Draft Background Report on Friant Dam Operations

SAN JOAQUIN RIVER
RESTORATION PROGRAM

February 7, 2008

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Attachments

Appendix A – Operational Guidelines for Water Service Friant Division Central Valley Project

List of Abbreviations and Acronyms

CDFG	California Department of Fish and Game
cfs	cubic feet per second
cm	centimeter
CVACS	Central Valley Automated Control System
CVP	Central Valley Project
Delta	Sacramento-San Joaquin Delta
DWR	California Department of Water Resources
FPA	Friant Power Authority
FWUA	Friant Water Users Authority
IDF	inflow design flood
km	kilometer
kW	kilowatt
M&I	municipal and industrial
msl	mean sea level
OCID	Orange Cove Irrigation District
PEIS/R	Program Environmental Impact Statement/Report
PG&E	Pacific Gas and Electric
PMF	probable maximum flood
Reclamation	United States Department of the Interior, Bureau of Reclamation
RWS	Reservoir Water Surface
SCCAO	South-Central California Area Office
SCE	Southern California Edison
SEED	Safety Evaluation of Existing Dams
SJRRP	San Joaquin River Restoration Program
SOP	standard operating procedures
TM	Technical Memorandum
USACE	United States Army Corps of Engineers

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This Draft Technical Memorandum (TM) was prepared by the San Joaquin River Restoration Program (SJRRP) Team as a draft document in support of preparing a Program Environmental Impact Statement/Report (PEIS/R). The purpose for circulating this document at this time is to facilitate early coordination regarding initial concepts and approaches currently under consideration by the Program Team with the Settling Parties, the Third Parties, other stakeholders, and interested members of the public. Therefore, the content of this document may not necessarily be included in the PEIS/R.

This Draft TM does not present findings, decisions, or policy statements of any of the Implementing Agencies. Additionally, all information presented in this document is intended to be consistent with the Settlement. To the extent inconsistencies exist, the Settlement should be the controlling document and the information in this document will be revised prior to its inclusion in future documents. While the Program Team is not requesting formal comments on this document, all comments received will be considered in refining the concepts and approaches described herein to the extent possible. Responses to comments will not be provided and this document will not be finalized; however, refinements will likely be reflected in subsequent SJRRP documents.

1.0 Introduction

The intent of this Technical Memorandum (TM) is to provide a cursory understanding of the operations of Friant Dam, which is located on the San Joaquin River, California. It does not replace standard operating procedures (SOP) or other emergency actions deemed sensitive and necessary by the United States Department of the Interior, Bureau of Reclamation (Reclamation), South-Central California Area Office (SCCAO), for operation of Friant Dam; rather, it is a general review of how the facility functions. This document is neither comprehensive, nor to be used in any other capacity except as general background information to assist implementation of the Stipulation of Settlement in Case No. CIV S-88-1658 LKK/GGH (*NRDC v. Rodgers*).

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2.0 General Information on Friant Dam

This section provides general information on the construction of Friant Dam and other associated facilities.

2.1 Purpose of the Project

Governor Culbert L. Olsen of California at the groundbreaking ceremony (1939).

Friant Dam, located in the foothills of the Sierra Nevada approximately 25.0 miles (40.2 kilometers (km) northeast of Fresno, California, on the San Joaquin River, is one of the principal features of Reclamation's Central Valley Project (CVP). The project was originally authorized for Federal construction by an Executive Order dated September 10, 1935, wherein President Roosevelt transferred $20 million of emergency relief appropriation funds to the Department of the Interior for construction of Friant Dam and other features of the CVP. Congressional authorization was provided in the River and Harbor Act (Public Law No. 392) of August 26, 1937 (50 Stat. 850), and the River and Harbor Act of October 17, 1940 (Ch. 895, 54 Stat. 1198, 1199), extended the authorization to include irrigation distribution systems. Friant Dam controls San Joaquin River flows, provides downstream releases to meet requirements above Mendota Pool, and provides flood control, conservation storage, and diversion into the Madera and Friant-Kern canals.

The primary purpose of Friant Dam is to store and regulate the flow of the San Joaquin River to obtain maximum use of the water for later irrigation and municipal and industrial (M&I) uses. Since annual runoff varies widely, it is important to schedule releases carefully to avoid unnecessary spilling, and to deliver available water when needed most. Water delivery and release schedules at Friant Dam depend on the following:

- Quantity of water available
- Time water becomes available
- Flood control requirements
- Release schedules from storage reservoirs above Millerton Lake
- Water user requirements

2.2 San Joaquin River Drainage

The San Joaquin River basin lies between the crests of the Sierra Nevada Range and the Coast Range, and extends from the southern boundary of the Tulare Lake basin, near Fresno, to the northern boundary of the Sacramento-San Joaquin Delta (Delta), near Stockton. The basin, drained by the San Joaquin River and its tributary system, has an area of about 16,000 square miles (41,439.8 square km), extending about 130 miles (209.2 km) from the crest of the Sierra Nevada Range to the crest of the Coast.

The watershed above Friant Dam (see Figure 2-1) drains 1,638.0 square miles (4,242.4 square km) on the western slope of the Sierra Nevada in Fresno and Madera counties, and is bounded on the north by the watersheds of the Merced and Fresno rivers, and on the south by the watershed of the Kings River. It extends east to the crest of the Sierra Nevada with a general ridge elevation of about 10,000 feet[1] above mean sea level (msl) (3,048.0 meters), and occasional peak elevations greater than 13,000.0 feet (3,962.4 meters), and westward to Friant Dam about 25 miles (40.3 km) north from Fresno at an elevation of about 350 feet (106.7 meters).

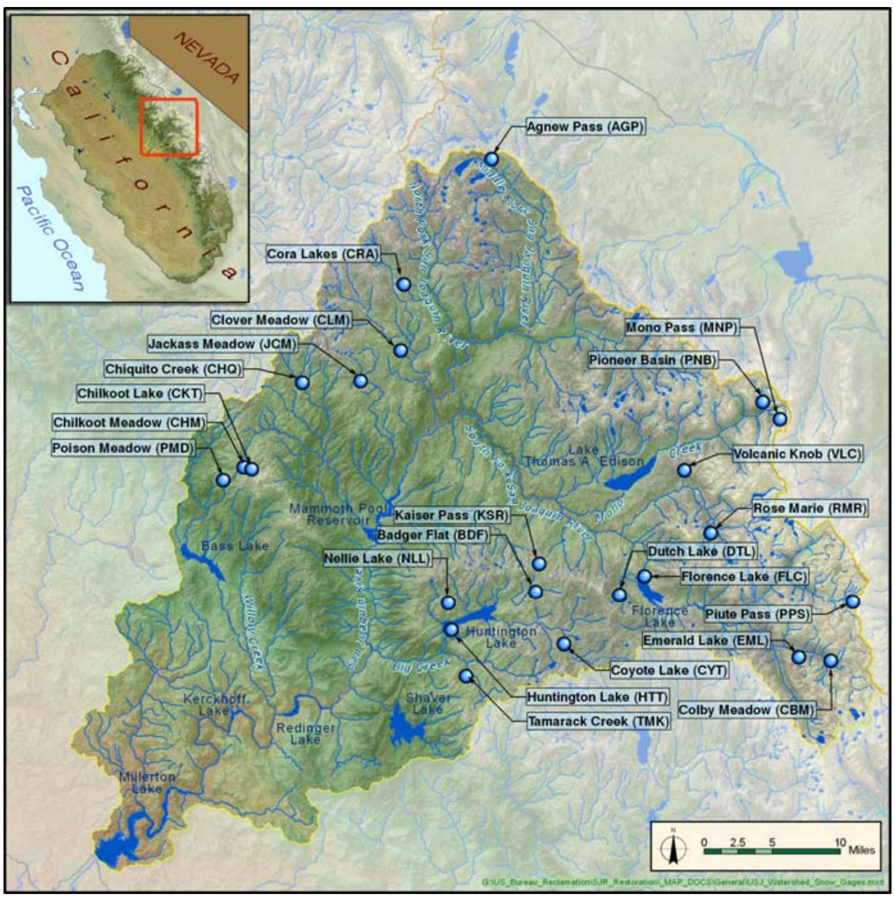


Figure 2-1 San Joaquin River Basin Above Friant Dam with Locations for Snow Survey

[1] Feet above mean sea level used throughout the TM.

The watershed above Friant Dam is extremely rugged in character and the geologic formations of the higher portion are largely granitic. The upper reaches of the river have several large branches; the three principal branches are the North, Middle, and South forks, each of which has its source in glacial lakes near the summit of the range. Of these streams, the South Fork drains the largest area and is considered the head of the main stream. The North Fork rises on the southern slope of Mount Lyell and flows in a nearly due south direction to its junction with the Middle Fork. The South Fork rises in Martha Lake, about elevation 11,000 feet (3,352.8 meters) southwest of Mount Hackel. The principal tributaries of the South Fork (Evolution, Piute, Bear, and Mono creeks) drain numerous lakelets, many of which are found at elevations of about 11,000 feet (3,352.8 meters). Below their confluence, the Middle and South forks form the main channel of the San Joaquin River, which flows in a narrow and deep canyon with steep sides until it begins to emerge from the foothills.

Below Friant Dam, the San Joaquin River basin above the mouth of the Merced River is bounded on the east by the foothill line, on the west by the Coast Range, and on the south by the Kings River basin. The San Joaquin River basin includes an area of about 7,900 square miles (20,460.9 square km), most of which are on the alluvial valley floor sloping gently from both sides toward the San Joaquin River. Elevations decrease from about 350 feet (106.7 meters) at the foothill line to about 60 feet (18.2 meters) at the mouth of the Merced River. To the west of the valley floor area, the Coast Range rises to a general ridge elevation of about 3,000 feet (914.4 meters), with peak elevations as high as about 5,000 feet (1,524 meters). The eastern slope of the Coast Range drains into the San Joaquin River through a group of relatively small intermittent streams, principally Panoche, Los Banos, and San Luis creeks, which enter the San Joaquin River between Mendota Dam (near the town of Mendota, Fresno County) and the mouth of the Merced River. From the mouth of the canyon below Friant Dam, the San Joaquin River flows in a southwesterly direction for about 60 miles (96.6 km) to Mendota Pool, and then in a northwesterly direction for about 85 miles (136.8 km) to the Merced River mouth near Newman.

Between Friant and Mendota dams, several small tributaries enter the river. The largest contributing tributary is Little Dry Creek, which, during major rain events, can contain significant amounts of floodwater diverted north from the Big Dry Creek Flood Control Project. During periods of high flows, floodwater can be diverted above Mendota Pool. The State-controlled lower San Joaquin levee system sends water through the Chowchilla Bypass, which begins about 10 miles (16.1 km) above the Mendota Pool and finally rejoins the San Joaquin River about 31 miles (49.9 km) downstream, near E1 Nido. Also, during periods of excess flood flows on the Kings River, water is diverted into the San Joaquin River at Mendota Pool via the Fresno Slough-James Bypass system. Inflows from the

San Joaquin River Below Friant Dam near Lost Lake State Park

San Joaquin River upstream from Friant Dam are modified by the many upstream reservoirs and diversions.

The flow of the upper San Joaquin River is similar in seasonal distribution and use to all other major streams flowing from the Sierra Nevada. Table 2-1 shows major characteristic of the San Joaquin River basin above Friant Dam.

Table 2-1
San Joaquin River Drainage Characteristics

Item	Description
Drainage Area	1,638 square miles (4,242.4 square kilometers)
Unimpaired Flows at Friant Dam	
Mean Annual Runoff (1873 to 1977)	1,790,000 acre-feet (2,207,932,489.2 cubic meters)
Maximum Annual Runoff	4,642,000 acre-feet (5,725,822,689.9 cubic meters)
Minimum Annual Runoff	361,000 acre-feet (445,286,943.4 cubic meters)
Maximum Instantaneous Inflow	97,000 cubic feet per second (2,746.3 cubic meters per second)
5-Day Volume (Dec. 23 to 28, 1955)	300,000 acre-feet (370,044,551.2 cubic meters)
Probable Maximum Flood (approved October 7, 1988)	
Peak Inflow	574,000 cubic feet per second (16,253.9 cubic meters per second)
Maximum 5-Day Volume	574,000 cubic feet per second (16,253.9 cubic meters per second)
Maximum 15-Day Volume	2,454,000 acre-feet (3,026,964,429.3 cubic meters)

Source: U.S. Department of the Interior (1981).

