Los Angeles Department of Water and Power

MONO BASIN

Grant Lake Operation Management Plan

Prepared for the State Water Resources Control Board

In response to the Mono Lake Basin Water Right Decision 1631

February 29, 1996

Grant Lake Operations and Management Plan

February 29, 1996

PREPARED BY THE LOS ANGELES DEPARTMENT OF WATER AND POWER

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GRANT LAKE OPERATIONS AND MANAGEMENT PLAN

EXECUTIVE SUMMARY

The Mono Lake Basin Water Right Decision 1631 was adopted by the State Water Resources Control Board (SWRCB) on September 28, 1994. This Decision amended Water Right Licenses 10191 and 10192, held by the City of Los Angeles, to meet the public trust needs of the Mono Basin environment, and to comply with Fish and Game Code Sections 5937 and 5946. The Decision defined instream flow requirements in the four streams from which the Los Angeles Department of Water and Power (LADWP) diverts water, and established water diversion criteria to protect wildlife and other environmental resources (air quality, scenic value, water quality standards) in the Mono Basin.

Decision 1631 requires LADWP to prepare a Stream and Stream Channel Restoration Plan, to "...restore, preserve and protect the streams and fisheries in Rush Creek, Lee Vining Creek, Walker Creek, and Parker Creek...". The Stream and Stream Channel Restoration Plan is to include recommendations on a 'Grant Lake Operations and Management Plan'. This document constitutes LADWP's proposed plan for operation of Grant Lake, and management of its facilities in the Mono Basin.

The Grant Lake Operations and Management Plan addresses four separate but inter-related components: Grant Lake operation, Lee Vining Conduit diversions, exports, and stream flows. In addressing these components, the plan also meets the Decision 1631 requirements regarding the upper Owens River. In providing the streamflows that are required by Decision 1631, both base flows as well as channel maintenance flows, the Grant Lake Operations and Management Plan provides the necessary flows for stream and stream channel restoration. Further, by adhering to the Decision's export criteria, the Plan allows the elevation of Mono Lake to rise to the target elevation, thus providing the most significant element of waterfowl habitat restoration.

The SWRCB Decision 1631 has not set any specific requirements for the operation of Grant Lake. The LADWP has identified the concerns associated with the storage level of Grant Lake by conferring with parties and individuals who are impacted by changes to that. The LADWP proposal is to maintain storage in Grant Lake between approximately 30,000 ac-ft and 35,000 ac-ft.

The LADWP proposal defines the criteria that will be used in deciding to divert water in the Lee Vining Conduit. The criteria define the creeks which may be diverted, the flow, and the beginning and ending dates for diversions.

The SWRCB Decision 1631 establishes water diversion criteria that correlate exports to the level of Mono Lake, as measured on April 1 of each year. The criteria are classified in the period before the lake reaches the elevation 6,391 feet (transition period), and the period after (post transition period). The LADWP proposal conforms with these requirements.

Base flows provide for fishery requirements in the streams. The SWRCB has set minimum requirements for base flows in four Mono Basin streams. Table 1 presents a side-by-side comparison of Decision 1631 instream flow requirements with the instream flows of the LADWP proposal. The LADWP proposal meets or exceeds these requirements for each of the streams, during all year types.

Peak, or flushing, flows are considered to be essential in maintaining stream channels in good condition. The SWRCB has defined the peak flow magnitude and duration that are to be met in each of the streams, during various year types (dry, normal, wet). The LADWP proposal for Rush Creek is to meet or exceed the required peak flows during all types of years. The proposal for Parker, Walker and Lee Vining creeks is to allow flow-through conditions, letting the peak flow be equal to the inflow at LADWP's facilities. Conceivably this would be greater than the SWRCB requirements, or at a minimum, no less than what nature has to offer. Table 2 presents a side-by-side comparison of Decision 1631 channel maintenance flow requirements with the channel maintenance flows of the LADWP proposal.

LADWP's proposal is to meet the requirements for incremental flow change, or ramping, operating as much as possible within the limitations of the existing facilities.

A fundamental element of the LADWP proposal is to allow flexibility of operations, while meeting all the requirements set by the SWRCB. Flexibility is necessary to accommodate the variability of nature. The Grant Lake Operations and Management Plan will be reviewed and modified as necessary in five-year intervals. An annual operating plan will be developed annually, and distributed to interested parties for review and comment.

The SWRCB Decision 1631 requires a review in 20 years from the date of the decision, should the lake level not reach the targeted 6,391 feet. LADWP calculations indicate that the targeted level will be achieved in a period of approximately 27 years. Thus it appears that a SWRCB review will occur before the end of the transition period. The LADWP proposal is primarily a proposal for the transition period (while the lake level is rising to the targeted 6,391 ft), knowing full well that it will be evaluated frequently, and significantly adjusted, if necessary, at the time of the SWRCB review. The LADWP Plan includes an analysis of various streamflow management scenarios in the post transition period, and their effects on Mono Lake elevation, but a detailed post transition operational proposal is not included.

The SWRCB Decision 1631 requires that the flow of the Owens River as measured below the East Portal discharge not exceed 250 cfs at any time. LADWP conferred with parties and individuals who are affected by flows in the upper Owens River to identify any additional concerns, beyond Decision 1631 requirements. The LADWP proposed flow regime meets these needs, and satisfies the SWRCB order.

