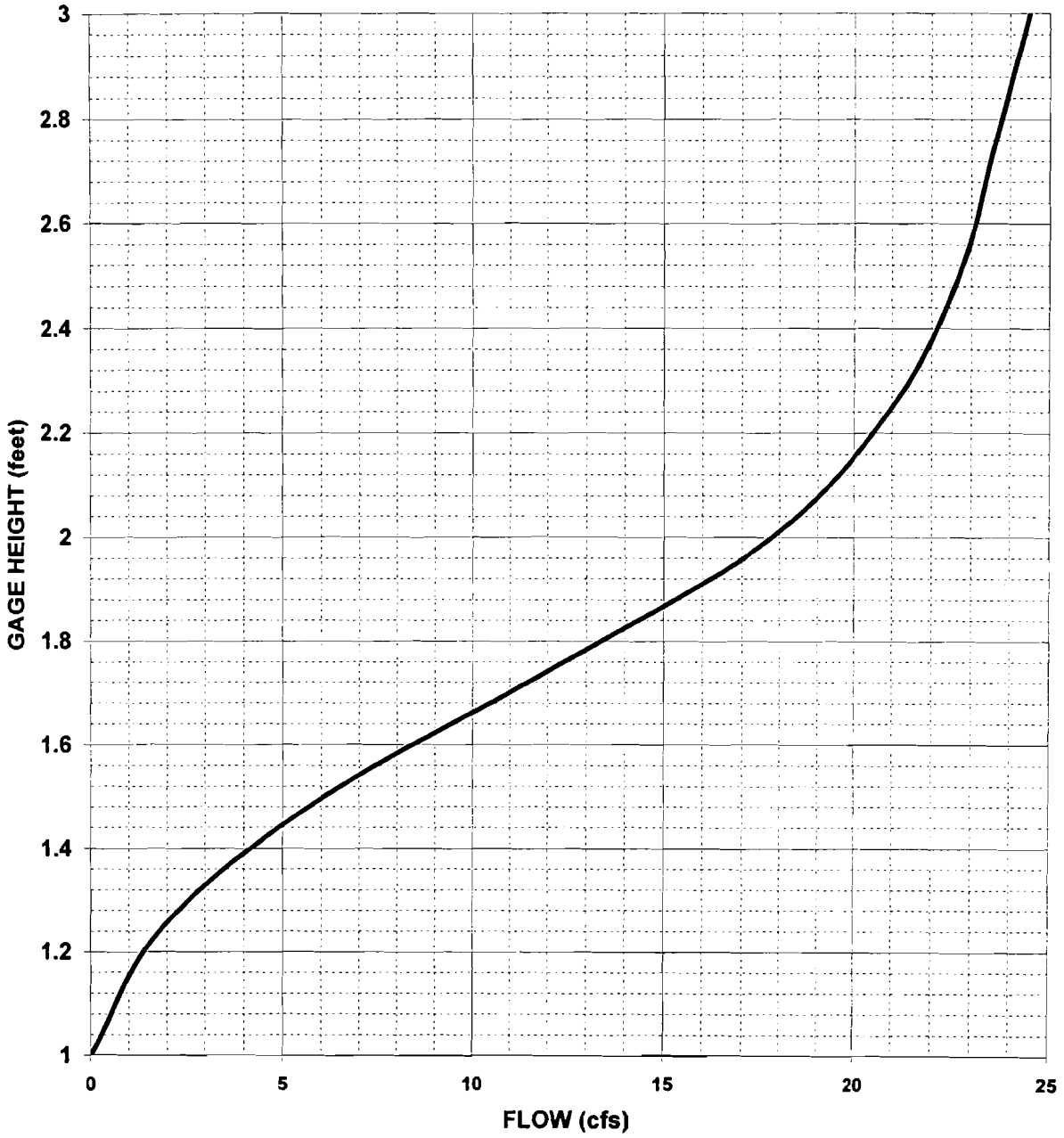
FOOTHILL DITCH
BELOW TERMINUS DAM
DISCHARGE RATING CURVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE A-8



NOTE:
Data extracted from
Corps of Engineers Rating Table #2

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

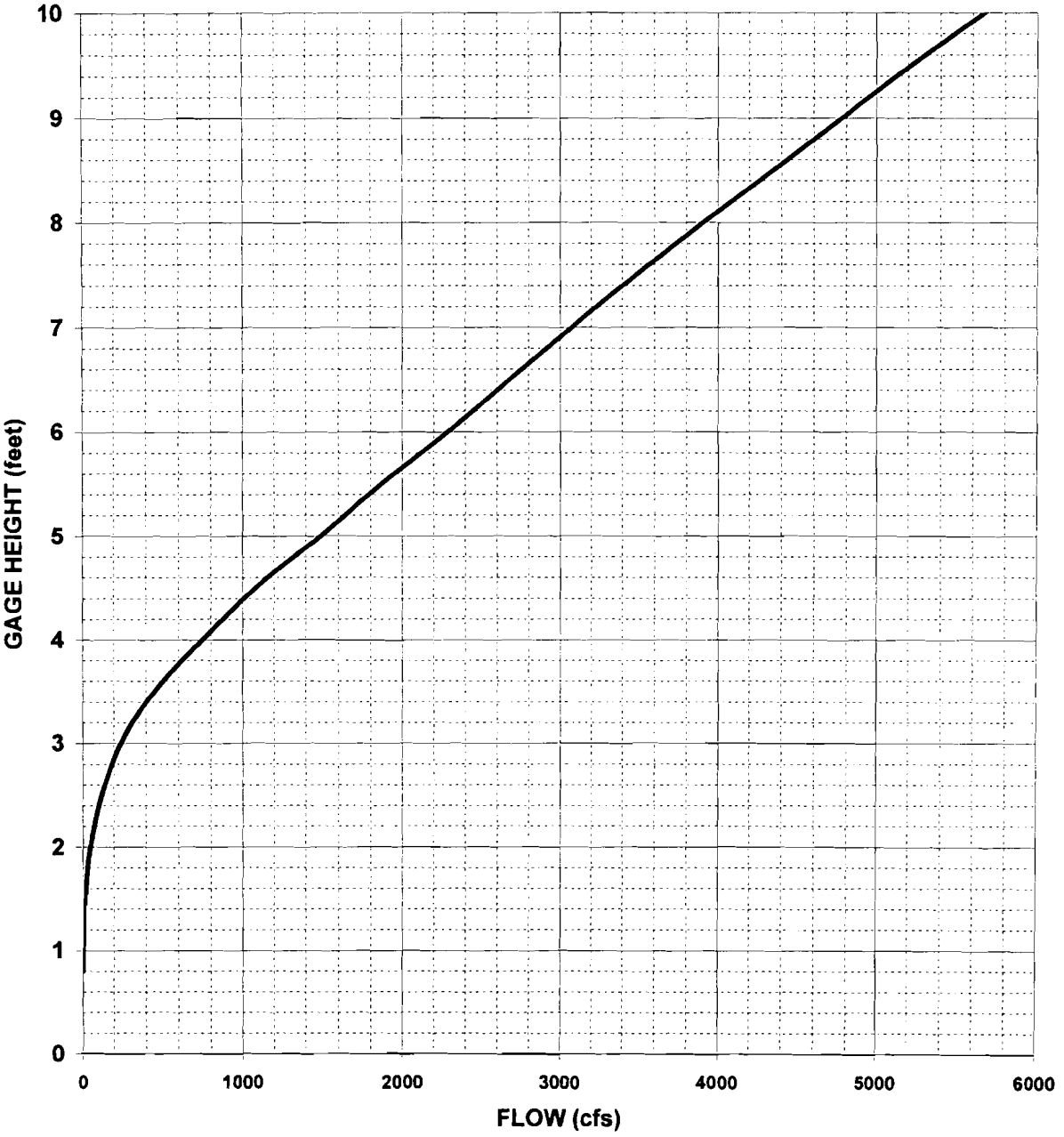
LEMONCOVE DITCH
BELOW TERMINUS DAM
DISCHARGE RATING CURVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE A-9