2.3 Friant Dam

Friant Dam is one of the key structures in the water resources development of the Central Valley. It is a concrete gravity dam structure located about 25 miles (40.2 km) northeast of Fresno and 25 miles (40.2 km) east of Madera. The dam was completed in 1942 and is 3,488.0 feet (1,063.1 meters) long at the crest. Other technical details of the dam are included in Table 2-2.

Friant Dam Under Construction

Table 2-2
Friant Dam Technical Information

Item	**Description**
Construction Period	**1939-1942**
Date of Closure (first storage)	February 21, 1944
Elevation: Top of Parapet	585.0 feet (178.3 meters)
Elevation: Crown of Roadway	581.0 feet (177.1 meters)
Maximum Height: Foundation to Crown of Roadway	319.0 feet (97.2 meters)
Hydraulic Height: Streambed to Maximum Controllable Water Surface	296.0 feet (90.2 meters)
Maximum Base Width	267.0 feet (81.4 meters)
Volume of Concrete	2,135,000.0 cubic yards (1,632,324.6 cubic meters per second)
Slope Upstream	Vertical
Slope Downstream	0.7:1
Crest	
Width of Crest	20.0 feet (6.1 meters)
Gross Crest Length	332.0 feet (101.1 meters)
Net Crest Length	300.0 feet (91.4 meters)
Crest Elevation	560.0 feet (170.7 meters)
Discharge Capacity	83,160.0 cubic feet per second (2,354.8 cubic meters per second)
Drum Gate (floating drum type)	
Number	One
Size	100.0 feet by 18 feet (30.5 meters by 5.5 meters)
Top Elevation When Lowered	560.0 feet (170.7 meters)
Top Elevation When Raised	578.0 feet (176.1 meters)
Crest Gate (Obermeyer crest type)	
Number	Two
Size	100.0 feet by 18.0 feet (30.5 meters by 5.5 meters)
Top Elevation When Lowered	560.0 feet (170.7 meters)
Top Elevation When Raised	578.0 feet (176.1 meters)

Source: U.S. Department of the Interior (1981).

2.3.1 Spillway

The spillway is a 332-foot-wide (101.2 meters) ogee-shaped overflow section, with a chute, and a stilling basin at the center of the dam. Flow over the spillway is controlled by one drum gate in the center bay and two Obermeyer crest gates in the two outside bays.

2.3.2 River Outlets

The river outlets are four 110-inch-diameter (279.4 centimeters (cm)) steel pipes (R1, R2, R3, and R4) through the dam in Blocks 34 and 35. All four outlet pipes are connected to 96-inch-diameter hollow-jet valves, which are used for regulating large discharges into the river. Outlet Pipe R1 branches off to a 48-inch-diameter (1.2 meters) penstock that supplies water to the Friant Power Authority's (FPA) River Outlet Powerplant. Outlet Pipes R1 and R2 branch off to feed a common 24-inch-diameter (61.0 cm) low-level pipe for the Orange Cove Powerplant and the fish water release system. Outlet Pipes R3 and R4 each branch off and feed an 18-inch-diameter (45.7 cm) pipe, which connects to 18-inch-diameter (45.7 cm) needle valves. These two needle valves are used to regulate small discharges to the river. The dam serves the dual purpose of storage for irrigation and flood control. Details of the river outlets are shown in Table 2-3. See Figure 2-2 for a sketch of the river outlet works.

Table 2-3
River Outlet Technical Information

Item	Description
Number of Steel Pipes	Four
Steep Pipe Diameter	110 inches (2.8 meters)
Intake Centerline Elevation	380.0 feet (115.8 meters)
Valves and Control	Four 96-inch-diameter (2.4 meters) hollow-jet valves, two 18-inch-diameter (45.7 centimeters) needle valves, and one 2,000 kW Francis turbine and induction generator
Capacity at Minimum Pool	13,000.0 cubic feet per second (368.1 cubic meters per second)
Capacity at Gross Pool	17,000.0 cubic feet per second (481.4 cubic meters per second)

Source: U.S. Dept. of Interior (1981).
Key:
kW = kilowatt

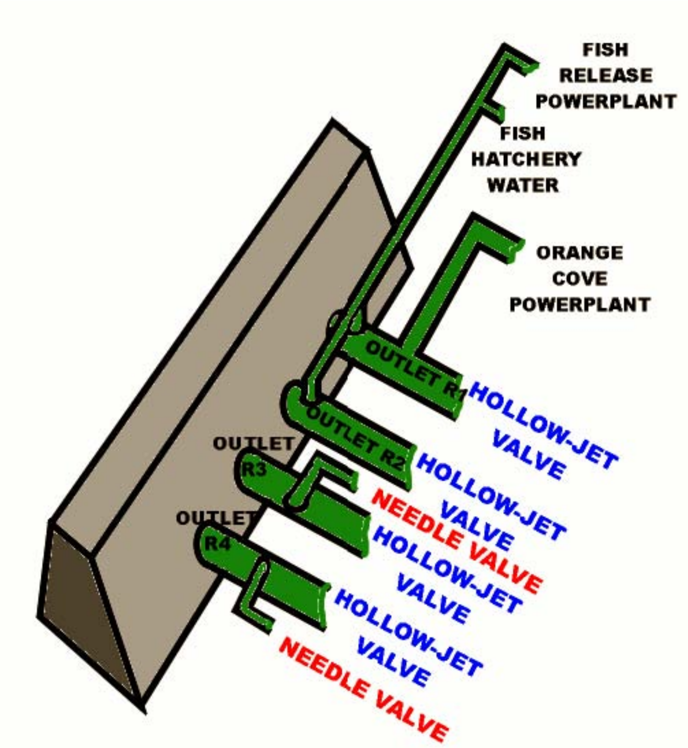


Figure 2-2
Sketch of River Outlet Works at Friant Dam.

2.4 Millerton Lake

Millerton Lake and Friant Dam

Millerton Lake, created behind Friant Dam, has a total capacity of 520,500.0 acre-feet (642,027,296.4 cubic meters) between its streambed and the top of the active conservation level. The lake was named after Millerton, a pioneer settlement that is now submerged below the lake.

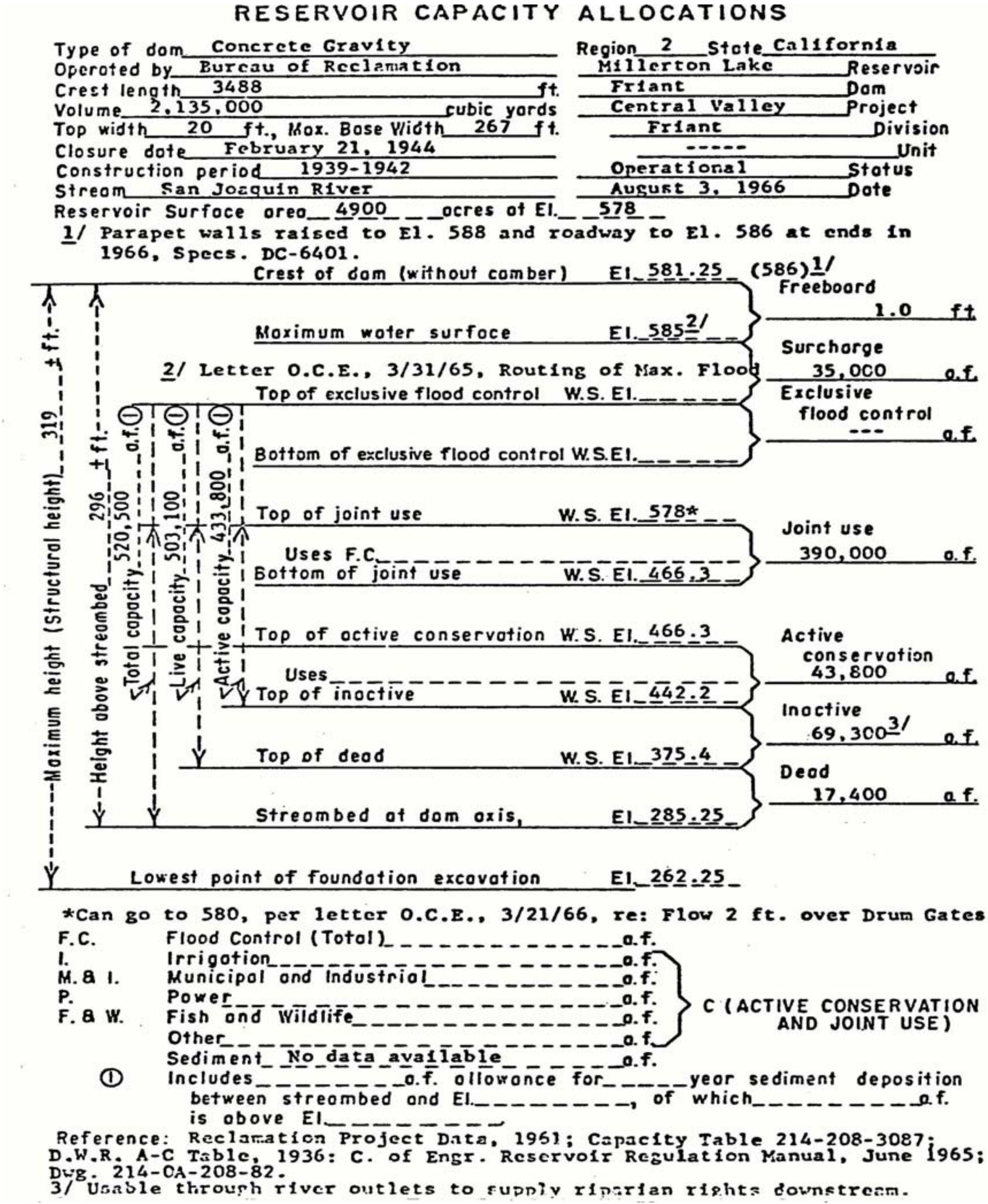
Millerton Lake covers 4,900.0 acres (1,983.0 hectares), and has a shoreline of 47.0 miles (75.6 km). The total active capacity (elevation 442.0 feet to 578.0 feet) (134.8 meters to 176.2 meters) is 433,800.0 acre-feet (547,419,239.5 cubic meters). Millerton Lake is 3.0 miles (4.9 km) wide at its widest point, and stretches more than 16.0 miles (25.7 km) back up the river canyon. The Millerton Lake State Recreation Area is administered by the State of California Department of Parks and Recreation. Technical information for Millerton Lake is presented in Table 2-4.

Table 2-4
Millerton Lake Technical Information

Item	Description
Elevation	
Minimum Operating Level Elevation	466.1 feet (142.1 meters)
Gross Pool Elevation	578.0 feet (176.2 meters)
Area	
Minimum Operating Level	2,100.0 acres (849.8 he)
Gross Pool	4,850.0 acres (1,962.7 he)
Storage Capacity	
Minimum Operating Level	130,000.0 acre-feet (160,352,638.9 cubic meters)
Gross Pool	520,500.0 acre-feet (642,027,296.4 cubic meters)
Length	16.0 miles (25.7 km)

Source: U.S. Department of the Interior (1981).
Key:
he = hectare km = kilometer

Water stored in Millerton Reservoir for irrigation is distributed through the Friant-Kern and Madera canals and provides downstream flood control releases to meet water rights requirements above Mendota Pool. The reservoir also serves as a recreational area providing camping, fishing, picnicking, and swimming. The allocation of reservoir space is summarized in Figure 2-3.



Source: U.S. Department of the Interior (1961).

Figure 2-3
Reservoir Capacity Allocation

2.5 Saddle Dams and Roadway Embankment

Three small earthfill dams (Dikes 1, 2, and 3), located in the Millerton Lake State Recreation Area, were originally constructed in 1942 to bring the reservoir rim up to elevation 590.0 feet (179.8 meters) throughout the recreation area. The recreation area was developed after construction of the dikes without regard to the elevation 590.0 feet (179.8 meters) criterion. Landscaping and road construction for the recreation area altered the shape of Dikes 1 and 2 such that these structures are now hardly recognizable. Dike 3 is located outside the Millerton Lake State Recreation Area, on Millerton Road, and remains essentially as it was originally constructed. During construction of the recreation area, a roadway embankment was built downstream from the original locations of Dikes 1 and 2. This embankment represents the low point in the reservoir rim, with an average crest elevation of 586.0 feet (178.6 meters). Dike 3 and the roadway embankment store water when the reservoir is at the top of active conservation, elevation 578.0 feet (176.2 meters).