TABLE 1: LADWP Proposed Base Flow Releases for Mono Basin Creeks

(all values in cfs)

Creek	Year-Type[1]	Decision 1631[2]		LADWP Proposed[3]						
		Apr-Sept	Oct-Mar	Apr	May	June	July	Aug	Sept	Oct-Mar
Rush	Dry	31	36	31	31	31	31	31	31	36
	Dry-Normal	47	44	47	47	47	47	47	47	44
	Normal	47	44	50	75	75	75	50	50	45
	Wet-Normal	47	44	50	100	100	100	50	50	45
	Wet	68	52	80	150	150	150	80	80	55
	Extreme	68	52	80	150	150	150	150	100	100
Lee Vining	Dry	37	25	37	37	37	37	37	37	25
	Normal & Wet	54	40	54	54	54	54	54	54	40
	Extreme	54	40	Flow through conditions for the entire year						
Parker	Dry	9	6	9	9	9	9	9	9	6
	Normal, Wet, & Extreme	9	6	Flow Through conditions for the entire year						
Walker	Dry	6	4.5	6	6	6	6	6	6	4.5
	Normal, Wet, & Extreme	6	4.5	Flow through conditions for the entire year						

TABLE 2: LADWP Proposed Channel Maintenance Flows for Mono Basin Creeks

Creek	Year-Type[1]	Channel Maintenance Flows	
		Decision 1631[2]	LADWP Proposed[3]
Rush	Dry	None	None
	Dry-Normal	None	100 cfs for 5 days
	Normal	200 cfs for 5 days	250 cfs for 5 days *or* 380 cfs for 5 days & 300 cfs for 7 days
	Wet Normal	300 cfs for 2 days & 200 cfs for 10 days	400 cfs for 5 days & 350 cfs for 10 days
	Wet	300 cfs for 2 days & 200 cfs for 10 days	450 cfs for 5 days & 400 cfs for 10 days
	Extreme	300 cfs for 2 days & 200 cfs for 10 days	500 cfs for 5 days & 400 cfs for 10 days
Lee Vining	Dry	None	None
	Normal	160 cfs for 3 days	Allow peak flows to pass
	Wet	160 cfs for 30 days	Allow peak flows to pass
	Extreme	160 cfs for 30 days	Flow through conditions
Parker	Dry	None	None
	Normal, Wet, & Extreme	25-40 cfs for 1-4 days	Flow through conditions
Walker	Dry	None	None
	Normal, Wet, & Extreme	15-30 cfs for 1-4 days	Flow through conditions

GRANT LAKE OPERATIONS AND MANAGEMENT PLAN

I. Introduction

The Mono Lake Basin Water Right Decision 1631 (Decision 1631) was adopted by the State Water Resources Control Board (SWRCB) on September 28, 1994. Decision 1631 limits the amount of water that can be exported from the Mono Basin. Included in Decision 1631 is a requirement for the Los Angeles Department of Water and Power (LADWP) to prepare a stream and stream channel restoration plan, and a waterfowl habitat restoration plan. Part of the Stream and Stream Channel Restoration Plan includes a requirement to prepare a Grant Lake Operations and Management Plan. The Decision lists a few items that must be in the plan, but it was vague about goals of the plan. In the draft scope of work for the plan, the objective stated was to develop a plan to operate Grant Lake reservoir and the diversion facilities in the Mono Basin in a way to efficiently distribute the water of the Mono Basin. Once approved, the plan will guide the LADWP in future operational decisions in the Mono Basin.

In the process of developing the plan, the LADWP first hosted a public meeting to solicit input from local interests. The focus of the meeting was on three issues: the operations of Grant Lake reservoir, the water exports to the upper Owens River, and LADWP land management in the area. More than 30 people attended the meeting, which was advertised in a local newspaper. In April, LADWP prepared a summary of the meeting and sent it to the meeting attendees. A copy of that summary is included in Appendix I. In addition to the public meeting, the LADWP hosted a number of Technical Advisory Group (TAG) meetings to discuss the developing plan and to consider new information.

II. Background of the Grant Lake Operations and Management Plan

In Decision 1631, the SWRCB established minimum instream flows, channel maintenance flows, and ramping rates for the Mono Basin streams. Additionally, the decision limits exports based on the April 1 elevation of Mono Lake. Tables A and B show Decision 1631 streamflow requirements and Mono Basin export limits. The decision places a limit of 250 cfs on the maximum flow of water in the upper Owens River when exports are taking place. Beyond those requirements, the decision does not place requirements on the pattern of release of water to Mono Lake above the minimum flows, the operation of Grant Lake reservoir, or ramping or flow patterns in the upper Owens River. The Grant Lake Operations and Management Plan addresses these issues.

Table A

Decision 1631 Mono Basin Streamflow Requirements

		Minimum Flows (cfs)			
Creek	**Year-Type**	**Apr-Sep**	**Oct-Mar**	**Flushing Flows**	**Ramping Rates**
Rush	Dry	31	36	None	10% up and down
	Dry-Normal	47	44	None	
	Mid-Normal	47	44	200 cfs - 5 days	
	Wet-Normal	47	44	200 cfs - 5 days	
	Wet	68	52	300 cfs - 2 days, 200 cfs - 10 days	
Lee Vining	Dry	37	25	None	20% up,
	Normal	54	40	160 cfs for 3 days	15% down
	Wet	54	40	160 cfs for 30 days	
Parker	Dry	9.0	6.0	None	10% up and down
	Normal/Wet	9.0	6.0	25 - 40 cfs - 1 to 4 days	
Walker	Dry	6.0	4.5	None	10% up and down
	Normal/Wet	6.0	4.5	15 - 30 cfs - 1 to 4 days	

Runoff year definition based on the combined Mono Basin runoff from Rush, Lee Vining, Walker, and Parker creeks:

Dry	less than 68.5% of average runoff	
Normal	Dry-Normal	between 68.5% and 82.5% of average runoff
	Mid-Normal	between 82.5% and 107% of average runoff
	Wet-Normal	between 107% and 136.5% of average runoff
Wet	greater than 136.5% of average runoff	

Table B

Mono Basin Water Diversion Criteria

	Mono Lake Level (feet)	**Allowable Export (acre-feet/year)**
During Transition	Below 6,377	- 0 -
	Between 6,377 and 6,380	up to 4,500
	Between 6,380 and 6,391	up to 16,000
After Transition	Above 6,391	all available water
	Between 6,388 and 6,391	up to 10,000
	Below 6,388	- 0 -

Computer models were used to assess the impacts of the different flow management scenarios identified in the Plan. Two hydrologic models in particular, the Los Angeles Aqueduct Simulation Model (LAASM) and the Grant Lake Operations Model (GLOM), were used by the LADWP in performing the analyses. Both models require input from the user, and process the inputs to produce results.