NOTE:
Data extracted from
Corps of Engineers Rating Table #29

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

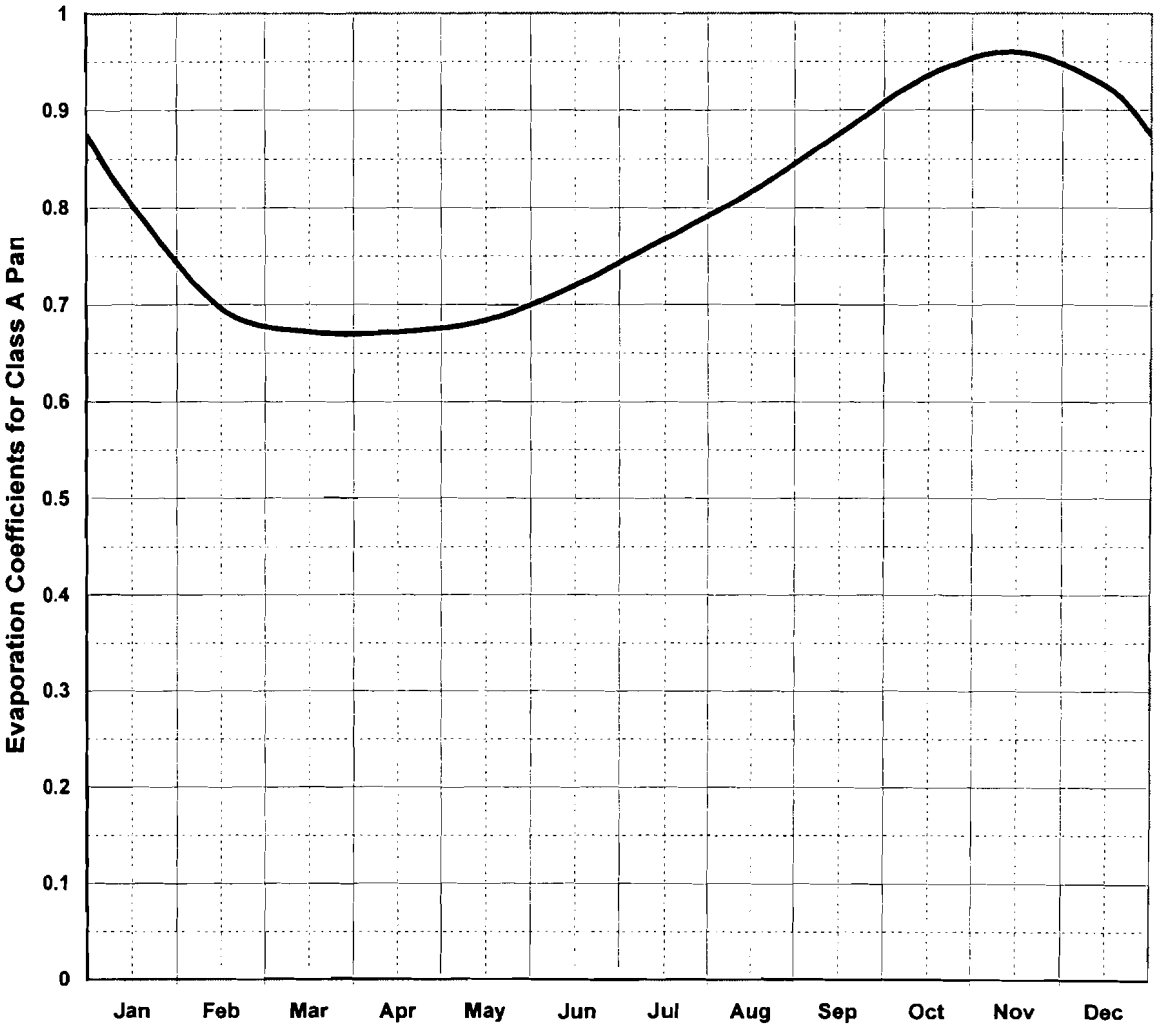
DRY CREEK
NEAR LEMONCOVE
DISCHARGE RATING CURVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by WLJ

Revised Jul 2005

PLATE A-10



EVAPORATION COEFFICIENT VALUES

Jan	0.804
Feb	0.696
Mar	0.672
Apr	0.672
May	0.684
June	0.720
July	0.768
Aug	0.816
Sep	0.876
Oct	0.936
Nov	0.960
Dec	0.924

Prepared by WLJ

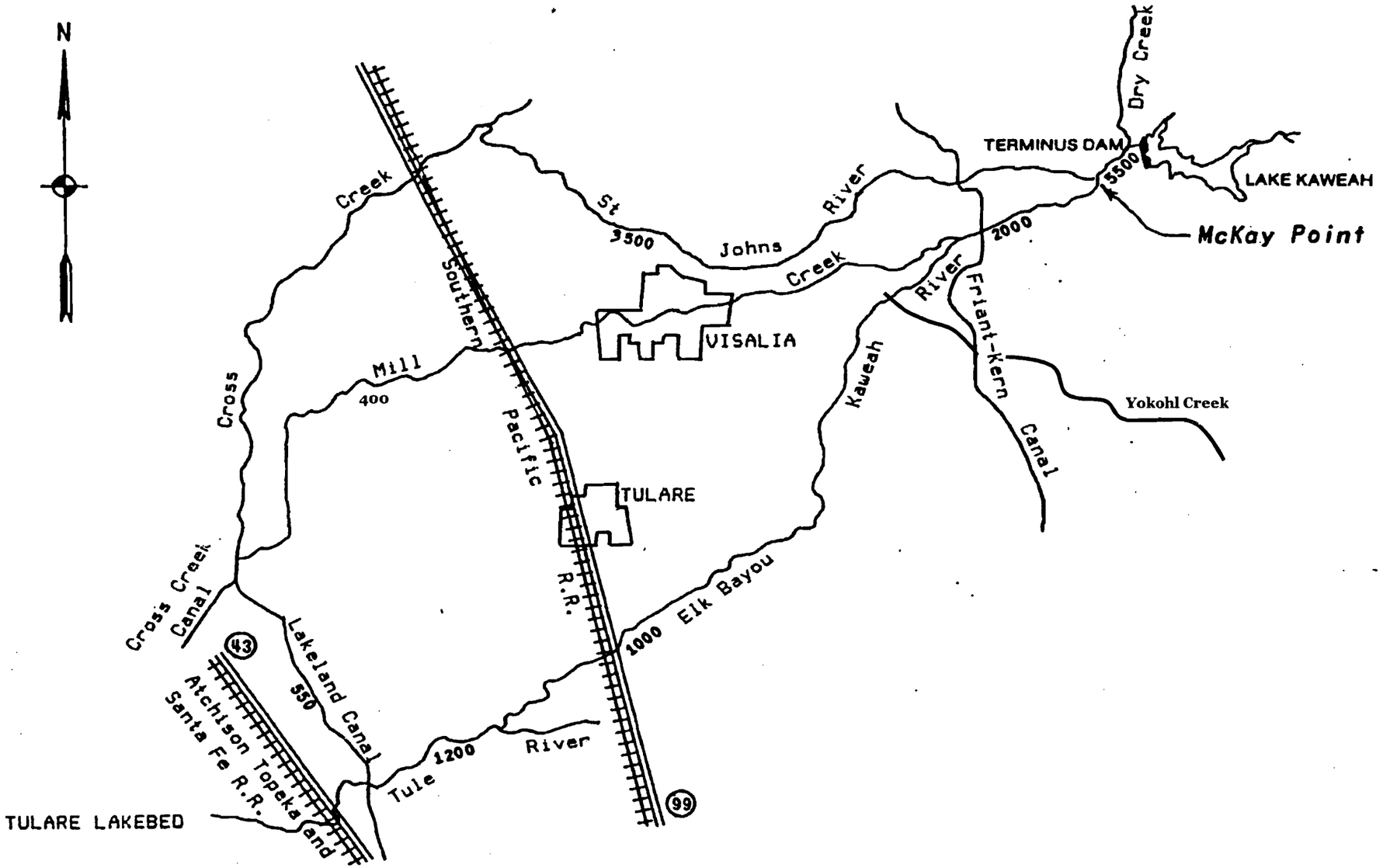
TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