2.6 Friant-Kern Canal

The Friant-Kern Canal carries water from Millerton Lake south for supplemental and new irrigation supplies in Fresno, Tulare, and Kern counties. Construction of the canal began in 1945 and was completed in 1951. The canal is 151.2 miles (243.3 km) long and has an initial capacity of 5,300.0 cubic feet per second (cfs) (150.1 cubic meters per second), which gradually decreases to 2,000.0 cfs (56.7 cubic meters per second) at its terminus in the Kern River about 4 miles (6.4 km) west of Bakersfield. Water is delivered to the Friant-Kern Canal from Millerton Lake through four 110-inch-diameter (279.4 cm) steel pipes through the dam. Figure 2-4 shows a diagram of the Friant-Kern Canal outlet works.

Two of the outlet pipes (F3 and F4) come through the dam in Block 20 and connect to two 96-inch-diameter (243.8 cm) hollow-jet valves. The other two outlet pipes (F1 and F2) come through the dam in Block 19 and then split (bifurcate) into two pipes. One branch from each outlet pipe is connected to two 108-inch-diameter fixed cone valves; the other branch is connected to form a common penstock and deliver water through to the 15,000-kilowatt (kW) FPA Kaplan turbine, located in the powerplant at the Friant-Kern Canal structure. Each powerplant branch has its own turbine shutoff butterfly valve. All outlets eventually discharge into the Friant-Kern Canal. An 18-inch-diameter line taps off the bottom of Outlet Pipe F4 and runs to the Friant Fish Hatchery mixing valve box. A 30-inch-diameter line taps off the top of Outlet Pipe F3 and runs to the Fish

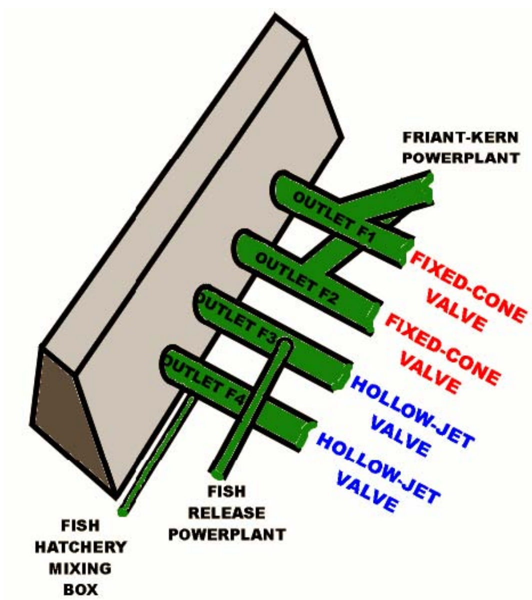


Figure 2-4
Sketch of Friant-Kern Canal Outlet Works at Friant Dam

Release Powerplant, owned and operated by the Orange Cove Irrigation District (OCID). Table 2-5 summarizes Friant-Kern Canal outlet works technical information.

Table 2-5
Friant-Kern Canal Outlet Works Technical Information

Item	Description
Material	Steel
Number	Four
Pipe Diameter	110.0 inches (2.8 meters)
Centerline Elevation	464.0 feet (141.4 meters)
Valves and Control	Two 96-inch-diameter (2.4 meters) hollow-jet valves, two 108-inch-diameter (2.7 meters) fixed-cone valves, and one 15,000.0 kW horizontal Kaplan turbine and synchronous generator
Total Capacity of Valves at Minimum Pool (elevation 466.3 feet/142.1 meters)	400.0 cubic feet per second (11.3 cubic meters per second)
Total Capacity of Valves at Gross Pool (elevation 578.0 feet/176.2 meters)	Limited by canal capacity
Capacity of Friant-Kern Canal at Head	5,300.0 cubic feet per second (150.1 cubic meters per second)

Source: U.S. Department of the Interior, (1981).
Key:
cfs = cubic feet per second   kW = kilowatt

2.7 Madera Canal

The 35.9-mile-long (57.8 km) Madera Canal carries water north from Millerton Lake to furnish lands in Madera County with a supplemental and new irrigation supply. The canal, completed in 1945, has an initial capacity of 1,250.0 cfs (35.4 cubic meters per second), decreasing to a capacity of 625.0 cfs (17.7 cubic meters per second) at the Chowchilla River. Water is delivered to the Madera Canal from Millerton Lake through two 91-inch-diameter (231.1 cm) steel pipes through the dam in Block 58. Figure 2-5 shows the diagram of Madera Canal outlet works.

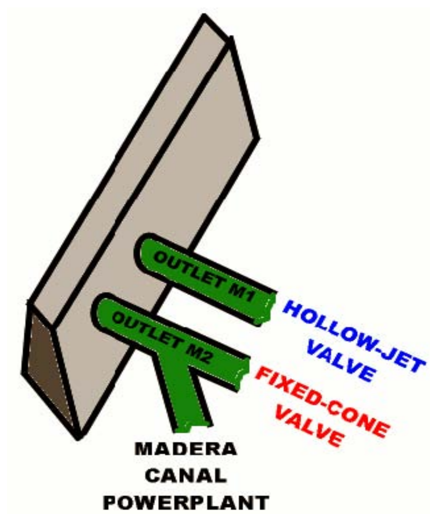


Figure 2-5
Sketch of Madera Canal Outlet Works at Friant Dam

One of the outlet pipes (M1) connects to a 96-inch-diameter (243.8 cm) hollow jet valve that was removed from the Friant-Kern Canal outlet works. The other outlet pipe (M2) splits (bifurcates) into two pipes. One branch from Outlet Pipe M2 connects to a 78-inch-diameter (2.0 meters) fixed cone valve. The other branch forms a penstock and delivers water through a butterfly valve to the 8,000.0 kW FPA horizontal Kaplan turbine, located in the powerplant at the Madera Canal structure. All outlets eventually discharge into the Madera Canal. Table 2-6 summarizes Madera Canal outlet works technical information.

Table 2-6
Madera Canal Outlet Works Technical Information

Item	Description
Material	Steel
Number	Two
Pipe Diameter	91.0 inches (2.3 meters)
Centerline Elevation	446.0 feet (136.0 meters)
Valves and Control	One 96-inch-diameter (2.4 meters) hollow-jet valve, one 78-inch-diameter (2.0 meters) fixed-cone valve, and one 8,000.0 kW horizontal Kaplan turbine and synchronous generator
Total Capacity of Valves at Minimum Pool (elevation 466.3 feet/142.1 meters)	Limited by canal capacity
Total Capacity of Valves at Gross Pool (elevation 578.0 feet/176.2 meters)	Limited by canal capacity
Capacity of Madera Canal at Head	1,275.0 cubic feet per second (36.1 cubic meters per second)

Source: U.S. Department of the Interior, (1981).
Key:
kW = kilowatt

3.0 Normal Operations at Friant Dam

This section summarizes Friant Dam operations during normal conditions. Flood control operations are summarized in the next section.

3.1 Runoff Forecasting

Eight dams located upstream from Friant Dam are operated and maintained by Southern California Edison (SCE). The Mammoth Pool Agreement, a contract between SCE and Reclamation, dictates how SCE will operate its facilities (Reclamation and SCE, 1957). On or about February 1 each year, SCE submits its Big Creek Water Management Plan to the Chief of the SCCAO Operations Division.

The State of California, Department of Water Resources (DWR), prepares an unimpaired flow forecast beginning February 1. Meanwhile, DWR updates the Water Supply Forecast on a monthly basis until runoff stabilizes (usually in June or July), and publishes the forecast on its Web site.[2]

Pacific Gas and Electric (PG&E) operates one dam upstream from Friant Dam. The Miller Lux Agreement, which is a contract between Reclamation and PG&E, dictates how PG&E will operate this facility (Reclamation and PG&E, 1909). On or about February 1, PG&E submits its water operation plan to the Chief of the SCCAO Operations Division.

Before February 20 each year, the SCCAO Operations Division notifies each water user with a long-term contract of the estimated water available for the contract year (March 1 through the following February), based on the February 1 forecast. Water users then send in schedules showing the quantities of water each plan will use each month during the contract year. The SCCAO Operations Division then summarizes the users' schedules. Based on the DWR forecast, SCE Water Management Plan, PG&E Water Plan, and water delivery schedules, Reclamation develops its initial Water Supply Forecast of 90 percent exceedence, 50 percent exceedence, and 10 percent exceedence.

Each subsequent month, a revised Water Supply Forecast is prepared from the most recent hydrological data and most recent user demands. This information is again summarized by the SCCAO Operations Division and presented to the Friant Water Users Authority (FWUA)[3] during its monthly Engineers-Managers meeting. Ten days following the meeting, a standing request

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[2] http://cdec.water.ca.gov

[3] The FWUA includes the following agencies: Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Exeter Irrigation District, Fresno Irrigation, Ivanhoe Irrigation District, Kern-Tulare Water District, Lindmore Irrigation District, Lindsay-Strathmore Irrigation District, Lower Tule River Irrigation District, Orange Cove Irrigation District, Pixley Irrigation District, Porterville Irrigation District, Rag Gulch Water District, Saucelito Irrigation District, Shafter-Wasco Irrigation District, Southern San Joaquin Municipal Utility District, Stone Corral Irrigation District, Tea Pot Dome Water District, Terra Bella Irrigation District, and Tulare Irrigation District.

for revised water schedules is sent to the SCCAO. The SCCAO Operations Division summarizes the "new" schedules and develops the Millerton Lake Operation Forecast of Water Supply and Requirements.

3.2 Daily Water Delivery

When the schedules are approved by the Chief of the SCCAO, the contract water users submit daily water orders based on their needs, and the approved schedules, to FWUA and the Madera and Chowchilla Water and Power Authority. The authorities then call in daily water orders to the dam tenders at Friant Dam. The procedures below are followed.

- Daily water delivery orders, based on approved water delivery schedules from the contract users, are placed with the appropriate FWUA office.

- FWUA consolidates orders for the Friant-Kern Canal and calls release requirements to the Friant Dam office.

- The Madera and Chowchilla Water and Power Authority consolidates orders for the Madera Canal and calls release requirements to the Friant Dam office.

- The dam operator at the Friant Dam office determines the required generator releases and/or valve settings. FPA and OCID are notified by the dam operator and adjust turbine outputs, as required. The dam operator adjusts any discharge valves needed to supplement the turbines and deliver the required flow. The dam operator is ultimately responsible for controlling the flow.

- The Reclamation computer model (USAN; Madeheim, 2000) is updated daily to analyze Millerton Lake operations and prepare future operations.

3.3 Friant-Kern Canal Releases

The Friant-Kern Canal outlet works consists of four 110-inch-diameter (2.8 meters) steel pipes through the dam. The discharge from Outlet Pipes F3 and F4 is controlled by two 96-inch-diameter (2.4 meters) hollow-jet valves. The discharge from Outlet Pipes F1 and F2 is controlled by two 108-inch-diameter (2.8 meters) fixed-cone valves, and one 15,000.0 kW Kaplan turbine and synchronous generator. See Figure 3-1 for a schematic of a hollow-jet valve.

Distribution of flows through the Friant-Kern Canal outlet works is determined by powerplant parameters, operating head, valve availability, and minimum and maximum valve flows, etc. Normally, as much water as possible is passed through the powerplant turbine; however, at low lake elevations, powerplant flows are limited by the low operating head, and at high lake levels, powerplant flows are limited by the generator design capacity. Larger turbine flows, up to a maximum of 3,500.0 cfs (99.1 cubic meters per second), are only available at intermediate lake elevations.

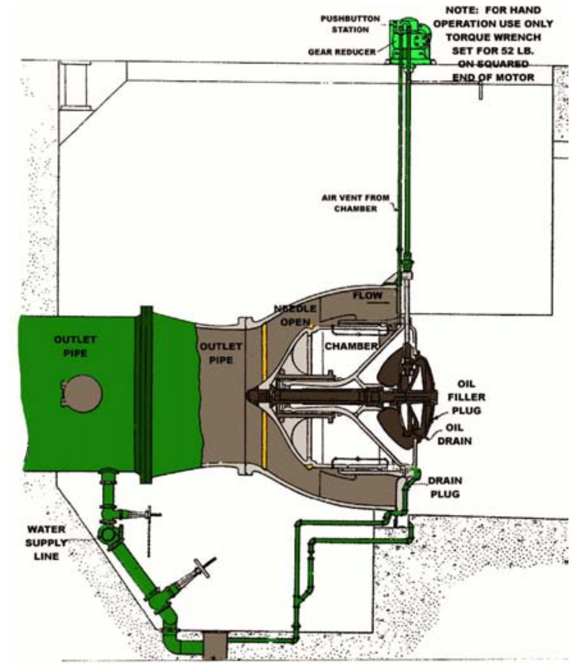

Figure 3-1
Schematic of Hollow-Jet Valve at Friant Dam

Normal operation of the Friant-Kern outlet works could occur as follows:

- Releases to the Friant-Kern Canal may be made through the following:
  - The 15,000.0 kW horizontal turbine
  - The 96-inch-diameter (2.4 meters) hollow-jet valves, F-3 and F-4
  - The 108-inch-diameter (2.7 meters) fixed-cone valves, F-1 or F-2
  - Any combination of the above

- The goal in delivering water to the canal system is to achieve at least a 3 percent variance in the requested flow. Optimal operations are best achieved by adhering to the following set of guidelines when using the 96-inch-diameter (2.4 meters) hollow-jet valves and/or 108-inch-diameter (2.7 meters) fixed cone valves:

  - When starting a valve for the first time, after a period of being idle, the valve should be flushed of any debris. This would require that the valve be opened to 20 percent to flush the valve and the penstock before adjusting the valve to the desired setting.