The LAASM is written in FORTRAN and was introduced as an exhibit in the Mono Basin Water Right Hearing. Its primary purpose was to analyze the long-term impacts through multi-year simulations of the various operational requirements discussed in this Plan. User-specified inputs include stream runoff, precipitation, fish flow release, monthly reservoir target storage, and various command inputs to direct logic within the model. Calculations produced by the LAASM include fish flow releases, Mono Lake and reservoir levels, basin exports, and Owens River flows. All hydrologic output is provided on a monthly basis, and can be easily interpreted by using a spreadsheet. The LAASM was recently modified to perform the Mono Basin operating requirements specified in Decision 1631.

The GLOM was developed to simulate daily storage fluctuations in Grant Lake due to various inflow and outflow conditions and to analyze Mono Basin creeks' flow patterns subject to various operational patterns. The GLOM allows a more detailed look at the impacts of various flow management scenarios through a single year simulation. User-specified inputs include daily flows for Lee Vining Creek above intake, Walker and Parker creeks' runoff, Rush Creek @ Damsite, upper Owens River above East Portal, daily or constant monthly Grant Lake outflow, and Grant Lake storage. Output from a model run is summarized in a one page spreadsheet, containing Mono Basin streamflows, Grant Lake storage, Mono Basin exports, and upper Owens River flows as well. Model output can also be interpreted using the various graphs prepared for the model.

III. Physical Description of the Mono Basin System and the Upper Owens River

Mono Basin

Annual Runoff

Surface water runoff in the Mono Basin is primarily snowmelt driven. There are three major creeks within the Mono Basin: Rush Creek, Lee Vining Creek, and Mill Creek. Average Mono Basin surface water runoff is tabulated by source in Table C below. During the 1941-1990 period, annual runoff in the Basin averaged approximately 145,500 acre feet. Figure 1 is a histogram of annual Mono Basin runoff[1] for the 1940-1995 period.

Table C

Mono Basin Annual Unimpaired Runoff

(average for the 1941-1990 period)

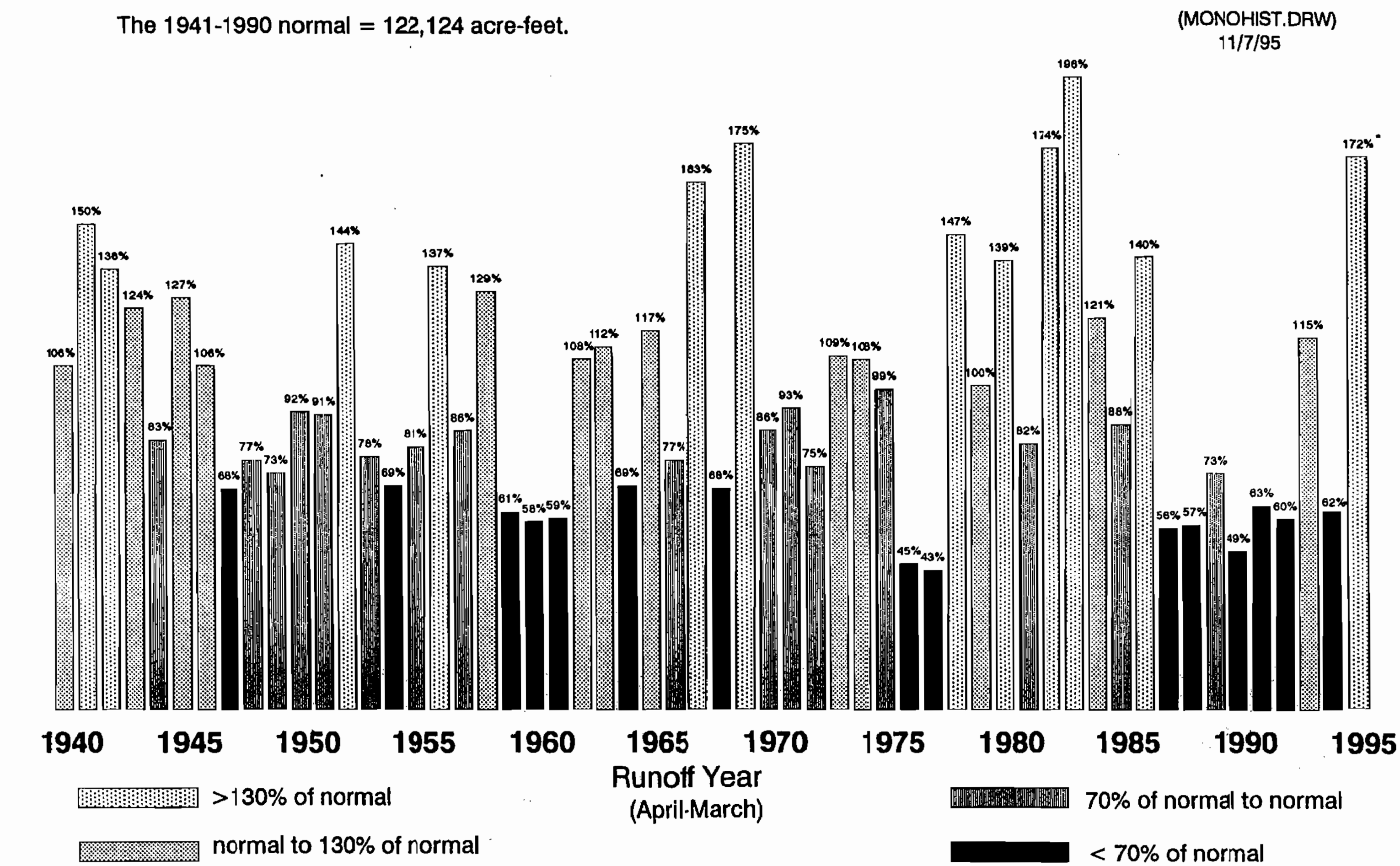
Source	Runoff (acre-feet)	% of Total
Rush Creek†	59,200	41%
Lee Vining Creek†	48,500	33%
Mill Creek	21,200	14%
Parker Creek†	9,100	6%
Walker Creek†	5,400	4%
South & East Parker Creek	1,200	1%
DeChambeau Creek	900	1%
Total Mono Basin Runoff	**145,500**	**100%**