EVAPORATION COEFFICIENTS

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

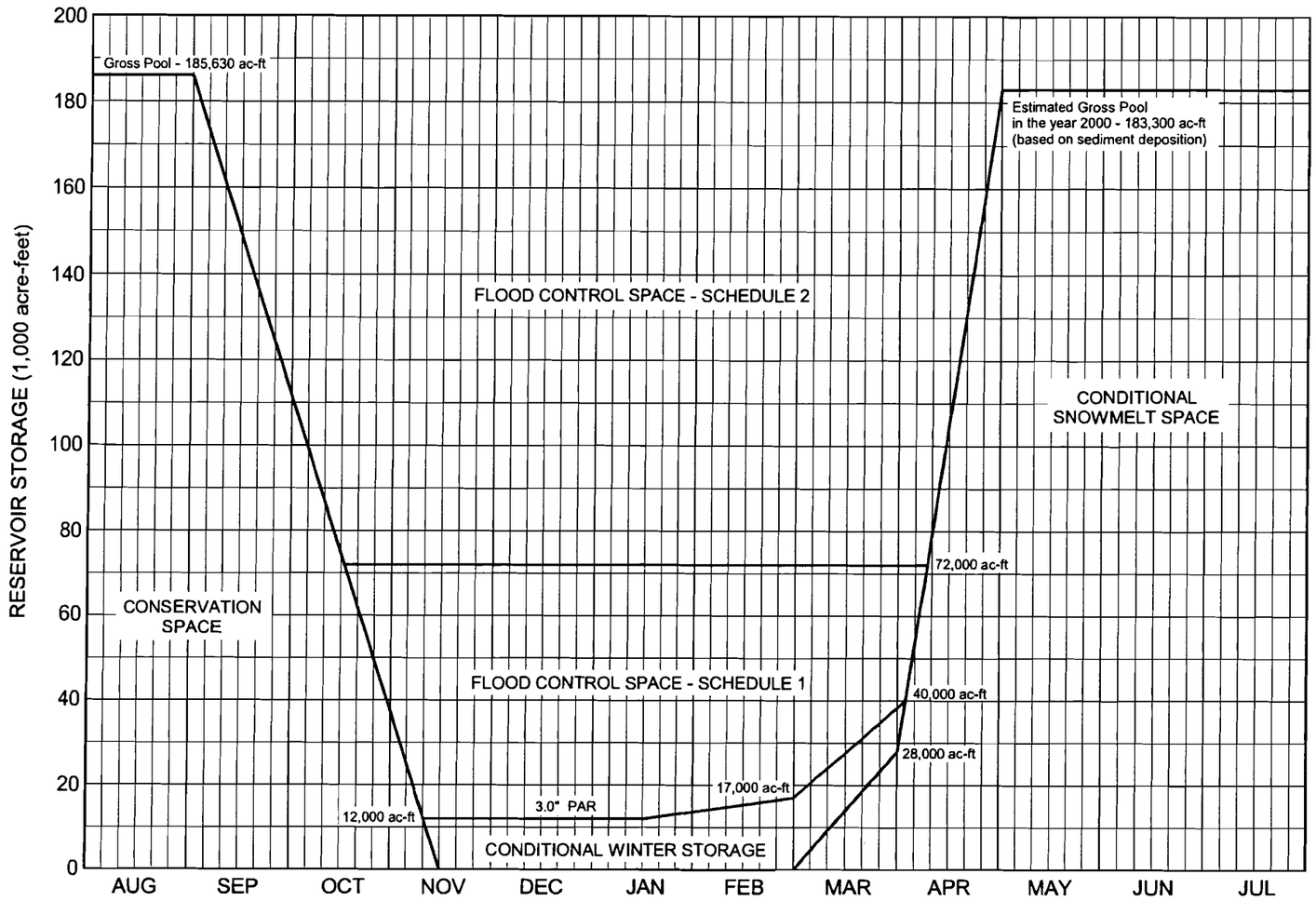
Revised Jul 2005

PLATE A-11



Prepared by WLJ

TERMINUS DAM AND LAKE KAWEAH KAWEAH RIVER, CALIFORNIA
DOWNSTREAM CHANNEL **CAPACITIES**
U.S. ARMY CORPS OF ENGINEERS SACRAMENTO DISTRICT



USE OF DIAGRAM

1. Water stored in Conservation Space will be released as prescribed by the Kaweah River Watermaster.
2. Water stored in Schedule 1 Space and Schedule 2 Space will be released in accordance with the schedule that applies to that space unless the Kaweah River Watermaster requires larger releases for benificial uses within the basin. The Corps will confer with the Kaweah River Watermaster and Tulare Lakebed representatives on all releases when water is stored in Schedule 1 Space and Schedule 2 Space.
3. Water stored in Conditional Snowmelt Space that is identified for flood management should be released as a supplemental release in addition to irrigation and spreading demands, which are determined by the Kaweah River Watermaster. The conditional space required for flood management is equal to the runoff in excess of irrigation and spreading demands adjusted for the expected "fill date" and "timing of the runoff." Specific computations to determine the flood management space and supplemental release for each water year will be done using models which simulate many historical events and parameters using this season's conditions. The results of these simulations will provide several scenarios from which the actual season's event may be forecasted. This process will be performed daily by the Corps of Engineers during the snowmelt period. The Corps will confer with the Kaweah River Watermaster and Tulare Lakebed representatives on all methodologies and parameters used in the above computations.
4. Releases may be deferred and stored as potential irrigation water in Schedule 1 Space based on a Basin Wetness Parameter (PAR). The amount of conditional winter space required varies according to the PAR and will vary at the rate of 1,500 acre-feet of required space for each additional inch of PAR above 3.0 inches. No additional storage is allowed when the PAR is 3.0 inches or less. The parameter is reset to zero on 1 September. A sample computation of PAR is shown in Exhibit A, Section A-02a(9).
5. If required to prevent forecasted damaging releases as determined by the Corps, all available space within the project, Lake Kaweah, no matter its designation, may be evacuated to store rain or snowmelt events.
6. This diagram will be adjusted as information concerning sediment deposition in the lake becomes available. Between sediment surveys, it will be assumed that the sediment deposition in the project space will be 12,000 acre-feet over a 100-year period, or 120 acre-feet per year. The sediment deposition into Lake Kaweah will reduce the Schedule 2 Space, the Conditional Snowmelt Space, and the Conservation Space on an acre-feet for acre-feet basis. Slopes for all lines on the diagram will remain fixed as sediment accumulates in the reservoir.
7. The Corps of Engineers may direct that flood control space and releases be increased or decreased from those required by this diagram based on conditions prevailing at the time.
8. The channel capacity of the Kaweah River at McKay Point is 5,500 cfs.
9. Flood releases as designated by the Corps in excess of irrigation and spreading demands will be diverted as required in the Tulare Lakebed Mitigation Site Operation and Maintenance Manual.

RELEASE SCHEDULES

CONSERVATION SPACE: Based on irrigation demands.

SCHEDULE 1 SPACE: Based on irrigation and spreading demands.

SCHEDULE 2 SPACE: Based on irrigation and spreading demands + supplemental rainflood release. The supplemental rainflood release is based on forecasted inflow and remaining reservoir space. Future inflow estimates and supplemental rainflood release computations will be made by the Corps of Engineers.

CONDITIONAL SNOWMELT SPACE: Based on computed 1 April - 31 July runoff forecast, irrigation demand and spreading capacity.