  - The valves should not be operated at less than 10 percent opening (to minimize cavitation damage).

  - The valves should not be operated at greater than 30 percent opening without being in combination with another delivery system.

  - All operations of the hollow-jet valves are made by Reclamation personnel. The valve settings are in tenths of percent increments. Normally, valve adjustments are made at the valve stand by manipulating the valve motor, as desired, while observing the valve position indicator. The valves can also be operated from the Central Valley Automated Control System (CVACS) in the Friant Dam operations office.

  - All operations of the fixed-cone valves are performed by FPA personnel. Valve settings are in tenths of percent increments. Valve adjustments are made through the powerplant controller. Reclamation personnel observe, and assist with, these adjustments.

  - Valve operations are performed with all slack out of the valve stem, motor, or ram to prevent the valve from drifting open. This is accomplished by making sure the motor on the hollow-jet valves and the ram on the fixed-cone valves are always stopped in the open direction when making adjustments.

- When the powerplant is off, valve use is as follows:

  - For discharges of 200.0 to 500.0 cfs (5.7 to 14.2 cubic meters per second) - use 1 valve
  - For discharges of 500.0 to 2,000.0 cfs (14.2 to 56.6 cubic meters per second) - may use 2 valves
  - For discharges of 1,000.0 to 2,000.0 cfs (28.3 to 56.6 cubic meters per second) - may use 4 valves
  - For discharges of 2,000.0 to 5,300.0 cfs (56.6 to 150.1 cubic meters per second) - use 4 valves

3.4 Madera Canal Releases

The Madera Canal outlet works consist of two 91-inch-diameter (2.3 meters) steel pipes through the dam. The discharge from Outlet Pipe M1 is controlled by one 96-inch-diameter (2.4 meters) hollow-jet valve. The discharge from Outlet Pipe M2 is controlled by one 78-inch-diameter (2.0 meters) fixed-cone valve, and one 8,000.0 kW Kaplan turbine and synchronous generator.

Distribution of flows through the Madera Canal outlet works is determined by powerplant parameters, operating head, valve availability, and minimum and maximum valve flows, etc. Normally, as much water as possible is passed through the powerplant turbine; however, at low lake elevations, powerplant flows are limited by the low operating head, and at high lake levels, powerplant flows are limited by the generator design capacity. Larger turbine flows, up to a maximum of ~1,000.0 cfs (28.3 cubic meters per second), are only available at intermediate to higher lake elevations.

Normal operation of the Madera Canal outlet works could be any of the following:

- Releases to the Madera Canal may be made through the following:
  - The 8,000.0 kW horizontal turbine
  - The 96-inch-diameter (2.4 meters) hollow-jet valve M-1
  - The 78-inch-diameter (2.0 meters) fixed-cone valve M-2
  - Any combination of the above

- The goal in delivering water to the canal system is to achieve at least a 3 percent variance in the requested flow. Optimal operations are best achieved by adhering to the following set of guidelines when using the 96-inch-diameter (2.4 meters) hollow-jet valves and/or 108-inch-diameter (2.7 meters) fixed cone valves:

  – When starting a valve for the first time, after a period of being idle, the valve should be flushed of any debris. This would require that the valve be opened to 20 percent to flush the valve and the penstock before adjusting the valve to the desired setting.

  – The valves should not be operated at less than 10 percent opening (to minimize cavitation damage).

  – The valves should not be operated at greater than 30 percent opening without being in combination with another delivery system.

  – All operations of the hollow-jet valve are made by Reclamation personnel. The valve settings are in tenths of percent increments. Normally, valve adjustments are made at the valve stand by manipulating the valve motor as desired while observing the valve position indicator. The valve can also be operated from the CVACS in the Friant Dam operations office.

  – All operations of the fixed-cone valve are made by FPA personnel. Valve settings are in tenths of percent increments. Valve adjustments are made through the powerplant controller. Reclamation personnel observe, and assist with, these adjustments.

  – Valve operations are performed with all slack out of the valve stem, motor, or ram to prevent the valve from drifting open. This is accomplished by making sure the motor on the hollow-jet valve, and the ram on the fixed-cone valve, are always stopped in the open direction when making adjustments.

- When the powerplant is off, valve use is as follows:

  – For discharges of 200.0 to 500.0 cfs (5.7 to 14.2 cubic meters per second) - use 1 valve

  – For discharges of 500.0 to 1,275.0 cfs (14.2 to 36.1 cubic meters per second) - use 2 valves

Frontal View of Madera Canal Outlet Works at Friant Dam

3.5 San Joaquin River Releases

The San Joaquin River outlet works consist of four 110-inch-diameter (2.8 meters) steel pipes (R1, R2, R3, and R4), each controlled by a 96-inch-diameter (2.4 meters) hollow-jet valve. Small releases to the river can be made through two 24-inch-diameter (.6 meters) steel pipes that branch from Outlet Pipes R3 and R4 and are controlled by two 18-inch-diameter (.5 meters) needle valves. Small releases can also be made through a 48-inch-diameter (1.2 meters) steel pipe that branches from Outlet Pipe R1, and delivers water to the FPA 2,000.0 kW powerplant, located just south of the stilling basin. Total capacity of the river outlet works is 17,000.0 cfs (481.4 cubic meters per second) at a full lake elevation of 578.0 feet (176.2 meter).

Reclamation has contractual commitments to deliver riparian water for the first 38 river miles below Friant Dam. Reclamation also has a contract with the State of California Department of Fish and Game (CDFG) to deliver water flows ranging up to 35.0 cfs (1.0 cubic meter per second) to the California State Fish Hatchery located below Friant Dam. When making deliveries to accommodate these contractual obligations, the required flow, or a portion of the flow, may be made available to the FPA powerplant (River Outlet Powerplant) and/or the OCID powerplant (Fish Release Powerplant) for power generation. Operation of these powerplants should not restrict Reclamation’s ability to fulfill its downstream obligations and contractual needs.

- **FPA River Outlet Powerplant –** Water for the FPA River Outlet Powerplant is delivered through the R-1 penstock on the river outlet works. Water goes through the powerplant and then enters the left stilling basin at the base of the dam. Operation of this powerplant, and flows through it, are made by FPA employees, as directed by the Reclamation dam tender on duty.

- **OCID Fish Release Powerplant on the Fish Hatchery Pipeline –** The OCID Fish Release Powerplant releases water to the main pipeline leading to the fish hatchery located downstream from the dam in the town of Friant. The water released through the pipeline system to the California State Fish Hatchery reenters the San Joaquin River channel above the Lost Lake Campground. Operation of this powerplant, and flows through it, are made by OCID employees, as directed by the Reclamation dam tender on duty.

Normal releases to the San Joaquin River can be a single or a combined release of any of the following:

- FPA River Outlet Powerplant
- OCID Fish Release Powerplant
- Needle valves, 18 inches (45.7 cm)

The following rules will apply when making this type of delivery:

- **OCID Fish Release Powerplant on the Fish Hatchery Pipeline –** Release flows through the powerplant can vary up to 45.0 cfs (1.3 cubic meters per second) according to the OCID license. Reclamation has a contract with CDFG to supply up to 35.0 cfs (1.0 cubic meter per second) to the fish hatchery. Calculated wicket gate openings (for a desired discharge) vary for this system due to varying head (reservoir elevation) at different times during a water year.

  When demands on the San Joaquin River are within the release capability of the powerplants (FPA and OCID), delivery through the OCID Fish Release Powerplant may be set at any flow up to 35.0 cfs (1.3 cubic meters per second), provided OCID is not using the fish hatchery pipeline overflow system or the powerplant bypass system (spilling water to the stilling basin).

  When the FPA River Outlet Powerplant has achieved maximum generation, or 100 percent wicket gate opening, OCID may increase generation at its powerplant up to a maximum flow rate of 45.0 cfs (1.3 cubic meters per second), and may use the pipeline overflow system, provided this increased flow does not exceed Reclamation-requested total San Joaquin River water release.

  Note that the total San Joaquin River water release from Friant Dam is considered to be waters released through the FPA River Outlet Powerplant, OCID Fish Release Powerplant (fish hatchery main pipeline) and any of the valve systems (18-inch-diameter/ 45.7 cm or 96-inch-diameter/2.4 meters).

- **Operation of the 18-Inch-Diameter (45.7 cm) Needle Valves –** When the demand releases on the San Joaquin River have exceeded the capability of the powerplants (FPA and OCID), one or two 18-inch-diameter (45.7 cm) needle valves may be used to supplement the flow.

  Note that the minimum opening on an 18-inch-diameter (45.7 cm) needle valve is 15 percent. When using the needle valves, releases through the OCID Fish Release Powerplant cannot exceed 35.0 cfs (1.0 cubic meter per second), and cannot spill to the stilling basin until the FPA River Outlet Powerplant has achieved maximum generation, or 100 percent wicket gate opening, and the minimum opening requirements for the 18-inch-diameter (45.7 cm) needle valves have been met. Once these requirements have been met, OCID may increase generation up to a maximum flow rate of 45.0 cfs (1.3 cubic meters per second) and use the pipeline overflow system, provided this increased flow does not exceed Reclamation-requested total San Joaquin River water releases.

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4.0 Flood Operations at Friant Dam

This section summarizes Friant Dam operations during flooding conditions.

4.1 Design Flood Study and Routing

4.1.1 Design Flood Characteristics

The current probable maximum flood (PMF) was approved for use in the Safety Evaluation of Existing Dams (SEED) Program in a memorandum from the Planning Services Manager to the Regional Director, Sacramento, California (Reclamation, 1998). Table 4-1 shows characteristics of the PMF.

Table 4-1
Probable Maximum Flood Characteristics

Peak Inflow	574,000.0 cubic feet per second (16,253.9 cubic meters per second)
Maximum 12-Hour Volume	552,000.0 acre-feet (680,881,974.3 cubic meters)
Maximum 1-Day Volume	1,028,000.0 acre-feet (1,268,019,329.0 cubic meters)
Maximum 5-Day Volume	2,240,000.0 acre-feet (2,762,999,316.10 cubic meters)
Maximum 15-Day Volume	2,454,000.0 acre-feet (3,026,964,429.3 cubic meters)
Peak Outflow	570,000.0 cfs (16,140.6 cubic meters per second)
Maximum Water Surface Elevation	595.60 feet (181.5 meters) (above msl)
Maximum Storage	611,500.0 acre-feet (754,274,143.7 cubic meters)

Source: U.S. Department of the Interior, Bureau of Reclamation, Safety Evaluation of Existing Dams Program, Memorandum from the Manager, Planning Services, to the Regional Director, Sacramento, California, October 7, 1998.
Key:
msl = mean sea level

The Reclamation Mid-Pacific Regional Office requested that the inflow design flood (IDF) be the flood that peaks just before overtopping, at elevation 585.0 feet (178.3 meters), which is the top of the parapet wall. TM No. FRD-3110-1-90, using the SOP for downstream releases, determined that 28 percent of the PMF will result in a maximum reservoir water surface (RWS) of 585.0 feet (178.3 meters), and therefore should be equated to the IDF (Reclamation, 1990).

4.1.2 Flood Routing Criteria

The IDF, as routed through Friant Dam, was subject to the following conditions:

- Both the river outlet works and the spillway were used as indicated by the SOP.
- The initial RWS elevation was 539.3 feet (164.4 meters), which is the bottom of the 170,000 acre-foot (209,691,912.4 cubic meters) flood pool.
- No use was made of either the Friant-Kern or Madera canal outlet works. It was assumed that with a flood of this magnitude, no flow could be tolerated in either canal.

4.1.3 Runoff Characteristics

The flow of the upper San Joaquin River is similar in seasonal distribution and use to all other major streams flowing from the Sierra Nevada. In general, runoff occurring during the months of April through July results from melting of the mountain snowpack accumulated during the winter. Large rain floods are rare during the snowmelt season.