† Creeks diverted by LADWP.

[1] Because LADWP has historically diverted Lee Vining, Walker, Parker and Rush creeks, LADWP defines Mono Basin runoff as the sum of runoff from these four creeks which averaged 122,124 acre-feet annually during the 1941-1990 period.

1940-1995 MONO BASIN RUNOFF

Percent of Normal



* Forecasted

Figure 1

Peak Flow Magnitude and Frequencies

In the Mono Basin, runoff generally peaks in June or July, although the peak can come as early as May or as late as August. In general, dry years tend to peak earlier and wet year tend to peak later. The magnitudes and frequencies of peak flows of the four Mono Basin creeks diverted for export are graphically shown in Figures 2 through 7. Figures 2 through 5 show the magnitude and frequencies of impaired flows (measured flow) on the creeks, while, Figures 6 and 7 show the magnitude and frequencies of the unimpaired flow (flows that would occur if SCE did not impound water) of Lee Vining and Rush creeks. These magnitude/frequency relationships were developed using the peak flows of the 22-year period, 1973-1994[2].

Daily Flow Pattern

During the peak runoff period, flows in some Mono Basin creeks undergo cyclical fluctuations on a daily basis. This diurnal effect is a direct result of the daily swing in temperature. The snowpack that feeds the creeks rapidly melts during the day when temperatures are highest and melts at a slower rate or refreezes at night when temperatures are lowest. Although this process affects all surface runoff in the Basin, the diurnal effect is not as evident on some creeks due to the dampening effect of instream lakes and reservoirs.

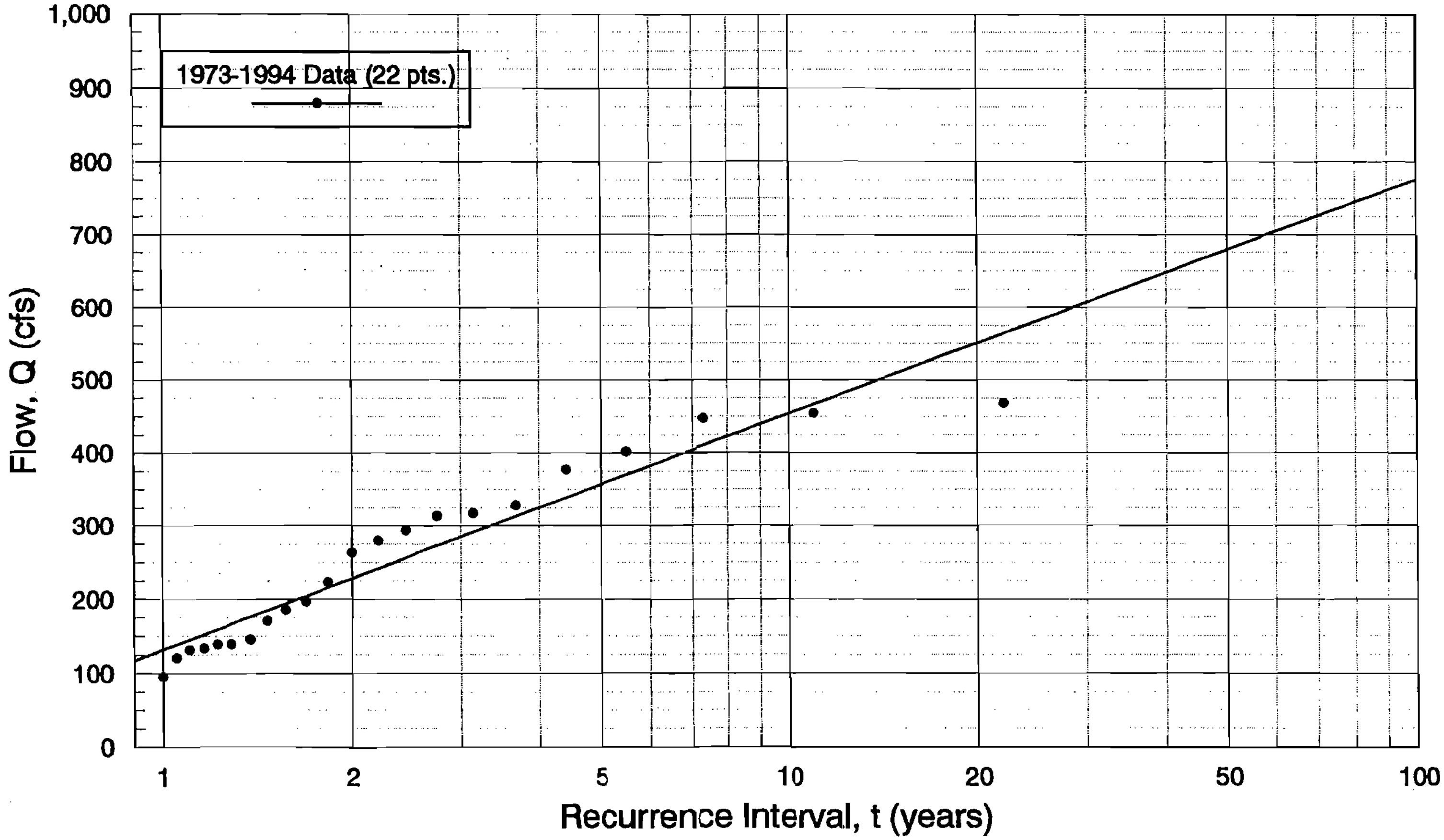
Figures 8 and 9 show the impaired flow of Lee Vining and Rush creeks, using an hourly time step, during the peak runoff weeks of 1995. Runoff on Lee Vining Creek peaked on July 9 at 553 cfs while runoff on Rush Creek peaked on July 30 at 676 cfs. The diurnal effect is very evident on Lee Vining Creek which routinely had diurnal flow fluctuations of 50 cfs during the week. Moreover, flow on Lee Vining Creek surged upward approximately 130 cfs during the 13 hour period immediately preceding the July 9 peak.