ESTIMATED MONTHLY IRRIGATION AND SPREADING DEMANDS

MONTH	IRRIGATION (1,000 acre-feet)	SPREADING (after filling basins)	*NORMAL ANTICIPATED IRRIGATION AND SPREADING DURING SNOWMELT PERIOD (1,000 acre-feet)
January	0 - 16.2		
February	16.2 - 29.4	1st Month 65,000 ac-ft	58.8 - 72.0
March	44.7	2nd Month 58,000 ac-ft	87.3
April	105.2	3rd Month 50,000 ac-ft	147.8
May	71.0	4th Month 40,000 ac-ft	113.6
June	101.8	5th Month - No spreading	144.4
July	130.6	to recover percolating capacity.	173.2
August	123.4		
September	76.4	Average demand for 5 month	
October	34.0	period equals 42,600 ac-ft per	
November	18.2 - 31.4	month.	
December	0 - 16.2		

*Based on average continuous spreading demand of 42,600 ac-ft per month.

Prepared by J.S.M.

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

WATER CONTROL DIAGRAM

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE A-13

WATER CONTROL MANUAL

TERMINUS DAM AND LAKE KAWEAH

Kaweah River
California

EXHIBIT B

CESPD-R-1110-2-8

GUIDANCE ON THE PREPARATION OF DEVIATIONS
FROM APPROVED WATER CONTROL PLANS

U.S. Army Corps of Engineers
Sacramento District
Sacramento, California

Manual Revised July 2005

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DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION CORPS OF ENGINEERS
333 Market Street
CESPD-MT-E San Francisco, California 94105-2195

REGULATION
No. 1110-2-8

12 September 2002

Engineering and Design
GUIDANCE ON THE PREPARATION OF DEVIATIONS
FROM APPROVED WATER CONTROL PLANS

1. PURPOSE. This document establishes the protocol for reporting deviations from approved Water Control Plans for water control projects within the South Pacific Division. It defines coordination, review, and approval procedures between the Division and District offices. Approval from Division must be obtained from all deviations (reference e., paragraph 6.b.) [1]

2. APPLICABILITY. The following is applicable to all South Pacific Division Districts and field-operating activities having civil works responsibilities.

3. REFERENCES. Authority and guidance can be found in:

a. ER 200-2-2 (33 CFR 230), 4 March 1988, subject: Procedures for Implementing NEPA.

b. ER 1105-2-100, 22 April 2000, subject: Guidance for Conducting Civil Works Planning Studies.

c. ER 1110-2-240 (33 CFR 222.5), 8 October 1982, subject: Water Control Management.

d. ER 1110-2-241 (33 CFR 208.1), 24 May 1990, subject: Use of Storage Allocated for Flood Control and Navigation at Non-Corps Projects.

e. ER 1110-2-1400, 30 September 1993, subject: Reservoir Water Control Centers.

f. ER 1110-2-8156, 31 August 1995, subject: Preparation of Water Control Manuals.

g. ER 1165-2-501, 30 September 1999, subject: Civil Works Ecosystem Restoration Policy.

[1] This regulation supercedes CESPD-ET-EW Regulation, Subject: Guidance On The Preparation Of Deviations From Approved Water Control Plans dated 1 August 1999.

h. EP 1165-2-502, 30 September 1999, subject: Ecosystem Restoration – Supporting Policy Information.

i. EM 1110-2-3600, 30 November 1987, subject: Management of Water Control Systems.

j. CESPD R 1110-2-8, August 1999, subject: Guidance on the Preparation of Deviations From Approved Water Control Plans.

4. OVERVIEW.

a. Water Control Plans are prepared for all Corps projects and non-Corps projects within Federal flood control space. For Corps projects, the Water Control Plan is all encompassing in that it covers regulation of the project over the entire regime of pool elevations and conditions. The Corps' responsibility regarding non-Corps reservoirs is defined by Section 7 of the Flood Control Act of 1944 (58 Stat 890), which directs the Secretary of the Army to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds.

b. Water Control Plans define the regulation criteria and guidelines that govern how and when water will be stored and released from a project. The process of formulation and eventual approval of the Water Control Plan is a complex and time-consuming process because the plan must account for diverse goals (flood control, the environment, water quality, recreation, water supply, hydropower, etc.) and situations (e.g. normal, flood, drought, and emergency operations). Formulation of these plans requires a comprehensive knowledge of such diverse items as: project goals, project history, authorizing legislation, Corps policies and regulations, how a project interacts with other reservoirs within a basin, the role of other water interests/agencies, the effects to the general public in relation to environmental and aesthetic considerations, basin meteorology and hydrology, changing conditions (e.g. sedimentation, channel capacity, scour, etc.), and the physical capabilities of project features, such as outlet works, spillways, flood routing characteristics, etc.). Prior to approval and implementation, the proposed Water Control Plan is released for public review and comment. The public review process normally occurs concurrently with the NEPA public review process.

c. Deviations from approved Water Control Plans occur because every possible circumstance cannot be accounted for in a Water Control Plan. The competing goals and complex interactions of interested groups/agencies can cause even seemingly inconsequential deviations from an approved plan to lead to unforeseen environmental and legal complications. This regulation serves to assist a District in preparing their deviation requests. It outlines a minimum set of considerations that need to be addressed when making a recommendation to deviate from an approved Water Control Plan.

d. Deviations from approved Water Control Plans are intended, therefore, to address unforeseen and unique circumstances. They are not intended as a means for identifying or

initiating new opportunities to re-operate or reallocate storage in response to new and changing public needs.

5. DEFINITIONS.

a. Emergency Deviations. An emergency deviation from an approved Water Control Plan is one that is required due to an emergency situation. An emergency situation is defined herein as a situation in which there is a potential for injury, loss of life, threat to the project, or other serious hazards; but furthermore, also demanding immediate action, such that time constraints render impractical notification to the division. Depending upon the need for immediate action, an emergency situation could include: drowning and other accidents, assistance to local authorities responding to an emergency (e.g. police and fire departments), failure of operations facilities, chemical spills, treatment plant failures, and other temporary pollution or water quality problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions.

b. Planned Deviations. Planned deviations cover all other deviations not addresses by an emergency deviation.

6. OFFICE OF RECORD. The originating District's water control management office will be responsible for maintaining all relevant records documenting the deviation.

7. GENERAL INFORMATION FOR PREPARING ALL DEVIATIONS.

a. Approval of Deviations. Approval for all deviations must be obtained from the Division Commander or delegated representative prior to their implementation. As noted in paragraph 5.a, an emergency deviation situation may warrant an immediate action, delegated to the Leader, Water Management Team or his designated representative. The Leader of the Water Management Team shall consult with the Chief of Engineering and Construction and appropriate SPD staff and subsequently advise the Director, Military and Technical Services Directorate of the temporary change. Approval may be made by telephone, E-mail, or FAX.

b. Preparation of Deviations. Processing of a deviation request originates at the District water control management office. The District Commander may delegate signature authority for requesting deviations from approved water control plans to the appropriate functional division head or designated representative. Consultation with the District staffs, including engineering, planning, environmental, economics, operations, construction and legal must take place.

c. Costs and Charges for Preparing Deviations. Deviations from approved Water Control Plans require a similar level of scrutiny as applied to permanent changes to a water control plan. Any District charges incurred for processing a deviation are to be assessed and collected from the agency/entity requesting the deviation. The District should estimate the cost to process the deviation and provide that estimate to the requesting agency/entity. The District must collect the funds (in a revolving fund advance account under Support for Others) prior to processing the deviation request. Examples of costs for which the requesting entity would be responsible include costs for any required reviews or studies concerning associated hydrologic, water

control, legal, real estate, and environmental maters. After the deviation work is completed, any amount of funds left over in the account would be paid back to the requesting entity.

d. Fees for Water Supply Deviations. Deviations that result in Corps project flood control space being used for water supply purposes must address reimbursement by the sponsor to the Federal government for use of the flood control space. The district's deviation request package must include an economic analysis that determines a value for the reallocated flood control space. Section 7 projects will not require the economic analysis, as water supply charges are under the authority of the project owner.