Annual runoff at Friant Dam has ranged from a minimum of 361,183.0 acre-feet (445,512,670.5 cubic meters) in water year 1976 to 1977, to a maximum of 4,641,604.0 acre-feet (5,725,334,231.1 cubic meters) in water year 1982 to 1983. These extremes represent 21 percent and 266 percent, respectively, of the 89-year average runoff of 1,745,700.0 acre-feet (2,153,289.8 cubic meters), based on Reclamation records. Annual runoff from the 1,633.0 square miles (4,229.5 square km) above Friant Dam averages about 21 inches (53.3 cm), and is about 52 percent of the total average annual precipitation of 40.0 inches (1.0 meter). About 72 percent of the runoff at Friant occurs during the snowmelt season (April through July). The monthly distribution of runoff is given in Table 4-2.

Table 4-2
Average Monthly Runoff Data

Month	(acre-feet / cubic meters)	Percent
October	20,900.0 / 25,779,770.4	1.2
November	32,000.0 / 39,471,418.8	1.8
December	56,500.0 / 69,691,723.8	2.2
January	82,600.0 / 101,885,599.8	4.7
February	101,800.0 / 125,568,451.1	5.8
March	146,000.0 / 180,088,348.3	8.3
April	238,900.0 / 294,678,811.0	13.7
May	434,200.0 / 535,577,813.9	24.9
June	383,000.0 / 472,423,543.8	21.9
July	172,000.0 / 212,158,876.1	9.9
August	53,100.0 / 65,497,885.6	3.0
September	24,600.0 / 30,343,653.2	1.4

Source: U.S. Department of the Interior, Bureau of Reclamation (2007).

4.1.4 Flood Characteristics

Floods in the upper San Joaquin River basin are typical of those occurring in other Sierra Nevada streams. Floods are rather frequent, and of two general types:

- Floods that occur during the late fall and winter, primarily as a result of intense rainfall in the mountains
- Floods that occur during the late spring and summer primarily as a result of mountain snowmelt.

Rain Floods

Rain floods, which generally occur from November through March, are characterized by high peak discharges caused by heavy rains, sometimes augmented by melting snows at intermediate elevations. High stages last only a few days and runoff volumes are comparatively small. The largest rain flood on record of the San Joaquin River at Friant was on December 1955. It produced a computed 2-hour instantaneous peak inflow to Millerton Reservoir of 97,000.0 cfs (2,746.7 cubic meters per second) and a 5-day volume of 300,000.0 acre-feet (370,044,551.3 cubic meters). The next largest was the flood of January 1997. It had a peak flow near the dam site of 95,000.0 cfs (2,690.1 cubic meters per second) and a 3-day volume of 308,636.0 acre-feet (380,696,900.4 cubic meters). The flood of January 1911 had a maximum daily flow of 38,000.0 cfs (1,076.0 cubic meters per second) and a 5-day volume of 170,000.0 acre-feet (209,691,912.4 cubic meters).

Damages from the 1867, 1911, 1914, 1937, and other rain floods that occurred before Friant Dam construction extended from the vicinity of Friant downstream to the mouth of the Merced River and below. Damage primarily affected agricultural areas, but some damage to roads and utilities was also incurred.

Snowmelt Floods

Snowmelt floods are characterized by sustained moderate flows yielding large volumes of runoff. The combination of such flows from other tributary streams with required releases from Friant Reservoir occasionally results in damaging flood flows in downstream reaches all along the lower San Joaquin River. The largest snowmelt flood on record of the upper San Joaquin River at Friant was in 1906. The flood had a maximum mean daily discharge of 26,300.0 cfs (744.7 cubic meters per second) and an April through July runoff volume of 3,339,400.0 acre-feet (4,119,089,248.3 cubic meters). The second largest snowmelt flood occurred in 1969, which had an unregulated maximum mean daily flow of 24,500.0 cfs (693.8 cubic meters per second) and an April through July volume of 2,898,690.0 acre-feet (3,575,481,467.7 cubic meters). Serious flooding (causing extensive agricultural damage) has resulted whenever total annual runoff was in excess of about 2,000,000 acre-feet (2,466,963,675.1 cubic meters).

4.2 Flood Forecasting

Flood forecasting for Millerton Lake is accomplished by the SCCAO Operations Division.

No forecast of rain flood inflow is used in operating Friant Reservoir. Use of the average preceding 15-day precipitation, in inches, for operating Friant Reservoir (Millerton Lake) during rain flood periods is discussed in Section 4.3 of this TM.

Seasonal forecasts used for control of snowmelt floods and conservation purposes are made by Reclamation after consultation with the United States Army Corps of Engineers (USACE) and the State of California.

The forecast of full natural runoff of the San Joaquin River below Friant Dam is provided by the DWR Division of Flood Management, Snow Course Measurement,[4] for the periods of February through July, March through July, and April through July, using the following:

- Equations that relate water equivalent of snow cover at various courses on the forecast date
- Various combinations of seasonal precipitation, both observed and expected
- Forecast runoff

Adjustments of the forecast, at any time in the season, are made by deducting the observed runoff since the date of forecast from the last forecast quantity.

The equations and curves shown in the USACE Flood Control Manual illustrate the relationships and list the precipitation stations and snow courses used in the various forecasts (1980a). These forecast equations are revised periodically, as necessary, to include up-to-date data. The equations evaluate the relationship between full natural runoff at Friant Dam and the independent variables of water equivalent of snow cover, antecedent precipitation, and runoff season precipitation. The index of antecedent precipitation is the average of the following four stations:

- Huntington Lake - elevation 7,000.0 feet (2,133.6 meters)
- Yosemite - elevation 4,000.0 feet (1,219.2 meters)
- Crane Valley Reservoir Power House - elevation 3,500.0 feet (1,066.8 meters)
- Auberry - elevation 2,050.0 (624.8 meters)

The water equivalent of the snow cover is determined as the mean of various snow courses on the date of the forecast. The combination of courses for any particular forecast, as shown in chart A-8 of the USACE Flood Control Manual, is based on data availability (1980a). The following courses are used (see Figure 2-1):

- Piute Pass - elevation 11,300.0 feet (3,444.2 meters)
- Blackcap Basin - elevation 10,300.0 feet (3,139.4 meters)
- Mammoth Pass - elevation 9,500.0 feet (2,895.6 meters)
- Agnew Pass - elevation 9,450.0 feet (2,880.4 meters)
- Kaiser Pass - elevation 9,200.0 feet (2,804.2 meters)
- Dutch Lake - elevation 9,100.0 feet (2,773.7 meters)
- Minarets No. 2 - elevation 9,000.0 feet (2,743.2 meters)
- Snow Flat - elevation 8,700.0 feet (2,651.8 meters)
- Minarets No. 1 - elevation 8,300.0 feet (2,529.8 meters)
- Chilkoot Lake - elevation 7,450.0 feet (2,270.8 meters)

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[4] http://cdec.water.ca.gov/snow

- Chilkoot Meadow - elevation 7,150.0 feet (2,179.3 meters)
- Florence Lake - elevation 7,200.0 feet (2,194.6 meters)
- Huntington Lake - elevation 7,000.0feet (2,133.6 meters)
- Peregoy Meadow - elevation 7,000.0 feet (2,133.6 meters)

Each forecast equation includes, as one of the variables, the subsequent precipitation to June 30. The frequency distributions of rainfall that may occur during the periods of February through June, March through June, and April through June are shown in the UASCE Flood Control Manual (1980a). Using these curves, the limits of the expected precipitation can be estimated for any degree of probability. After the forecast runoff is determined, its monthly distribution is based on historical distributions for hydrographs of comparable flows.

4.3 Flood Operation Criteria

This section describes the flood operation criteria for Friant Dam.

4.3.1 General

The authority for issuing instructions for the operation of reservoirs constructed or operated for flood control is vested in the Secretary of Defense and implemented by USACE through the District Engineer in charge of the locality in which the storage facility is located. In the case of Reclamation-constructed or operated facilities with designated USACE flood space, the District Engineer charges the Regional Director with the responsibility of reporting specific data and operating the facility according to current USACE recommendations.

4.3.2 Flood Operations and Criteria

Friant Dam shall be operated for flood control purposes, as provided for in the Flood Control Storage Reservation Diagram. For additional details, see the Reservoir Regulation Manual for Flood Control, Friant Dam and Reservoir (USACE, 1980).

4.3.3 Flood Control Regulations

The following regulations are from the above-mentioned flood control manual for Friant Dam operation.

December 10, 1955 (Rev. August 1980)
TITLE 33 - NAVIGATION AND NAVIGABLE WATERS
Chapter II - Corps of Engineers
PART 208 - FLOOD CONTROL REGULATIONS FRIANT DAM AND RESERVOIR (MILLERTON LAKE) SAN JOAQUIN RIVER, CALIFORNIA

Pursuant to the provisions of Section 7 of the act of Congress approved December 22, 1944 (58 Stat. 890, 33 U.S.C. 709), 208.85 is hereby prescribed to govern the use and operation of Friant Dam and Reservoir on San Joaquin River, California, for flood control purposes:

A. Releases from Friant Dam

Releases from Friant Dam shall be restricted to quantities which will not cause downstream flows to exceed, insofar as possible, any of the following criteria:

- *8,000 cfs (226.53 cubic meters per second) between Friant and Little Dry Creek, which is computed as the sum of the flow at the USGS gauging station "San Joaquin River below Friant", the flow at the USBR Station "Little Dry Creek near Friant", and the flow into Little Dry Creek from Big Dry Creek Reservoir.*
- *6,500 cfs (184.05 cubic meters per second) at the USGS gauging station "San Joaquin River near Mendota".*

B. Storage Space in Millerton Lake

Reservoir storage space shall be kept available for flood control purposes in accordance with the Flood Control Storage Reservation Diagram currently in force, except when storage of flood water is necessary to limit releases as prescribed above.

Any water temporarily stored in the flood control space shall be released as rapidly as can be safely accomplished without causing downstream flows to exceed the criteria prescribed above.

The Flood Control Storage Reservation Diagram in force as of the promulgating of this section is that dated 1997, File No. SJ-8-26-10, and is on file in the Office of the Chief of Engineers, Department of the Army, Washington, DC, and in the office of the Commissioner of Bureau of Reclamation, Washington, DC.

Revisions to the Flood Control Storage Reservation Diagram, may be developed from time to time as necessary by the Corps of Engineers and the Bureau of Reclamation. Each such revision shall be effective upon the date specified in the approval thereof by the Chief. Corps of Engineers and the

Commissioner, Bureau of Reclamation and remain in effect until another revision is made. Copies of the Flood Control Storage Reservation Diagram currently in force shall be kept on file in, and may be obtained from, the District Engineer, Corps of Engineers, and the Mid-Pacific Regional Director, Bureau of Reclamation.

C. Reservoir Elevation Above Elevation 578.0 Feet (176.17 m)

In the event that the reservoir level rises above elevation 578.0 feet (176.17 m) at the Dam (top of spillway gates), operation of the Dam shall be adjusted so as to:

- *Not exceed the criteria as outlined above, and*
- *Not to cause the maximum release from the reservoir to exceed the estimated maximum flow that would have occurred under the conditions which existed prior to the construction of the Dam (the natural flow).*

D. Rapid Release Changes

Nothing in the regulations shall be construed to require dangerous rapid changes in magnitudes of releases, or that releases be made at rates or in a manner that would be inconsistent with requirements for protecting the Dam and reservoir from major damage.

E. Operational Responsibility

The Bureau of Reclamation shall procure current basic hydrologic data, make current determinations of required flood control storage reservation from the Flood Control Storage Reservation Diagram currently in force, and procure current calculations of permissible releases from the reservoir as are required to accomplish the flood-control objectives prescribed in this section.

F. Operational Coordination

The operation of Friant Dam and Reservoir shall be coordinated with that of Big Dry Creek Reservoir Project,[5] *on Big Dry Creek, California, and the Fresno Metropolitan Flood Control District, in Fresno, California, so the downstream flow in the San Joaquin River will be restricted to the quantities prescribed above.*

[5] Big Dry Creek Dam and Reservoir are existing flood control structures in Fresno County, near Clovis, operated by the Fresno Metropolitan Flood Control District. Current flood operation procedures direct most floodwater (up to 700 cfs) to the San Joaquin River through the Little Dry Creek low-level release facility to the Little Dry Creek Flood Channel.