In contrast, Rush Creek does not demonstrate a diurnal characteristic. Any sign of a diurnal fluctuation is absent in Figure 9. It should be noted that the SCE reservoirs were spilling on both creeks when the peak flows occurred. The absence of the diurnal on Rush Creek may be attributed to the influence of several lakes -- most notably Silver Lake -- upstream of the measuring point which tend to dampen out rapid flow changes.

[2] The 1973-1994 period was used because the Lee Vining Above Intake station was constructed in 1973. On Rush Creek, the 1973-1994 and 1941-1990 periods were compared to see how well the two periods correlate. The two periods correlate well. The maximum differences were: 6% for impaired and 15% for unimpaired.

LEE VINING CREEK IMPAIRED PEAK FLOWS

Lee Vining Creek Above Intake
1973-94 Period



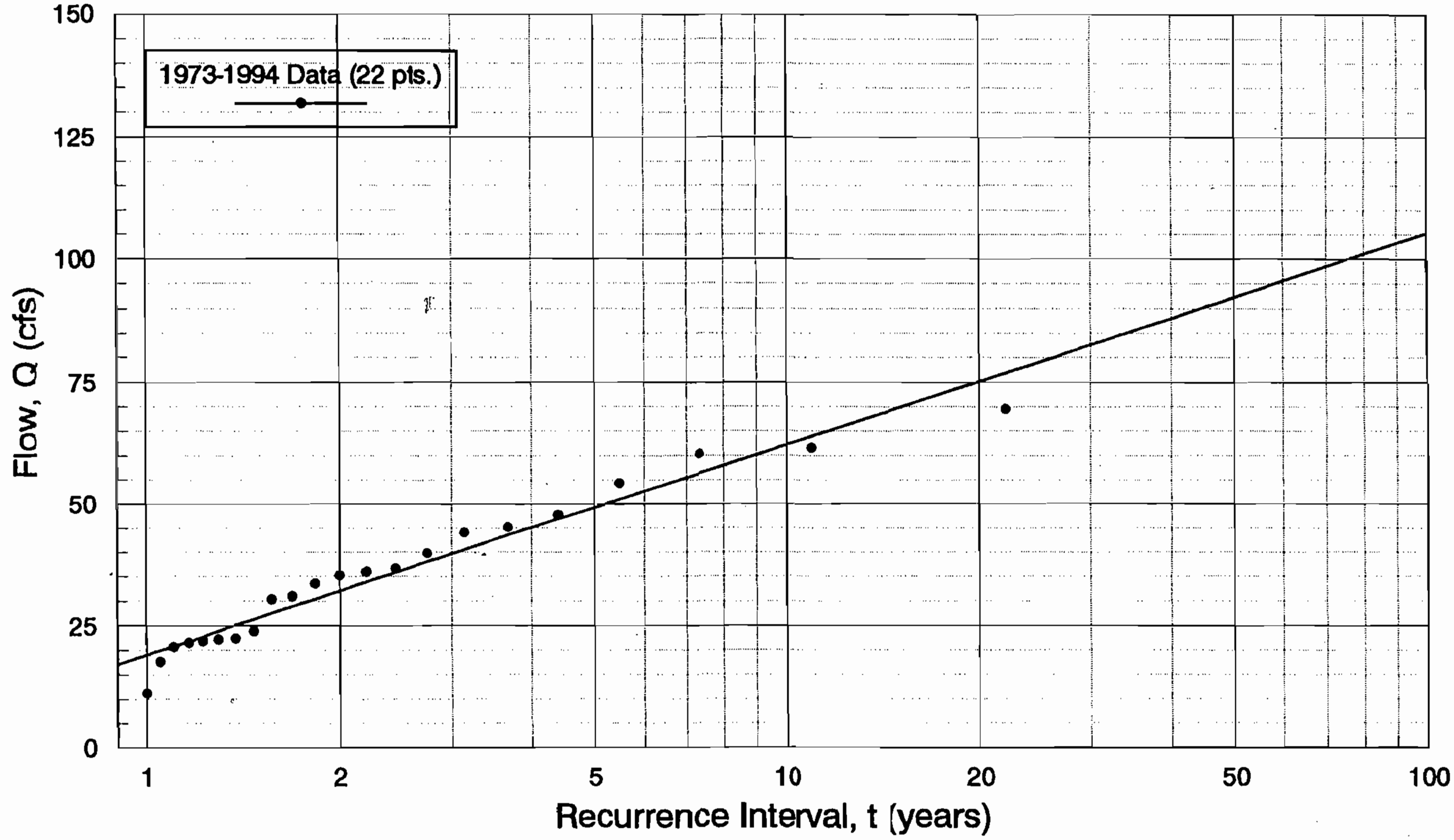
(1973-1994) Equation: Q = 131.5 + 140.0(ln(t))
R^2 = 0.92