e. Time to Prepare Deviations. District offices should also inform potential agencies/entities that the lead time required to assemble the necessary information required to evaluate a deviation request may be on the order of months (normally due to the required environmental analysis and the public review process). Thus, the request to the District should be made well in advance of the proposed initiation date fro the deviation. The requesting agency/entity should also be made aware that approval of the deviation request would depend upon such things as a review of the impacts (e.g., environmental, hydrologic, legal, etc.).

f. Coordinating with Division Staff. Preparation of a deviation package is a time consuming and costly undertaking, and incomplete or inadequate package can delay approval, District personnel are encouraged to coordinate any questions or concerns about potential deviations and to discuss any atypical situations with their Division counterparts early in the process and before the package submittal. All technical review will be conducted at the District level and will provide a review certification. In an emergency situation, a formal quality certification will most likely not be required. Appendix D lists the Division staff with which deviation-related issues are to be coordinated Division will provide updates to Appendix A as needed.

g. Non-Corps Projects. Deviation requests fro non-Corps (Section 7) projects must be prepared with the approval of the project owner. This is required because project owners are responsible for assuring that the project is operated as prescribed in the Water Control Plan developed in concert with the Corps' flood control interest. The owner is also ultimately responsible for dam safety at the project and for funding the project.

h. Environmental Requirements. Each deviation request shall include a summary of the environmental effects of the proposed deviation and a statement of how the proposal is in compliance with pertinent environmental requirements, including but not limited to the National Environmental Policy Act (NEPA), Endangered Species Act, the Clean Water Act, and the Clean Air Act and Section 176 Conformity Determination. NEPA documentation requirements ordinarily are met by an Environmental Assessment (EA) of the proposed action with a Finding of No Significant Impact (FONSI) signed by the District Commander. If an existing Environmental Impact Statement/Record of Decision or EA/FONSI accurately covers the action, and if there have been no environmental changes since that documentation, this can be cited. Supporting environmental documents shall be included in the deviation request package when it is submitted. Typically these will include an EA, a signed FONSI, a Biological Assessment, and a final Biological Opinion or a letter from Fish & Wildlife or National Marine and Fishery

Service concurring that there is not likely to be adverse effect on listed species. Sometimes other documents, such as 404(b)(1) evaluation are required. In the case of emergency deviation, the emergency provisions and requirements of he various environmental laws should be followed.

i. Required Information/Analysis. Table 1 outlines the information and analysis that are required in a deviation request package that is submitted to Division.

TABLE 1
Information and Analysis Required in a Deviation Request Package

a. Copy of sponsor's/project owner's letter requesting a deviation.
b. A description of the deviation.
c. Its effects on the operational objectives or project purposes.
d. A description of the potential flood threat over the period of the deviation.
e. The current and predicted maximum reservoir storage and elevation.
f. Documentation that the proposed deviation is in compliance with all pertinent environmental laws.
g. The effect on other agencies and individual interest.
h. The coordination that has taken place with other agencies.
i. Alternative measures that could be taken.
j. Recommendation/rationale on whether a permanent change to the Water Control Plan for this situation is warranted.
k. A District legal opinion.
l. Any recommended fees or reimbursements to the Federal Government.
m. Any other information that may be pertinent to the deviation request.
n. The District Commander's recommendation.
o. Quality Control Certification

8. PREPARING EMERGENCY DEVIATIONS

a. Emergency deviations are the only type of deviation that do not require prior approval from Division, and must only be used if events warrant an immediate emergency action, such that time constraints render impractical notification to the Division. However, even in an emergency situation, the District shall notify the Division of the action as soon as possible, and shall comply with all applicable requirements.

b. A record of the emergency deviation shall be developed at the district office and transmitted to the Division office within a day of the action taken.

c. Procedures for emergency deviations:

(1) Take the necessary action.

(2) Contact Division as soon as possible (See Appendix A for telephone numbers) to describe the action taken and the cause (NOTE: The order of (1) and (2) may be reversed depending on the nature of the emergency). Continuation of the deviation will require Division approval.

(3) The District shall provide written conformation to the Division office within 7 days of the deviation. The correspondence shall include the items outlined in Table 1 (as applicable).

(4) The Division shall respond within 3 days of the district's notification of the emergency deviation.

9. PREPARING PLANNED DEVIATIONS.

a. The District shall inform Division within 2 days of receiving a request for a proposed deviation.

b. At least 7 days prior to the proposed action, the District shall transmit a deviation request package to the Division office. The deviation request package shall include the items in Table 1. This package may be initially transmitted electronically.

c. The Division shall review the proposal and approve or disapprove the District's deviation request within 5 days, assuming a complete package with all required documentation has been received. Early, detailed, coordination and transmittal of documents to Division may reduce the processing time.

d. The District and Division shall follow-up with formal correspondence within 3 days of their electronically transmitted request (District) and approval/disapproval (Division).

10. SPECIAL CIRCUMSTANCES.

Per reference 3.c, Water Control Plans are subject to continuing and progressive study in order to keep them current. Should a new re-operation or reallocation opportunity be identified for a Corps project, then it should be addressed under authority of Section 216 of Public Law 911-611, an Initial Appraisal Report can be conducted with O&M funding to determine whether or not a study, if deemed appropriate, among other things, could initiate the process to incorporate the new opportunity in the project's Water Control Plan. Re-operation or reallocation studies for non-Corps projects would need to be initiated by the project owner.

FOR ROBERT L. DAVIS
BG, USA
Commanding

COL, EN
DEPCDR

1 Appendix
APP A – CESPD Phone list for Coordination of Water Control Plan Deviations
APP B - Quality Control Certification

DISTRIBUTION:
Electronic Copy Available

APPENDIX B

DISTRICT ENGINEER'S QUALITY CERTIFICATION

COMPLETION OF QUALITY CONTROL ACTIVITIES

The District has completed the review/analysis of the water control deviation from the Approved Water Control Plan for *(Project Name and Location).* Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent in this analysis have been completed.

GENERAL FINDINGS

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, data and the reasonableness of the results. The undersigned recommends certification of the quality control certification for this deviation request.

(Signature) *(Date)*

Chief, Responsible Functional Element

CERTIFICATION OF LEGAL REVIEW*

The request for a water control deviation from the approved Water Control Plan report for *indicate name of project*, has been fully reviewed by the Office of Counsel, and is approved as legally sufficient.

(Signature) *(Date)*

District Counsel

QUALITY CERTIFICATION

All issues and concerns resulting from technical review of the water control deviation have been resolved. This deviation is recommended for approval.

(Signature) *(Date)*

District Commander

WATER CONTROL MANUAL

TERMINUS DAM AND LAKE KAWEAH

Kaweah River
California

EXHIBIT C

DROUGHT CONTINGENCY PLAN
FOR
TERMINUS DAM AND LAKE KAWEAH

U.S. Army Corps of Engineers
Sacramento District
Sacramento, California

Revised July 2005

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TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

EXHIBIT C

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VII – COORDINATION AND TECHNICAL PROCEDURES

LIST OF PLATES

Plate No	Title
C-1	Average Annual Runoff Expressed as a Percent of Historic Annual Runoff
C-2	Forecasted Annual Runoff Based on Total Inflow During Indicated Period
C-3	Estimated Annual Runoff Plus Stored Water above 1000 Acre-Feet Expressed as Percent of Average October - July Runoff
C-4	Drought Management Committees

EXHIBIT C

DROUGHT CONTINGENCY PLAN

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

I - INTRODUCTION

1-01. Purpose. The purpose of this exhibit is to provide guidance for coordinating with local entities and for implementing possible modifications to the operation of Lake Kaweah during droughts. Guidance in this exhibit concerns aspects of drought management pertaining to the operation of Lake Kaweah and should be used to complement the State's drought management activities.

The provisions of this plan will mainly apply to extreme situations when there is insufficient water to meet the health and safety needs of urban and rural communities. This plan will have very little impact on releases for irrigation, because the Corps of Engineers does not govern such releases. Rather, the Kaweah River Water Conservation District, which is responsible for managing all irrigation storage within Lake Kaweah, will direct releases for this purpose.

1-02. Authorities. This plan is prepared under the authority of ER 1110-2-1941, "Engineering and Design, Drought Contingency Plans," dated 15 September 1981.