- *The operators of the two projects shall exchange data in order to forecast releases from Big Dry Creek Project into Little Dry Creek (a downstream tributary of San Joaquin River) and current stages at the downstream control gauges on San Joaquin River.*

- *Due consideration shall be given to any releases from Big Dry Creek Project as part of the flow of Little Dry Creek in the calculation of permissible releases from Friant Reservoir.*

- *In the event that such consideration would adversely affect the ability of Friant Dam to restrict downstream flows in San Joaquin River to prescribed levels, the representative of the Bureau of Reclamation in immediate charge of operation of Friant Dam shall notify the District Engineer, Corps of Engineers, Department of the Army, of this fact. The District Engineer shall then, after due consideration of conditions at both projects, issue such instructions as he/she may deem necessary.*

G. Advisory Information

Reclamation shall keep the District Engineer, Corps of Engineers, Department of the Army, advised of reservoir release, reservoir storage, and such other operating data as the District Engineer may request, and also of those basic operating criteria which affect the schedule of operation. Also, the Bureau of Reclamation shall keep the State Engineer, acting for the Department of Public Works of the State of California, currently advised of reservoir releases.

H. Modification of the Regulations

The flood control regulations are subject to temporary modification by the District Engineer, Corps of Engineers, if found necessary in time of emergency. Requests for and action on such modifications may be made by any available means of communication, and the action taken by the District Engineer shall be confirmed in writing under the date of the request to the office of the Mid-Pacific Regional Director of the Bureau of Reclamation.

4.3.4 Schedule of Flood Control Operations

Flood control operations of Friant Dam and Reservoir consist of the following:

- Restricting the release to the San Joaquin River from the reservoir to a variable quantity, of up to 8,000.0 cfs (226.5 cubic meters per second), depending on the following:
  - Magnitude of flow entering the river from Little Dry Creek (including the flow into Little Dry Creek from Big Dry Creek Reservoir), or
  - Flow entering above Mendota Pool from Kings River North (James Bypass)

- Reserving storage space in the reservoir on the basis of the Flood Control Storage Reservation Diagram, which indicates variable storage space requirements according to the current flood hazard (USACE, 1980a).

The flood hazard during the winter is measured by the average preceding 15-day precipitation in inches at Huntington Lake, Crane Valley, and Friant. In the spring, it is measured by the predicted full natural runoff from the area above Friant Dam between any given day and July 31, as forecast by Reclamation.

Whenever encroachment into the required flood control reservation occurs, releases (irrigation or other requirements), are increased as rapidly as is feasible while minimizing storage in the flood control space, not exceeding the maximum value permitted by downstream flow criteria. As long as there is significant storage in the flood control space, the rate of release is varied, as necessary, to maintain the permitted flows in the downstream channel.

The required reservation of storage space for flood control at any given time is determined from a Reservoir Capacity Allocations Table. This table indicates the flood control storage reservation required in the flood season from October 1 to July 31. The requirements are as follows:

- Minimum storage space reservation for control of rain flood runoff, consisting of 85,000.0 acre-feet (104,845,956.2 cubic meters) from October 15 to March 1, increasing from zero on October 1 and decreasing again to zero on April 1.

- Supplemental rain flood space reservation up to a maximum of 85,000.0 acre-feet (104,845,956.2 cubic meters) from November 1 to February 1, increasing from zero on October 15 and decreasing again to zero on March 1.

- Supplemental space reservation for control of runoff from snowmelt up to a maximum of 390,000.0 acre-feet (481,057,916.6 cubic meters) from February 1 to July 1.

The supplemental rain flood space reservation varies according to parameters based on the average 15-day precipitation in inches at Huntington Lake, Crane Valley, and Friant. It constitutes an increment between the 85,000.0 acre-feet (104,845,956.2 cubic meters) of space considered necessary for control of rain flood runoff under dry conditions, and the 170,000.0 acre-feet (209,691,912.4 cubic meters) considered necessary for control of rain flood runoff under wet conditions. This space represents a compromise between flood control and conservation requirements.

The snowmelt space reservation varies according to the predicted full natural inflow from the area above Friant Dam between the given day and July 31. Required space shall be the larger of that determined by use of precipitation parameters, and that determined from snowmelt forecast parameters. Adjustment of required space, as indicated by the snowmelt forecast parameter, will be made when applicable in accordance with paragraphs 4 and 5 of the Flood Control Storage Reservation Diagram (USACE, 1980a).

Flood control operation each day during the rain flood season, October 1 through April 1, consists of determining the required storage space reservation, 24 hours in advance, and scheduling releases to provide the required space reservation by the end of the day, whenever possible. During the snowmelt runoff season, required space is determined as each runoff forecast becomes available, and is adjusted daily for actual runoff and for changes in forecast outlook.

4.3.5 Credit for Upstream Storage Space

The upper San Joaquin River has been extensively developed for power purposes, and a larger amount of regulatory storage has been developed by SCE and PG&E. When computing required space from precipitation parameters, credit may be taken for space that may be available in Mammoth Pool. Such credit is limited to the portion of required space over and above 85,000.0 acre-feet (104,845,956.2 cubic meters). Space required, as indicated by snowmelt parameters, may be decreased by an amount equal to the storage space available in upstream reservoirs, but such decreases shall not exceed 80 percent of the total snowmelt reservation, nor the limitation determined using the Flood Control Storage Reservation Diagram (USACE, 1980a). This latter limitation is based on experience in the upstream storage rate, which shows that a substantial portion of the upstream space is not used by the time of maximum storage at Friant.

4.3.6 Emergency Spillway Operations

Although operation of spillway gates during extreme emergencies has been excluded from the official flood control regulations, advance preparation for such possible emergencies is considered to be highly desirable. Whenever the reservoir level approaches gross pool level, and the reservoir is rising rapidly because of flood inflow, the necessity for emergency releases should be determined. The Emergency Spillway Release Diagram in the USACE Flood Control Manual has been devised for the convenience of Reclamation, and indicates the minimum permissible releases that can be made without endangering the structure, and without releasing quantities in excess of natural runoff (1980a). If deemed necessary to assure the structure or to minimize surcharge, Reclamation may, on the basis of forecasts, make releases greater than those indicated by the diagram.

The diagram is derived in accordance with procedures outlined in the USACE Engineering and Design Management of Water Control Systems Manual, EM1110-2-3600 (1980b), and is based on minimum remaining volume of inflow when only reservoir elevations and rate of rise are known. This minimum volume of remaining inflow was estimated on the basis that inflow peak was past, and that recession of flow would be somewhat steeper than in most observed floods (approximately that observed in the December 1937 flood). The diagram is thus designed to defer emergency releases until it is virtually certain that those or larger releases will be necessary. When such releases are indicated by the diagram, it is essential that they be made immediately to prevent the necessity of making larger releases. For this reason, reservoir operators at the dam should be thoroughly familiar with the emergency release diagram and should be empowered by standing instructions to initiate use of the diagram, if required, when communication with the SCCAO in Fresno is disrupted.

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Appendix A

OPERATIONAL GUIDELINES FOR WATER SERVICE

SAN JOAQUIN RIVER RESTORATION PROGRAM

UNITED STATES
DEPARTMENT OF THE INTERIOR
SOUTH-CENTRAL CALIFORNIA AREA OFFICE

OPERATIONAL GUIDELINES FOR WATER SERVICE
FRIANT DIVISION
CENTRAL VALLEY PROJECT

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SOUTH-CENTRAL CALIFORNIA AREA OFFICE

OPERATIONAL GUIDELINES FOR WATER SERVICE
FRIANT DIVISION
CENTRAL VALLEY PROJECT

I. Introduction

These Operational Guidelines are written to establish the procedures to be used in managing the water supplies of the Friant Division, Central Valley Project, California. The intent is to define and set forth the priority for water service, water scheduling, and proration guidelines used in the Friant Division Service Area so that the water supplies may be optimized and managed efficiently and in compliance with the water service contracts and the Operations and Maintenance Agreement(s) between the United States and the Operating Non-Federal Entity. The Operational Guidelines are considered an operating tool to help manage the Project Water within the Friant Division Service Area and does not take any precedence over other binding contracts. In the event of a conflict between these guidelines and the Friant Division water service contracts or other contracts, the contract will control. These guidelines will be reviewed on an annual basis to reflect current operation practices.

II. Definition of Terms

The following are definitions of terms used in these Operational Guidelines and generally follow the definitions contained in the water service contracts:

"Class 1 Water" shall mean that supply of water stored in or flowing through Millerton Lake which, subject to the contingencies described in the water service contract, will be available for delivery from Millerton Lake and the Friant-Kern and Madera Canals as a dependable water supply during each Contract Year.

"Class 2 Water" shall mean that supply of water which can be made available subject to the contingencies described in the water service contract for delivery from Millerton Lake and the Friant-Kern and Madera Canals in addition to the supply of Class 1 water. Because of its uncertainty as to availability and time of occurrence, such water will be undependable in character and will be furnished only if, as, and when it can be made available as determined by the Contracting Officer.

"Contract Year" shall mean the period from and including March 1 of each calendar year through the last day of February of the following calendar year.

"Contracting Officer" shall mean the Secretary of the Interior's duly authorized representative acting pursuant to these Operational Guidelines or applicable Reclamation law or regulation.

"Contractors" shall mean individually and collectively Friant Division Long-Term Contractors, Cross Valley Contractors, and Temporary Contractors as defined herein.

"Cross Valley Contractors" shall mean Lower Tule River Irrigation District, Pixley Irrigation District, Hills Valley Irrigation District, Tri-Valley Water District, Kern-Tulare Water District, Rag Gulch Water District, County of Fresno and its existing subcontractors and County of Tulare and its existing subcontractors as long as they maintain a contract with the United States for a specified quantity of water from the Central Valley Project with its basis originating from the San Joaquin Delta.

"Friant Division" shall mean the combined CVP facilities of Friant Dam, Millerton Lake, Friant-Kern Canal, and Madera Canal that are used to store, divert, transport, and deliver Project Water to the Friant Division Service Area.

"Friant Division Service Area" shall mean the area within which CVP water may be served to Friant Division water users as defined by project authorizations and the State Water Resources Control Board.

"Inflow Prorate" shall mean a reduction of water deliveries which occurs whenever the scheduled demand exceeds Millerton Lake inflow and storage in Millerton Lake is insufficient to meet demand, generally recognized as occurring when the water in storage is approximately 135,000 acre feet .

"Irrigation Water" shall mean water made available from the Friant Division that is used primarily in the production of agricultural crops or livestock, including domestic use incidental thereto, and watering of livestock.

"Long-Term Contractors" shall mean all parties who have water service contracts for a specified quantity of Class 1 and/or Class 2 water from the Friant Division of the Central Valley Project with the United States pursuant to Federal Reclamation law.

"Municipal and Industrial (M&I) Water" shall mean water made available from the Friant Division, other than Irrigation water, to the Long-Term Contractors. M&I water shall include water used for human consumption and purposes such as the watering of landscaping or pasture for animals (e.g. horses) which are kept for personal enjoyment or water delivered to landholdings operated in units of less than five (5) acres unless the Long-Term Contractor establishes, to the satisfaction of the Contracting Officer, that the use of the water delivered to any such landholding is a use described under "Irrigation water".

"Operating Non-Federal Entity" shall mean a Non-Federal entity which has the obligation to operate and maintain all or a portion of the Friant Division facilities pursuant to an agreement with the United States and which may have funding obligations with respect thereto.

"Project Water" shall mean all water that is developed, diverted, stored, or delivered by the

Contracting Officer for the benefit of the Friant Division Service Area available from Millerton Lake in accordance with the statutes authorizing the Friant Division and in accordance with the terms and conditions of water rights permits acquired pursuant to California law.

"Surplus Water" shall mean a temporary supply of water, other than Class 1 or Class 2, made available to the Contractors in addition to water provided pursuant to water service contracts, including water made available that is not subject to acreage limitation pursuant to Section 215 of the Reclamation Reform Act of October 12, 1982 (96 Stat. 1263), as amended.

"Temporary Contractors" shall mean water users who have contracted with the United States for a period not to exceed one year.

"Uncontrolled Season" shall mean any time during the Contract Year the Contracting Officer determines that a need exists to evacuate water from Millerton Lake in order to prevent or minimize spill or to meet flood control criteria, taking into consideration, among other things, anticipated upstream reservoir operations and the most probable forecast of snowmelt and runoff projections for the upper San Joaquin River.