Figure 2

WALKER CREEK IMPAIRED PEAK FLOWS

Walker Creek Above Conduit

1973-94 Period



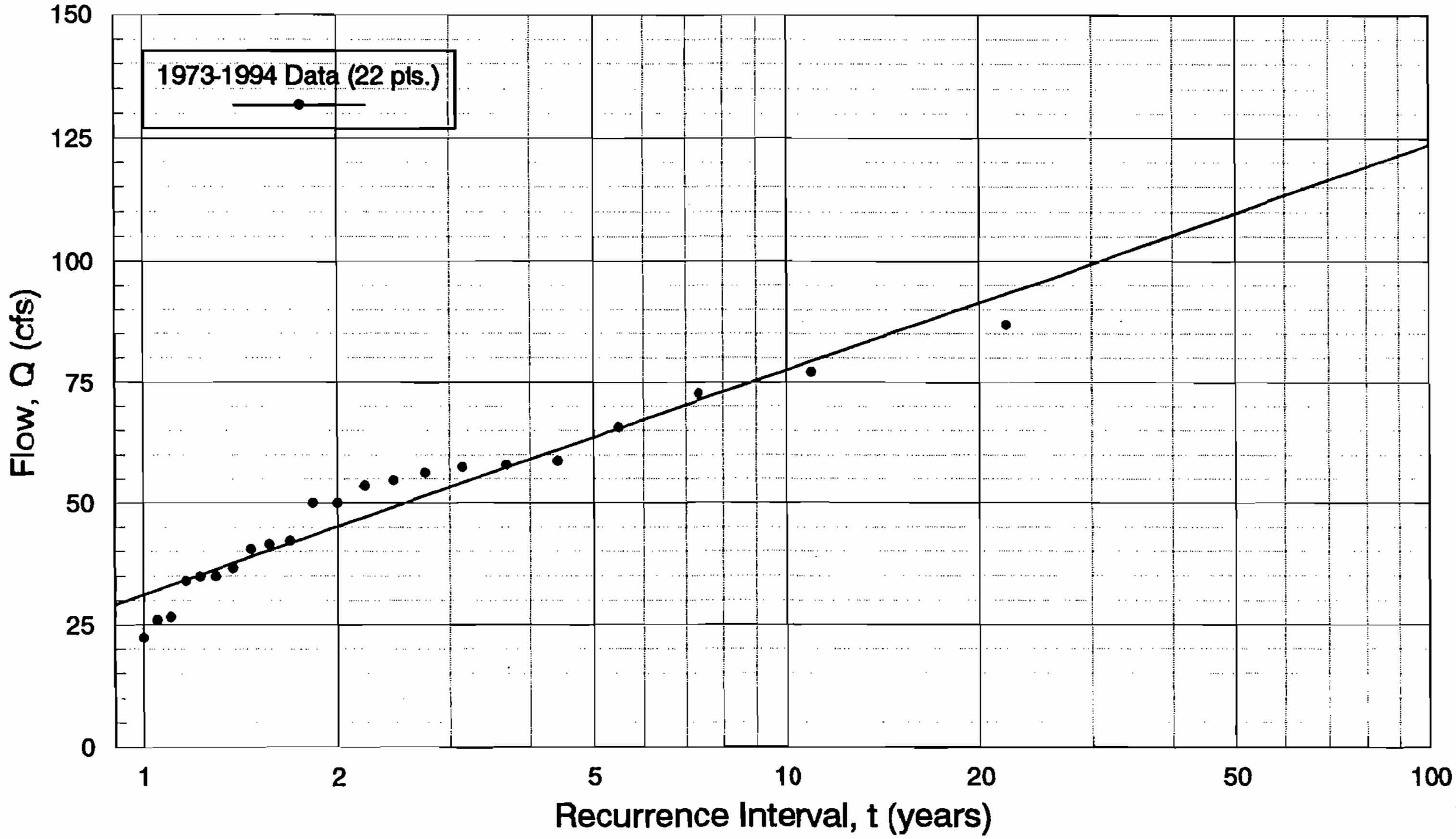
(1973-1994) Equation: Q = 19.2 + 18.7(ln(t))
R^2 = 0.96