II - DROUGHTS

2-01. Historical. Kaweah River flow is highly variable. Between 1904 and 2002 the average annual runoff has varied from approximately 22% of the historic average in water year 1977 to 331% in 1983. Runoff has been below 50% of average for approximately 17% of the time. The driest 5 consecutive years have been 1988 through 1992 and the driest 10 years, 1924 through 1933. Plate C-1 depicts the percent of average annual runoff for different durations from 1912 through 2004.

2-02. Drought Indicators. The State of California has developed criteria to judge drought severity based on inflow to the Delta at the mouths of the Sacramento and San Joaquin Rivers. Drought conditions are subdivided into three categories: **Below Average**, **Dry,** and **Critical**. For purposes of this plan, a drought indicator has been devised based on total forecasted October-July runoff plus the volume of water stored above 12,000 acre-feet in Lake Kaweah at the start of the water year. An October through July runoff forecast can be obtained from the graph on Plate C-2. Values provided by this chart have approximately a 50% chance of not being exceeded.

A historic depiction of water supply conditions is provided on Plate C-3. For purposes of this exhibit, the drought categories have been assigned the following criteria: A forecast less than 100% of average October through July runoff and equal to or greater than 75% is considered **Below Average**. A forecast of less than 75% of average but equal to or greater than 50% is considered **Dry**. A forecast less than 50% of average October through July runoff is considered **Critical**.

III - BASIN/PROJECT DESCRIPTION

3-01. Basin Description. Chapter IV of the Terminus Dam and Lake Kaweah Water Control Manual provides a basin description.

3-02. Project Description. Chapter II of the Terminus Dam and Lake Kaweah Water Control Manual provides a description of the project.

IV - WATER USES/USERS

4-01. Current Uses/Users. Releases from Lake Kaweah are either for flood control in accordance with the current Water Control Plan or for irrigation as directed by the Kaweah Delta Water Conservation District. Kaweah Delta Water Conservation District's duties are described in Chapter IX of the Water Control Manual.

4-02. Available Storage. The allocation of storage in Lake Kaweah is discussed in numerous portions of the Water Control Manual. Basically, the reservoir can store up to 185,630 acre-feet of water. During the rainflood season, up to 173,630 acre-feet of space must be kept empty to control rain floods. Furthermore, up to the total reservoir capacity may be devoted to controlling snowmelt floods (from February through July), dependent upon the forecasted snowmelt runoff. Refer to the calculations involved on Plate A-13 in Exhibit A. Flood releases during the spring and summer may be coordinated in order to fill the reservoir toward the end of the season, if runoff is sufficient. A small amount of encroachment into the rainflood reservation may be permissible based on the ground wetness index described in Section A-02a(9). It is assumed that the sediment deposition in the project space will be 12,000 acre-feet over a 100-year period or 120 acre-feet per year.

4-03. Potential Uses/Users. In extreme cases, water stored in Lake Kaweah has potential for municipal and industrial uses. In a drought emergency, the Governor has broad powers to intervene in local water distribution decisions. He can nullify existing water rights contracts and redistribute water to areas where it is most needed. Drought emergencies may be state-wide or confined to local areas.

V - CONSTRAINTS

5-01. Water Control Plan. Constraints on project operation are governed by the Water Control Plan. The basic Water Control Plan is explained in detail in Exhibit A of the Water Control Manual.

5-02. Contracts. The Bureau of Reclamation is the federal agent for the contract between the federal government and the local project sponsor. The repayment contract number is 14-06-200-1729A. Significant deviations from the Water Control Plan which require repayment would be coordinated with the Bureau of Reclamation.

5-03. Water Rights. The State Water Resources Control Board (SWRCB) has declared that all water in the Kaweah River is appropriated.

VI - DROUGHT MANAGEMENT PLAN

6-01. General. At the District level, the Water Management Section, Engineering Division, monitors water supply opportunities on a continual basis. The Office of Counsel, the Operations Branch, Construction-Operation Division, and the Environmental Resources Branch (Planning Division) provides support. This makes up the Corps Drought Management Committee.

A rough estimate of the water supply at Lake Kaweah can be obtained from the criteria in Section 2-02 of Exhibit C and is shown on Plate C-3. This estimate may be of use to plan drought impacts on Lake Kaweah recreation facilities. However, a drought declaration, which will significantly impact project operation, will be the responsibility of the State. The Governor can declare a statewide drought emergency, giving him broad powers to override the SWRCB.

Upon notification of a drought emergency, coordination with an Interdisciplinary Technical Committee (ITC) will commence. It may be beneficial for the ITC to coordinate when the water supply forecast is critical. The ITC is composed of people most familiar with the project and local area. The ITC may identify possible modifications to Lake Kaweah operation to help alleviate the drought and will be notified of proposals by other interests. The ITC's recommendations will be forwarded to the District Engineer. The District Engineer will report to the Division Engineer, who is a member of the State Drought Action Team created by Executive Order No. W-3-91.

6-02. Interdisciplinary Technical Committee. The Interdisciplinary Technical Committee will be composed of representatives from agencies listed on Plate C-4.

6-03. State Drought Action Team. The State Drought Action Team (SDAT) is composed of key state and federal personnel. The team is responsible for overseeing and coordinating state and federal responses to droughts. The Division Engineer is a member of the State Drought Action Team.

VII - COORDINATION AND TECHNICAL PROCEDURES

7-01. Internal Coordination. Recommended deviations from the Water Control Plan will be coordinated with Division staff and submitted to South Pacific Division for approval per Corps of Engineers, South Pacific Division, memorandum CESPD R-1110-2-8 dated 12 September 2002. A copy of this memorandum is found in Exhibit B of this manual.

7-02. Interagency Coordination. Interagency coordination will be carried out at all levels as required. Coordination between members of the ITC and numerous local, state, and federal agencies will often be required prior to submittal of deviation plans to the Division Engineer.

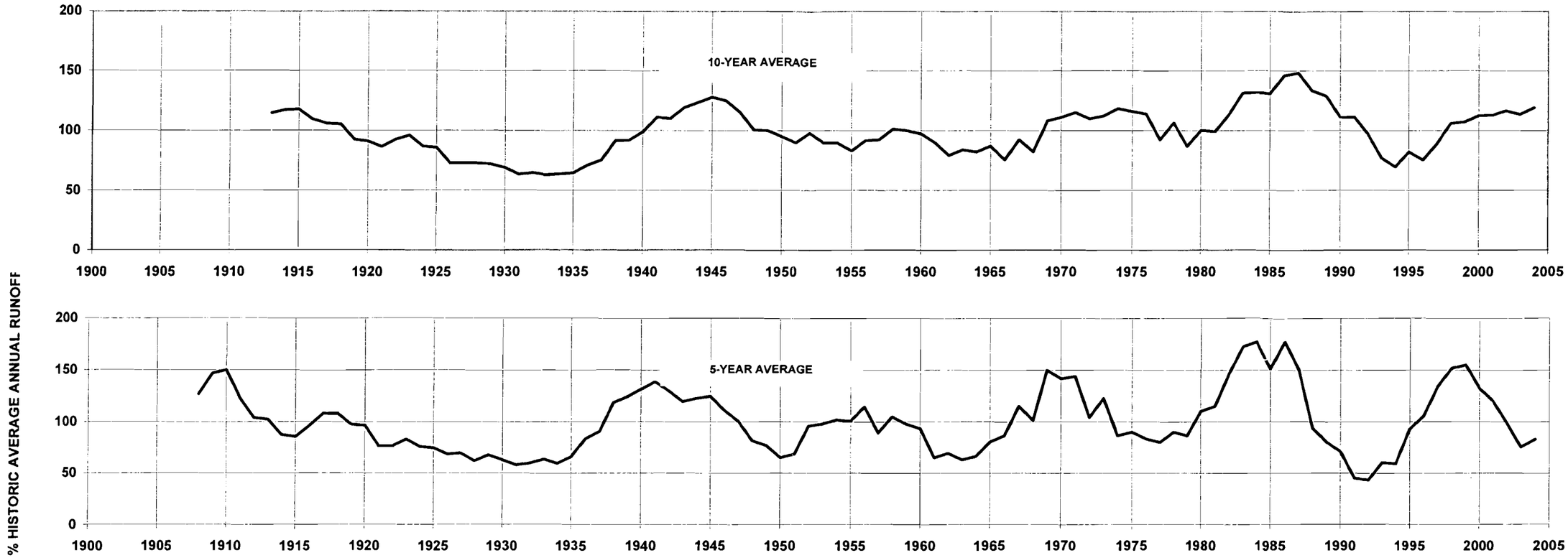
7-03. Contracts. Under extreme conditions it may be desirable to release water for public safety. The regulation found in ER 1105-2-100, Planning Guidance Notebook, <http://www.usace.army.mil/inet/usace-docs/eng-regs/er1105-2-100/toc.htm>, dated 22 April 2000, Appendix E, Civil Works Programs, Section VIII, Water Supply, E-27, Other Authorities, Paragraph (C), Drought Contingency Water Supply, Page E-215, requires compensation for drought contingency withdrawals. Rates should be at least sufficient to recapture lost project revenues, an appropriate share of yearly project joint-use operation, maintenance and major replacement expense, and any expense specifically attributed to the water withdrawal. This includes contract administration costs and mitigation costs for environmental impacts. The format for the contract is described in Section VIII, E-58, Water Supply Agreements, Paragraph (3), Page E-223. The template for the form is found on the internet at: <http://www.hq.usace.army.mil/cecc/ccpca.htm>, Sample Water Agreements and Permits, Appendix K of ER 1105-2-100, Part 3, page 25 and 26. The preferred approach will be for a local agent to enter into a contract with the United States of America, and to agree to act as a wholesaler for all water requirements of the individual users.