III. <u>Priority of Water Service</u>

The Contracting Officer shall allocate Project Water to the Contractors in the following order of priority, provided that it is understood that allocation of Project Water to priorities 4 through 7 will occur only after all of the water supply demands of the Long-Term Contractors have been met:

1. Long-Term Contractors – Class 1 supply (Irrigation and M & I)
2. Long-Term Contractors – Class 2 supply
3. Long-Term Contractors with temporary water supply contracts
4. Cross Valley Contractors project water supply from the Friant Division
5. Cross Valley Contractors with temporary water supply contracts
6. Other CVP Contractors with temporary contracts
7. Non-CVP temporary contractors

IV. <u>Water Allocation</u>

By written notice to the Long-Term Contractors, on or before February 20th of each year, the Contracting Officer shall make an initial allocation of the quantities of Class 1 water and Class 2 water to be available for delivery during the following Contract Year. The water operation plan for Millerton Lake will be updated by the Contracting Officer at least monthly, and presented at meetings with the Long-Term Contractors. Monthly meetings to discuss the water operation plan for Millerton Lake will continue until the Long-Term Contractors and Contracting Officer agree that additional meetings are no longer necessary. Changes in water supply allocations will be made by written notice to the Long-Term Contractors. The procedure for determining the water supply allocation shall be consistent with the following:

A. Allocation Procedures

1. The estimated amount of water to be made available during the March through September period will be based on the California Department of Water Resources forecast for the April-July San Joaquin River runoff period. The Contracting Officer may, at his or her discretion, make allocation decisions based on scenarios between the 50 percent exceedence and the 90 percent exceedence forecasts. For the period October through the following February, the Contracting Officer will use lower quartile runoff projections in developing the water supply allocation in his or her decision-making for operating Millerton Lake. Calculations of available water supply will include, but not be limited to, losses, river demands, retained storage and accretions for the entire upper San Joaquin River system.

2. In calculating the available water supply, the Contracting Officer will use the following parameters:

- Artificial dead storage volume of 135,000 acre-feet in Millerton Lake
- Corp of Engineer's Reservoir Regulation for Flood Control Manual
- Southern California Edison's (SCE) water plan
- Pacific Gas and Electric's (PG&E) water plan
- Department of Water Resources (DWR) forecast
- Terms and conditions of water rights for the Friant Division and other water rights agreements or contracts
- Water delivery schedules
- Canal capacity
- San Joaquin River water contractual obligations

3. The terms and conditions of the water rights for the Friant Division precludes Reclamation from storing project water from on or about August 1 through on or about November 1. During this period, any water that is stored must be released within 30 days. If it becomes necessary to release water, the release priority will be as follows: any Class 2 water that has not been utilized will be released first. The evacuated water will be prorated among the Long-Term Contractors who have allocated but unused Class 2 water. Once the Class 2 water has been exhausted, Class 1 water will be evacuated and prorated among the Long-Term Contractor's who have remaining Class 1 water. This water may be marketed to the Long-Term Contractors up to 100 percent of their respective contractual entitlement in accordance with the Priority of Water Service, Section III. Once the demands of Long-Term Contractors have been met, any remaining water may be marketed as Surplus Water in accordance with Article XII of these guidelines. All water released, and subsequently reallocated, must be delivered during the release period.

4. In developing the water operation plan, the Contracting Officer may, at his or her discretion, consider the Class 1 water scheduled for use after October 1 to be supplied from runoff that occurs after October 1. Therefore, the amount of Class 1 water scheduled for delivery after October 1 may be added back into the available supply during the July through September period when preparing the water supply allocation for the Contract Year, provided that in no event shall the amount of water that is added back into the supply exceed 100,000 acre-feet without consultation with the Long-Term Contractors.

5. The Contracting Officer will, to the extent possible, maximize the available water supply available to Long-Term Contractors. At the same time, the Contracting Officer will also, to the extent possible, avoid creating an Inflow Prorate. To this end, meetings between the Contracting Officer and Long-Term Contractors may take place more frequently than monthly when it appears that, for any reason, an Inflow Prorate may occur. The purpose of these additional meetings will be to make adjustments in the water delivery schedules and/or water supply allocation in order to maximize use while ensuring that there is sufficient water supply to meet remaining scheduled demands. These adjustments will include consideration of raising the artificial dead storage volume from 135,000 acre-feet to 145,000 acre-feet for purposes of calculating the available water supply.

6. Water allowed to be carried over from the previous Contract Year will not be included in the calculations of the new water supply allocation for the following Contract Year.

7. Water that is pre-used before the start of the Contract Year will be considered in determining the supply to be declared in the following Contract Year.

8. After October 1, there will be no additional changes in the water supply declaration unless the Contracting Officer, after consultation with the Long-Term Contractors, determines that the flood control regulations require a release from Millerton Lake.

B. Uncontrolled Season Procedures

1. At the beginning of the Contract Year and at least weekly thereafter, the Contracting Officer will analyze Millerton Lake operations taking into consideration the desired delivery schedules of Long-Term Contractors, anticipated upstream reservoir operations and the most probable forecast of snowmelt and runoff projections for the upper San Joaquin River. From such analysis, the Contracting Officer will determine whether there is a need to evacuate water from Millerton Lake in order to prevent or minimize a spill or meet flood control criteria. If an evacuation is required, the Contracting Officer will announce an Uncontrolled Season, including an estimate of the expected duration of the Uncontrolled Season. With that announcement, the Contracting Officer will provide an estimate of the period of time Millerton Lake is expected to be in this mode of operation and an estimate of the total volume of water to be evacuated for each calendar week that the Uncontrolled Season is anticipated to

last.

2. Upon the announcement of an Uncontrolled Season, Long-Term Contractors will provide, within one business day, a water delivery schedule which will include an estimate of the amount of water expected to be delivered during each calendar week of the Uncontrolled Season. Long-Term Contractors that wish to transfer or exchange any Class 2 water during Uncontrolled Season must identify the proposed flow rates and quantities to be transferred or exchanged.

3. Based on the delivery schedules submitted, the actual water deliveries, and the assessment of anticipated inflows, the Contracting Officer will analyze the need to evacuate additional water from Millerton Lake. The Contracting Officer will allocate, on a calendar week basis, the lesser of, the volume of water to be delivered to each contractor scheduling Class 2 water based on that contractor's percentage of the total contracted Class 2 water or the volume of water scheduled by the contractor. After the first allocation is calculated, if the Contracting Officer determines that more water needs to be evacuated for that week, the process of allocation will be repeated until all Uncontrolled Season water scheduled is allocated. If additional water needs to be evacuated, then the Contractor Officer may extend or adjust the level of the Uncontrolled Season and may declare Surplus Water available. The quantity, delivery time and price of the Surplus Water will be determined at that time.

4. For the duration of the uncontrolled season the Contracting Officer will, each Friday by 11:00 a.m., update the estimated period of time Millerton Lake is expected to be in this mode of operation and an estimate of total volume of water to be evacuated for each calendar week that the uncontrolled season is anticipated to last. Long-Term Contractors will provide, by 3:00 p.m., a water delivery schedule which will include an estimate of the amount of water expected to be delivered during each calendar week of the uncontrolled season. Based on the delivery schedules submitted, the Contracting Officer will utilize the methodology in section (b3) to allocate the volume of water to be delivered to each contractor scheduling Class 2 water.

5. After approving schedules for Class 1 and Uncontrolled Season Class 2 water if additional water needs to be evacuated then the Contracting Officer will extend the uncontrolled season and declare Surplus Water available. The quantity, delivery time, and price of the Surplus Water will be determined at that time.

6. When the Contracting Officer has determined that the threat of spill has been eliminated and that Millerton Lake is under control and/or flood control criteria has been met, the Contracting Officer will terminate the uncontrolled season. The Contracting Officer will provide as much advance notice of the uncontrolled season termination as reasonably possible with at least two days notice to the Contractors.

7. In the event that an unexpected spill from Millerton Lake occurs and it is determined that it is not practical to declare an uncontrolled season, the Contracting Officer will declare the water deliveries taken during the period of spill to be accounted for as water taken during a declared uncontrolled season, provided that the quantity taken

by a contractor during such period can be determined with reasonable accuracy.

8. Upon termination of the uncontrolled season, the Contracting Officer will re-evaluate the hydrologic conditions of the San Joaquin River Basin and determine the availability of water supplies for Long-Term Contractors for the balance of the Contract Year using water allocation procedures described in Paragraph 1 of this section. Water used by any Long-Term Contractor during the Uncontrolled Season will be in addition to the water supply allocation for the balance of the Contract Year to the Long-Term Contractor's contract entitlement.

If the Contracting Officer determines that the allocation that was declared prior to the announcement of the Uncontrolled Season must be reduced, then the following shall apply.

- All Contractors shall have access to the new reduced allocation, for use in the balance of the Year, in addition to any and all Uncontrolled Season water up to their Contract totals.

- If a Contractor has already used the full Class 2 allocation that was declared prior to an Uncontrolled Season, and said Class 2 declaration is subsequently reduced, that portion of the Contractors deliveries representing the difference between the reduced declaration and the prior higher declaration shall be accounted for as taken during an Uncontrolled Season and shall be in addition to those supplies made available for the balance of the year.

V. Schedules

In accordance with the water service contracts, the Contractor shall submit a written schedule on or before March 1 and at such other times as necessary, satisfactory to the Contracting Officer, showing the monthly quantities of Project Water to be delivered on behalf of the Contractors for the year commencing on March 1. The Contractor shall not schedule Project Water in excess of the quantity of Project Water the Contractor intends to put to reasonable and beneficial use within the Contractor's service area or to sell, transfer or exchange. The total amount of water requested in that schedule must not exceed the quantities allotted by the Contracting Officer. The Contractor shall not schedule the delivery of any water during any period as to which the Contractor is notified by the Contracting Officer or Operating Non-Federal Entity that Project facilities required to make deliveries to the Contractor will not be in operation because of scheduled operations and maintenance (O&M) activities. Following the initial allocation of the water supply by the Contracting Officer, each Long-Term Contractor will submit an initial schedule no later than ten (10) calendar days after the allocation. Schedules must show the projected use of all allocated water supplies during the upcoming Contract Year. The delivery schedules will be reviewed by the Contracting Officer to determine if deliveries can be made on a monthly basis as scheduled.

The Contracting Officer will meet all scheduled deliveries subject to system capacity and his/her ability to regulate supplies in the system. If it appears that deliveries cannot be made as scheduled, each Long-Term Contractor with water scheduled for delivery will be contacted by the Contracting Officer or the Operating Non-Federal Entity and asked to adjust its schedule as necessary to match water supply or capacity limitations. The Contracting Officer will provide written notice to each Long-Term Contractor regarding approval or disapproval of delivery schedules within 15 calendar days of submittal of a delivery schedule to the Contracting Officer.

Following each subsequent allocation of increased or decreased water supplies by the Contracting Officer, each Long-Term contractor with a change in the water supply shall, within ten (10) calendar days of such allocation, submit a revised schedule showing the projected use of all allocated water supplies during the Contract Year. The procedures and criteria for approval of revised schedules by the Contracting Officer shall be the same as used for the initial allocation and schedule. In addition, the Contracting Officer may request additional schedules as necessary to assist its determination of subsequent water supply allocations.

Each month following determination of actual use, a Long-Term Contractor may request that adjustments be made in its monthly schedules provided there is sufficient water supply and canal capacity available to meet the revised schedules. Requests for schedule revisions for any month must be received before the fifteenth day of the month unless otherwise determined by the Contracting Officer. Requests for schedule revisions to meet emergency conditions may be made at any time during the Contract Year. If the actual water use is different from the previous month's scheduled water then the water may be rescheduled by the Long-Term Contractor from or to succeeding months within the Contract Year.

The Contracting Officer will approve revised schedules after all revisions are considered and found to be satisfactory within 15 calendar days of submittal of a delivery schedule to the Contracting Officer. Deliveries made during prorate periods may not be reclassified from a higher priority to a lower prorate priority after the fact.

VI. Transfers or Exchanges of Project Water

Transfers or Exchanges of Project Water under the Friant water service contracts are allowed in accordance with applicable Federal and State Laws and applicable guidelines or regulations then in effect. Guidelines specific to Exchanges have not been fully developed but will generally follow guidelines applicable to Transfers where appropriate. Additional criteria may apply to multi-year exchanges or ground water transactions.

The criteria for the transfer of Project Water is set forth in Reclamation's Interim Guidelines for the Implementation of the Water Transfer Provisions of the Central Valley Project Improvement Act (CVPIA). A copy of the Interim Guidelines is attached hereto as Exhibit A and is made a part of hereof. The criteria in the Interim Guidelines applies to all transfers of Project water under long-term or short-term contracts for water service from the Friant Division. Also attached for reference is the Final CVPIA Administrative Proposal on Water Transfers dated April 16, 1998 (Exhibit B). As these documents are revised or replaced, the new version(s) will be incorporated into these Guidelines.

All requests for the transfer of Project water shall be submitted in accordance with the criteria in the Interim Guidelines and shall be subject to the prior written approval of the Contracting Officer. Exceptions include the annual short-term transfers of Project water, as recognized in Article 9(b) of the Friant Long Term Renewal Contracts (LTRC), which will continue to be conducted with advance notice to Reclamation under Reclamation's accelerated water transfer program approval process currently set at up to 150,000 acre-feet per year. Cross Valley contractor's exchange arrangements, other then the previously approved exchange arrangements with Arvin-Edison Water Storage District, shall be submitted to the Contracting Officer for approval in accordance with the principles historically applied by the Contracting Officer in approving Cross Valley exchanges arrangements. These exchange arrangements which allow Cross Valley contractors to take delivery of their CVP supplies are in addition to the 150,000 limit mentioned above.

<u>VII. Canal Capacity Prorate</u>

During periods when water demands exceed canal capacity and it becomes evident there is a need for a delivery prorate, the Contractors shall meet or otherwise confer and may take mutually agreeable action to coordinate water demands and alternate water supplies in order to avoid or minimize a canal prorate. If a canal capacity prorate is required, the prorate priority shall be pursuant to the tiers defined in Sections VII-A and VII-B below. Each entity with requested water in the affected tier is entitled to a percentage of the available supply based on its prorata share of their contractual entitlement within that tier. If a Contractor has not requested water or has otherwise used its water within the tier being prorated, that share of canal capacity shall be distributed among the other affected users.

A. Friant-Kern Canal

Tiers of priority of water deliveries in those reaches of the Friant-Kern Canal that are affected during a canal capacity prorate shall be as follows:

1. Class 1 water used by Friant-Kern Canal (FKC) Long-Term Contractors

2. Class 1 water transferred or exchanged from a FKC Long-Term Contractor to a FKC Long-Term Contractor or Cross Valley Contractor (including subcontractors), provided that the change in the point of diversion of the transferred water does not cause a Class 2 contractor to suffer a loss of prorated canal capacity that would not have otherwise occurred had the transfer not been approved. A transfer that causes a loss in the prorated canal capacity of a Class 2 contractor due to a change in the point of diversion of the transferred water shall lose its priority over Class 2 water used by a FKC Long-Term Contractor.

3. Class 2 water used by FKC Long-Term Contractors

4. Class 2 water transferred or exchanged from FKC Long-Term Contractors to a FKC Long-Term Contractor or Cross Valley Contractor (including subcontractors).

5. Class 1 water transferred or exchanged from a Madera Canal (MC) Long-Term

Contractor to a FKC Long-Term Contractor

6. Class 2 water transferred or exchanged from a MC Long-Term Contractor to a FKC Long-Term Contractor

7. Class 1 water transferred or exchanged from a FKC Long-Term Contractor to a non Long-Term Contractor

8. Class 2 water transferred or exchanged from a FKC Long-Term Contractor to a non Long-Term Contractor

9. Class 1 water transferred or exchanged from a MC Long-Term Contractor to a non Long-Term Contractor

10. Class 2 water transferred or exchanged from a MC Long-Term Contractor to a non Long-Term Contractor

11. Surplus Water used by a FKC Long-Term Contractor

12. Cross Valley Contractor contract water supply

13. Surplus Water used by a CVC Contractor

14. Surplus Water used by a non Long-Term Contractor and non Cross Valley Contractors

15. Non-Project Water supplies with the execution of a Warren Act Contract

B. Madera Canal

Tiers of priority of water deliveries in the Madera Canal (MC) during a canal capacity prorate shall be as follows:

1. Class 1 water used by MC Long-Term Contractor

2. Class 1 water transferred or exchanged between Madera Irrigation District (MID) and Chowchilla Water District (CWD)

3. Class 2 water used by a MC Long-Term Contractor

4. Class 2 water transferred or exchanged between MID and CWD

5. Non-Project Water from water rights owned by a MC Long-Term Contractor with the execution of a Warren Act Contract

6. Class 1 water transferred or exchanged from a FKC Long-Term Contractor to a MC Long-Term Contractor

7. Class 2 water transferred or exchanged from a FKC Long-Term Contractor to a MC Long-Term Contractor

8. Class 1 water transferred or exchanged from a MC Long-Term Contractor to a non Long-Term Contractor

9. Class 2 water transferred or exchanged from a MC Long-Term Contractor to a non Long-Term Contractor

10. Surplus Water used by a MC Long-Term Contractor

11. Class 1 water transferred or exchanged from a FKC Long-Term Contractor to a non Long-Term Contractor

12. Class 2 water transferred or exchanged from a FKC Long-Term Contractor to a non Long-Term Contractor

13. Non-Project Water supplies delivered to a MC Long-Term Contractor from a water right not owned by a MC Long-Term Contractor with the execution of a Warren Act Contract

14. Surplus Water delivered by FKC Long-Term and Cross Valley Contractors

15. Surplus Water delivered by non Long-Term Contractor

16. Non-Project Water supplies delivered to a non Long-Term Contractor with the execution of a Warren Act Contract

VIII. Inflow Prorate

The Contracting Officer will, to the extent possible, minimize the need of an Inflow Prorate. In the event that an Inflow Prorate is necessary, as determined by the Contracting Officer, the following procedures will be put into effect:

A. The amount of water available for delivery will be determined daily based on the inflow and the amount of storage available in Millerton Lake. Both Friant-Kern Canal and Madera Canal contractors will be prorated at the same time once an Inflow Prorate is declared.

B. Long-Term Contractors with a Class 1 entitlement will be given a percentage of the water available based on each Long-Term Contractor's prorata share of the total of Class 1 contractual entitlement of Long-Term Contractors requesting Class 1 water. Notwithstanding provisions of the Section VI these guidelines, a Long-Term Contractor's prorated percentage of water available may be used for delivery of transferred Class 1 water.

C. In the event that water remains available after having satisfied Class 1 demands, Long-Term Contractors with Class 2 entitlement will be given a percentage of the water available based upon each Long-Term Contractor's prorata share of the total of Class 2 contractual entitlement of Long-Term Contractors requesting Class 2 water. Notwithstanding provisions of Section VI of these guidelines, a Long-Term Contractor's prorated percentage of water available may be used for delivery of transferred Class 2 water.

D. Members of the Friant Power Authority (FPA) have agreed that, in the event low head reservoir conditions result in the FPA generator not passing the total water ordered for release into the Friant-Kern Canal or the Madera Canal, FPA Members shall have the option of decreasing their collective water orders so that generator bypass does not occur. In the event that FPA members cannot or will not reduce their water orders to an amount sufficient to avoid generator bypass, then FPA shall bypass its generator so that water releases shall equal demand. Please refer to attached letter from the Friant Power Authority dated May 25, 1984.

IX. Preuse Water

The Contractor may, during the period November 1 through and including the last day of February of that Contract year, request delivery of any amount of Class 1 water estimated by the Contracting Officer to be made available to it during the following Contract Year. The Contractor may, during the period from and including January 1 of each year (or such earlier date as may be determined by the Contracting Officer) through and including the last day of February of that Contract Year, request delivery of any amount of Class 2 water estimated by the Contracting Officer to be made available to it during the following Contract Year. Such requests must be submitted in writing by the Contractor for a specified quantity of peruse and shall be subject to the approval of the Contracting Officer.

X. Carryover Water

Carryover (or Rescheduling) of Project Water is allowed in conformance with the water service contract, the current Carryover (Rescheduling) Guidelines for the Friant Division, and the Standard Operating Procedure. The current Carryover (Rescheduling) Guidelines (Exhibit D) and the Standard Operating Procedure (SOP) (Exhibit E) are attached for reference. If either said Carryover (Rescheduling) Guidelines and/or said SOP are revised or replaced, the new version(s) are incorporated into these Guidelines by reference.

XI. Surplus Water

If the Contracting Officer determines Surplus Water is available when water supply conditions occur that result in a water supply that is not otherwise storable for Project purposes, such Surplus Water will be made available under temporary contracts. The term of said contracts will not extend beyond the end of the current Contract Year.

Priority of allocation for Surplus Water made available from the Friant Division Service Area shall be as follows:

A. Long-Term Contractors

B. Cross Valley Contractors

C. Other parties within the Friant Division Service Area with direct delivery capabilities

D. CVP Contractors outside of the Friant Division Service Area

E. Other parties

XII. Operating Procedures

Reclamation and the Operating Non-Federal Entity will strive, whenever possible, to meet the demands of Contractors in order to optimize both Contractor efficiency and on-farm irrigation efficiency.

Changes to water orders from the Operating Non-Federal Entity to Friant Dam Operations are to be made during regular working hours which are Monday through Friday between 7:00 a.m. and 1:30 p.m., weekends and holidays between 7:00 a.m. and 10:00 a.m. Contractors and the Operating Non-Federal Entity acknowledge that emergency water order changes can be made 24 hours a day. All parties agree that each will endeavor to fully serve the Friant Division Service Area water users, and without compromising this first priority, will attempt to minimize the need for overtime call outs if possible.

The Contracting Officer and the Operating Non-Federal Entity reserve the right to deny or delay water order changes and reduce deliveries if operating conditions so require.

In the event an emergency is declared by the Contracting Officer or Operating Non-Federal Entity, previous water orders may be waived and immediate reductions to water deliveries may be initiated. The Operating Non-Federal Entity shall provide notification to affected Contractors as soon as possible. After such emergency reductions are made, new water orders must be placed by the Contractors, acknowledging the necessary operational delays for water deliveries through the canal.

Prior the beginning of each Contract Year, the Contracting Officer, the Operating Non-Federal Entity, and the Contractors shall provide each with emergency and after-hour personnel contact phone numbers.

A. Friant-Kern Canal

1. Since large changes in canal deliveries require more planning and coordination than small ones, Contractor water delivery changes in excess of the greater of 50 cfs or 10 percent of the previous order will require advance planning between the Contractor,

and the responsible canal Operating Non-Federal Entity. These larger changes will ordinarily require a corresponding change from Millerton Lake.

2. Contractors shall provide all changes to the Operating Non-Federal Entity by 9:30 a.m. each day. FKC service areas to the north of Kings River Check can take deliveries, based on these orders, the same day. FKC service areas to the south of Kings River Check can take deliveries, based on these orders, 24 hours later. The Contracting Officer and the Operating Non-Federal Entity reserve the right to extend delivery time to 48 hours if operating conditions so require.

3. Water orders will be received on Saturdays and holidays in the same manner as on weekdays. Water orders for Monday must be made no later than Saturday. No water orders will be received on Sunday.

B. Madera Canal

1. Changes in water orders from contractors are to be provided to the Operating Non-Federal Entity between 6:00 am and 4:30 pm for changes to be made on the Madera Canal that day or the next.

XIII. Water Accounting

By the 20th of the following month, the Contractor shall submit a monthly written report of water subtypes and quantities for the water delivered to the Contractor for the prior month. Said report shall include the use of all Contractor supplies including all transfers and exchanges.

The Contractors will subsequently be provided with a report of water deliveries for each month including transfers or exchanges.

Procedures for monthly water accounting of Class 1 water, Class 2 water, and water that is transferred and/or exchanged are as follows:

A) Deliveries to Contractors with only Class 1 or Class 2 supplies will reduce that contractor's remaining allocation by the amount used.

B) Deliveries to a Contractor with Class 1 and Class 2 water available will be first accounted as Class 2 water use unless the contractor requests the use of Class 1 water. Such deliveries will reduce that contractor's remaining allocation by the amount and class used.

C) Unless notified by the Contractor, transfer water will be the first water delivered following the acknowledged delivery date of transfer, subject to Inflow Prorate, and Canal Capacity Prorate provisions (refer to Sections VIII and IX).

D) If the forecast indicates a change in the water supply after the initial water supply allocation, an adjustment of Class 2 and possibly Class 1 will be made. If the water supply allocation is decreased, a portion of the original Class 2 allocation, if any, will be reduced prior to reducing Class 1. A contractor who has used more Class 2 than the reduction indicates will be charged for Class 1 to cover the overuse. If all classes of water have been used, the deficit will be charged as preuse. If the water supply allocation is increased the additional supply will be added to its previous allotment not to exceed its full contractual entitlement.

XIV. Miscellaneous Provisions

The Adobe Ranch on the Madera Canal has a severance water right of 300 acre-feet annually and the Round Mountain Ranch on the Friant-Kern Canal has a severance water right of 90 acre-feet to be delivered as stipulated in their respective contracts with the United States.

Changes or amendments to these guidelines shall not be made prior to consulting with the Long-Term Contractors.

In the event that unforeseen conditions occur which affect the operation of Millerton Lake that are not addressed by these operational guidelines, Reclamation may, at its discretion and after consultation in accordance with Article 19 of the long-term water service contracts, take action as necessary to address said unforeseen conditions.