7-04. Environmental Coordination. Depending upon the nature of any specific proposal put forward for the modification of the Water Control Plan, the environmental effects and the required environmental coordination, NEPA documentation, and mitigation could vary widely. When a proposal is made, an environmental assessment (EA) will be prepared, and coordination with the appropriate resource agencies will be undertaken. The EA will briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS), or a finding of no significant impact. Coordination will include the U.S. Fish and Wildlife Service and the California Department of Fish and Game, in accordance with the Fish and Wildlife Coordination Act. It may also include other resource agencies and groups, depending on the nature of the proposal and the resources that might be affected. Mitigation, if any is required, will be determined through the NEPA process.

7-05. Public Information. General information on Corps actions is disseminated to the public through the Public Affairs Office, which is briefed by the Chief, Water Management Section, Engineering Division. Furthermore, District and/or Division representatives of the Corps report Corps drought activities at the periodic meetings of the Governor's Drought Action Team and the Interagency Drought Task Force, which, along with the California Department of Water

Resources (DWR) State Drought Information Center, is California's designated lead agency in providing information to the public. The State Drought Center publishes a Weekly Update on Drought Conditions.

7-06. Responsibilities. The Water Management Section of the Sacramento District is responsible for the preparation, revision and implementation of the subject Drought Contingency Plan. The Program Technical Division of the South Pacific Division has the responsibility for review and approval.



Prepared by TLT

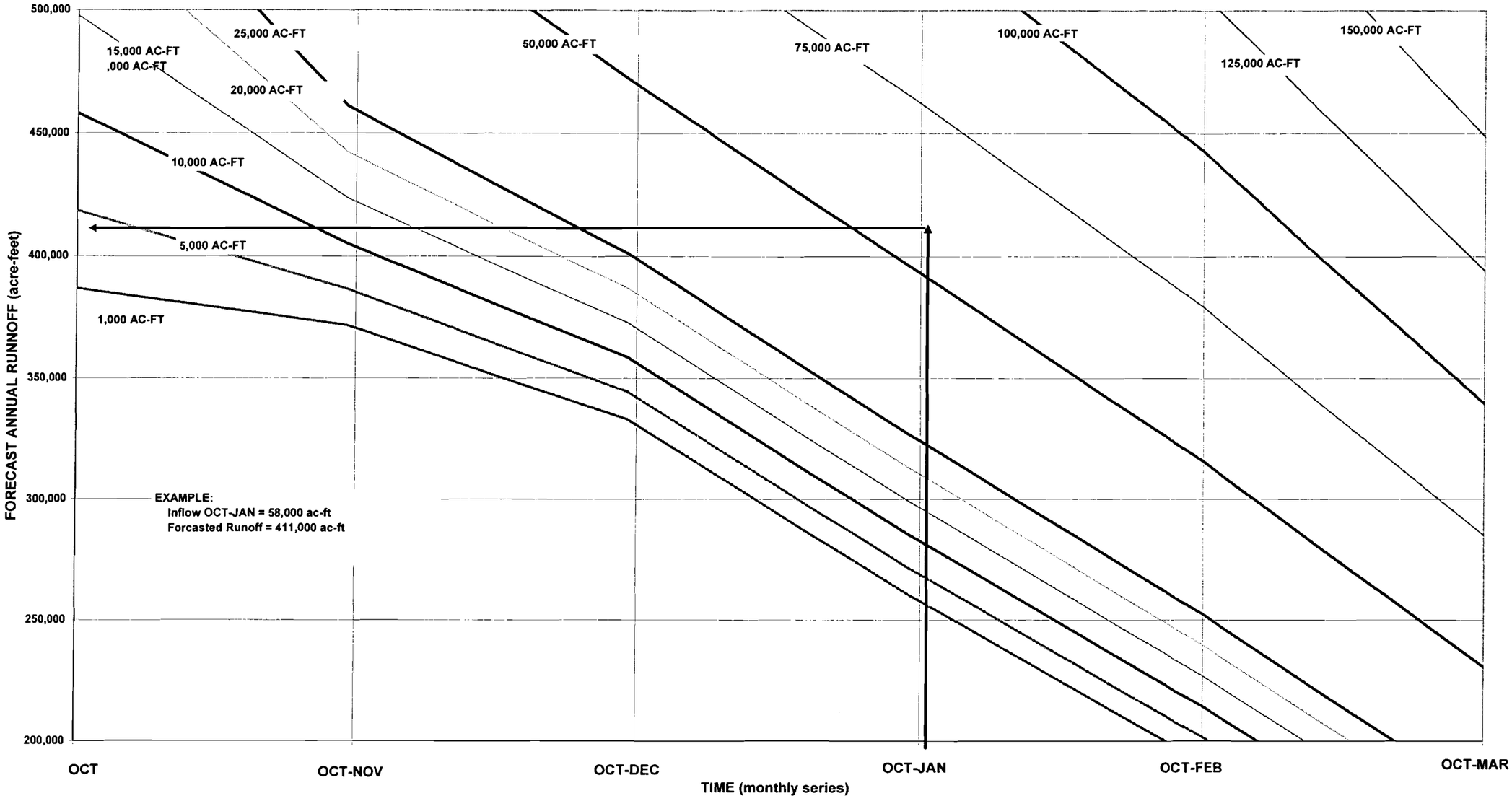
TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

AVERAGE ANNUAL RUNOFF EXPRESSED AS A PERCENT OF HISTORIC ANNUAL RUNOFF

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE C-1



AVERAGE ANNUAL RUNOFF 433,000 ac-ft
Based on period of record 1904-2004

LABELS ARE TOTAL INFLOW DURING
PERIOD IN ACRE-FEET

Prepared by TLT

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

**FORECASTED ANNUAL RUNOFF
BASED ON TOTAL INFLOW
DURING INDICATED PERIOD**

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE C-2

ESTIMATED ANNUAL RUNOFF PLUS STORED WATER ABOVE 1,000 ACRE-FEET EXPRESSED AS PERCENT OF AVERAGE OCT - JUL RUNOFF

Drought Level Associated with Estimated Water Available

CRIT	DRY	BLW AVG	*
50	75	100	>100

Historic drought levels based on the above criteria:

Water year	OCT	NOV	DEC	JAN	FEB	MAR
1962	BLW AVG	BLW AVG	BLW AVG	BLW AVG	BLW AVG	BLW AVG
1963	BLW AVG	BLW AVG	BLW AVG	BLW AVG	*	*
1964	*	*	*	BLW AVG	DRY	DRY
1965	BLW AVG	BLW AVG	*	*	*	*
1966	BLW AVG	*	*	BLW AVG	BLW AVG	BLW AVG
1967	BLW AVG	BLW AVG	*	*	*	*
1968	*	*	*	BLW AVG	BLW AVG	BLW AVG
1969	BLW AVG	BLW AVG	BLW AVG	*	*	*
1970	*	*	*	*	*	*
1971	BLW AVG	BLW AVG	BLW AVG	BLW AVG	BLW AVG	BLW AVG
1972	BLW AVG	BLW AVG	BLW AVG	BLW AVG	DRY	DRY
1973	BLW AVG	BLW AVG	BLW AVG	*	*	*
1974	*	*	*	*	*	*
1975	BLW AVG	BLW AVG	BLW AVG	BLW AVG	DRY	DRY
1976	*	*	BLW AVG	BLW AVG	DRY	DRY
1977	*	*	BLW AVG	BLW AVG	DRY	CRIT
1978	BLW AVG	BLW AVG	BLW AVG	*	*	*
1979	*	*	*	BLW AVG	BLW AVG	BLW AVG
1980	*	*	BLW AVG	*	*	*
1981	*	*	BLW AVG	BLW AVG	BLW AVG	DRY
1982	*	*	*	*	*	*
1983	*	*	*	*	*	*
1984	*	*	*	*	*	*
1985	*	*	*	*	BLW AVG	BLW AVG

* Indicates estimated water available is above average

A forecast less than 100% of average annual runoff and equal to or greater than 75% is considered **Below Average**.
A forecast of less than 75% of average, but equal to or greater than 50%, is considered **Dry**.
A forecast less than 50% of average annual runoff is considered **Critical**.

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

ESTIMATED ANNUAL RUNOFF PLUS STORED WATER ABOVE 1000 ACRE-FEET EXPRESSED AS PERCENT OF AVERAGE OCT - JUL RUNOFF

Prepared by TLT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005 (Sheet 1 of 2) PLATE C-3

ESTIMATED ANNUAL RUNOFF PLUS STORED WATER ABOVE 1,000 ACRE-FEET EXPRESSED AS PERCENT OF AVERAGE OCT - JUL RUNOFF

Drought Level Associated with Estimated Water Available

CRIT	DRY	BLW AVG	*
50	75	100	>100

Historic drought levels based on the above criteria:

Water year	OCT	NOV	DEC	JAN	FEB	MAR
1986	*	*	*	*	*	*
1987	*	*	BLW AVG	BLW AVG	DRY	DRY
1988	BLW AVG	BLW AVG	BLW AVG	BLW AVG	BLW AVG	DRY
1989	BLW AVG	BLW AVG	BLW AVG	BLW AVG	DRY	DRY
1990	BLW AVG	BLW AVG	BLW AVG	DRY	DRY	DRY
1991	BLW AVG	BLW AVG	BLW AVG	DRY	DRY	DRY
1992	BLW AVG	BLW AVG	BLW AVG	BLW AVG	DRY	DRY
1993	*	BLW AVG	BLW AVG	*	*	*
1994	BLW AVG	BLW AVG	BLW AVG	BLW AVG	DRY	DRY
1995	*	BLW AVG	BLW AVG	*	*	*
1996	*	BLW AVG	BLW AVG	BLW AVG	*	*
1997	BLW AVG	*	*	*	*	*
1998	*	*	BLW AVG	BLW AVG	*	*
1999	*	*	*	*	BLW AVG	BLW AVG
2000	BLW AVG	BLW AVG	BLW AVG	BLW AVG	BLW AVG	BLW AVG
2001	*	*	BLW AVG	BLW AVG	DRY	DRY
2002	BLW AVG	BLW AVG	*	*	BLW AVG	BLW AVG
2003	BLW AVG	BLW AVG	*	*	BLW AVG	BLW AVG
2004	BLW AVG	BLW AVG	DRY	BLW AVG	BLW AVG	BLW AVG

* Indicates estimated water available is above average

A forecast less than 100% of average annual runoff and equal to or greater than 75% is considered **Below Average.**

A forecast of less than 75% of average, but equal to or greater than 50%, is considered **Dry.**

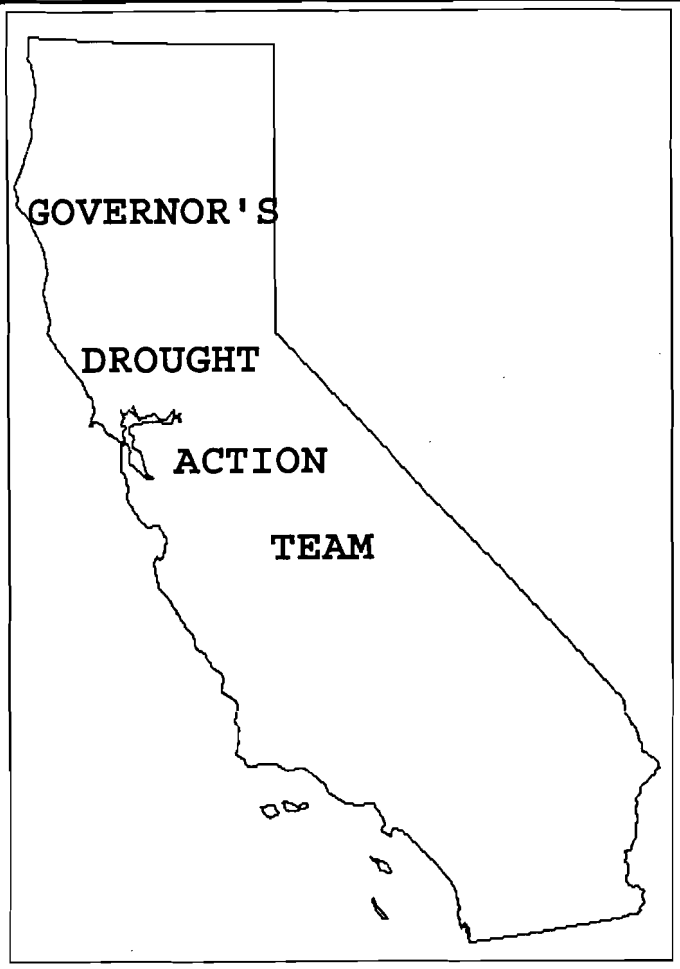
A forecast less than 50% of average annual runoff is considered **Critical.**

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

ESTIMATED ANNUAL RUNOFF PLUS STORED WATER ABOVE 1000 ACRE-FEET EXPRESSED AS PERCENT OF AVERAGE OCT - JUL RUNOFF

Prepared by TLT

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



State Resource Agency
Department of Food and Agriculture
Office of Emergency Services
Department of Finance
Department of Fish and Game
Department of Forestry and Fire Protection
Department of Health Services
Office of Planning and Research
Adjutant General of the Military Department

Under the Governor's Executive Order W-3-91, representatives from other boards or agencies, as follows, can be appointed.

State Water Resources Control Board
Public Utilities Commission
United States Department of Agriculture
United States Department of the Interior
United States Army Corps of Engineers
Federal Emergency Management Agency

TERMINUS DAM AND LAKE KAWEAH
KAWEAH RIVER, CALIFORNIA

DROUGHT MANAGEMENT COMMITTEES

Prepared by WLJ

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised Jul 2005

PLATE C-4

WATER CONTROL MANUAL

TERMINUS DAM AND LAKE KAWEAH

Kaweah River
California

EXHIBIT D

EMERGENCY SEISMIC ACTION PLAN
FOR
TERMINUS DAM AND LAKE KAWEAH

U.S. Army Corps of Engineers
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Sacramento, California

Revised July 2005

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