Figure 3

PARKER CREEK IMPAIRED PEAK FLOWS

Parker Creek Above Conduit

1973-94 Period



(1973-1994) Equation: $Q = 31.3 + 20.1(\ln(t))$

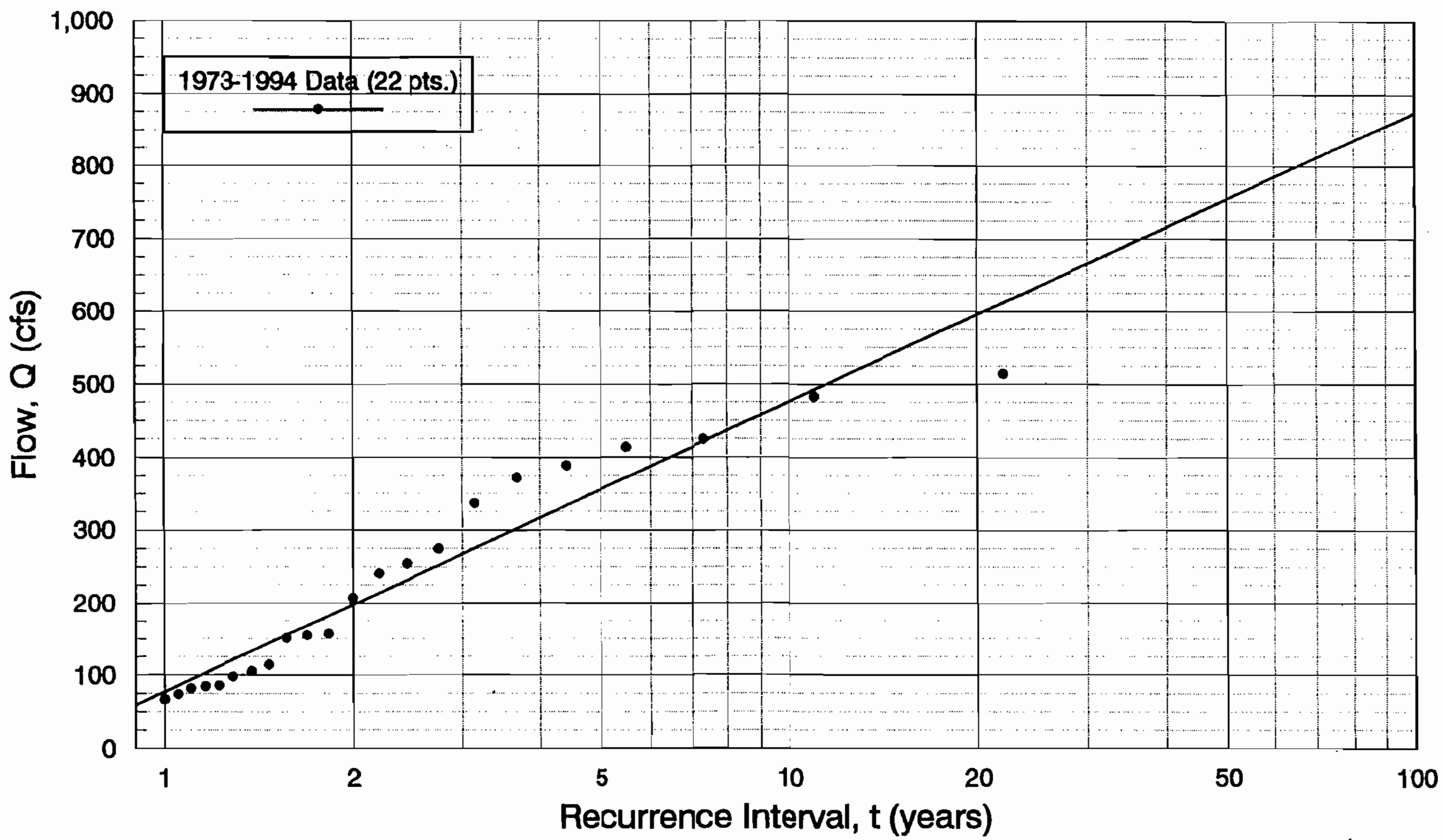
$R^2 = 0.93$

Figure 4

RUSH CREEK IMPAIRED PEAK FLOWS

Rush Creek @ Damsite

1973-94 Period



(1973-1994) Equation: $Q = 77.5 + 173.2(\ln(t))$

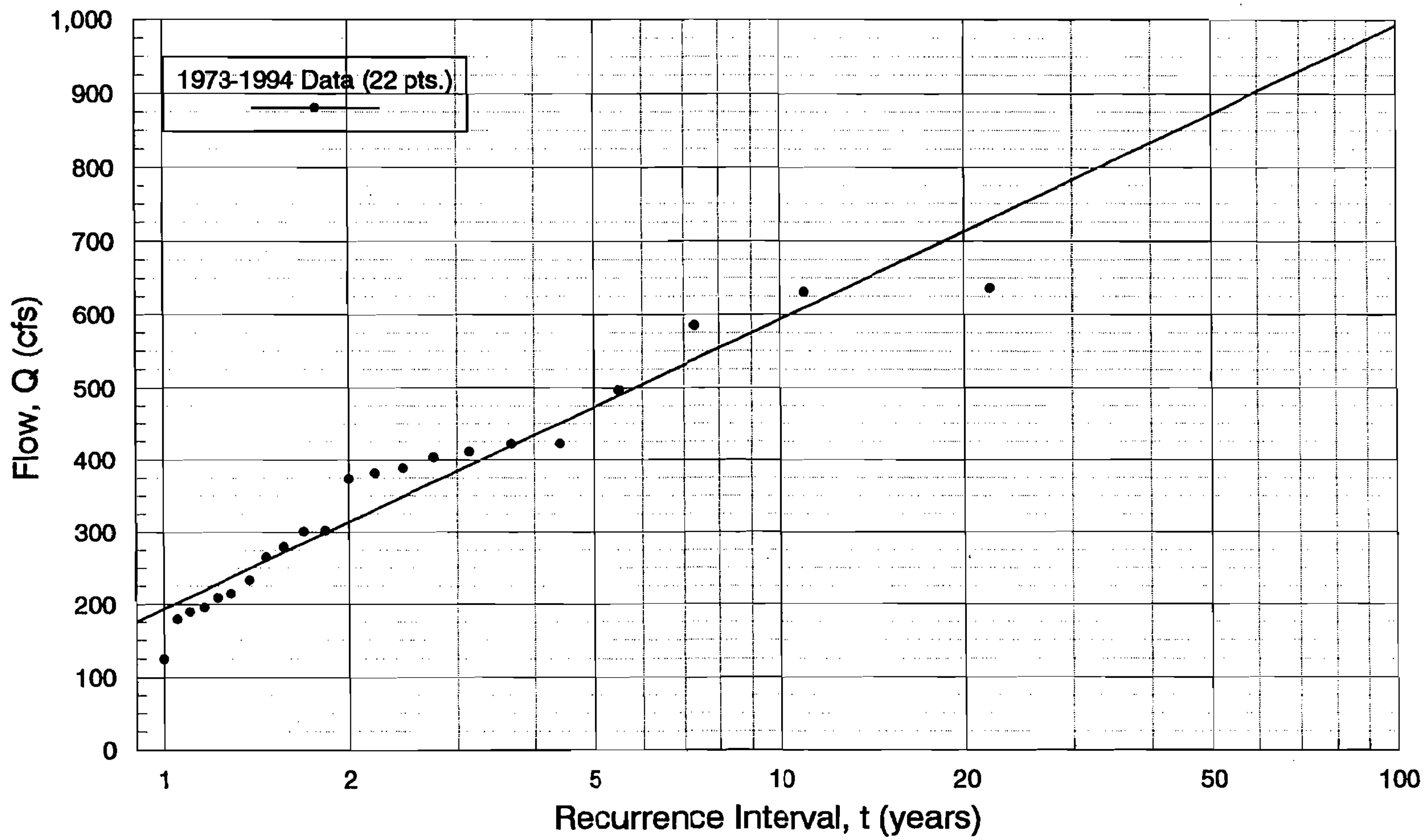
$R^2 = 0.94$

Figure 5

LEE VINING CREEK UNIMPAIRED PEAK FLOWS

Lee Vining Creek Above Intake + SCE Storage Change

1973-94 Period



(1973-1994) Equation: $Q = 194.3 + 173.3(\ln(t))$

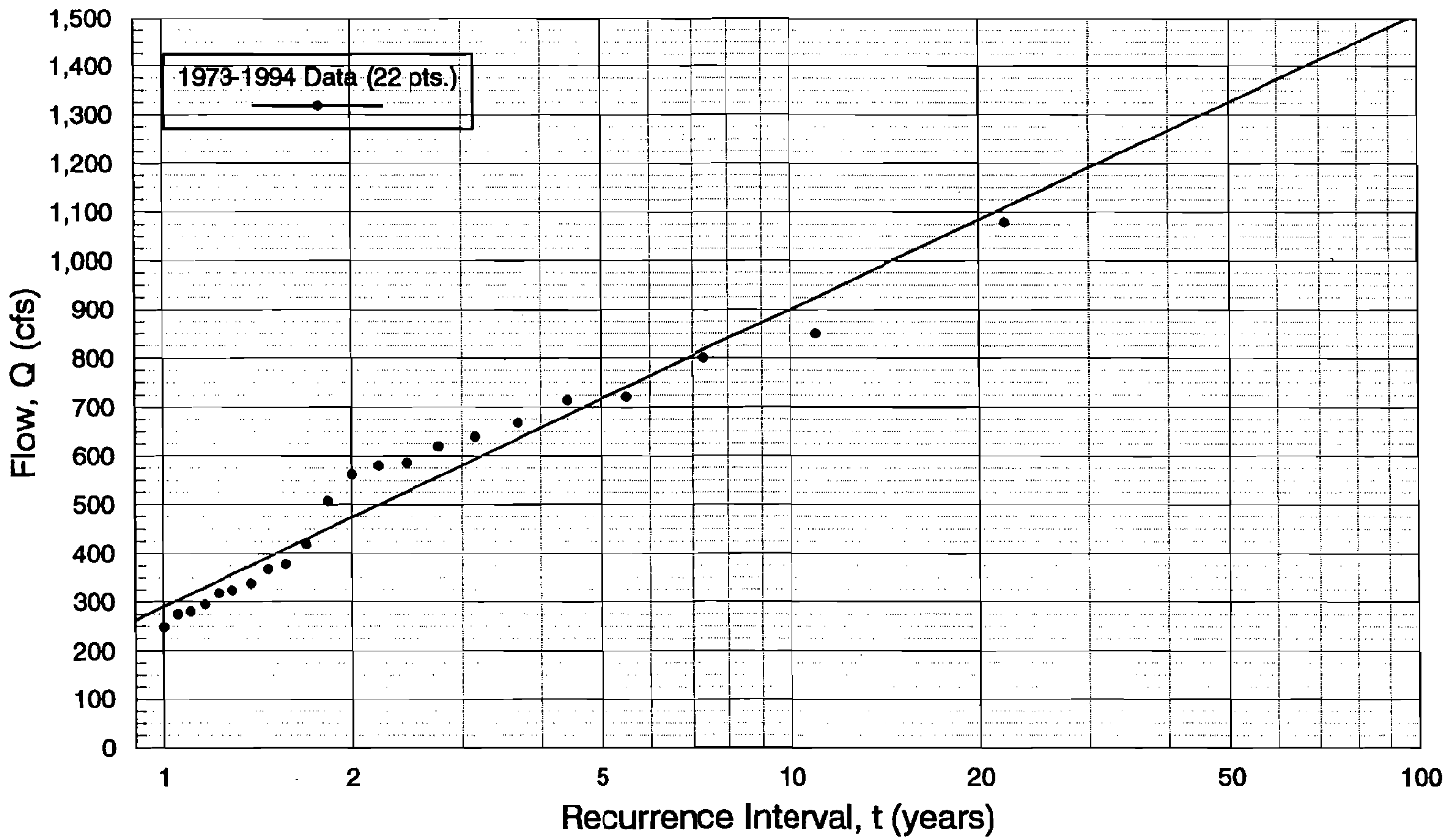
$R^2 = 0.94$

Figure 6

RUSH CREEK UNIMPAIRED PEAK FLOWS

Rush Creek @ Damsite + SCE Storage Change

1973-94 Period



(1973-1994) Equation: Q = 291.1 + 264.7(ln(t))
$R^2 = 0.96$

Figure 7

Southern California Edison Effect on Flows

As part of their hydroelectric power operations in the Sierra Nevada, SCE operates seven reservoirs in the Mono Basin: three on Rush Creek, three on Lee Vining Creek, and one on Mill Creek. The storage capacities of the seven reservoirs are shown in Table D below. SCE uses these reservoirs to regulate flow for power generation by storing water during the summer months when flows are the highest and releasing water to augment flows during the remainder of the year after the natural flows have subsided. Although the operation of these reservoir redistributes flow on a monthly basis, net storage change during the runoff year (April 1 to March 31) is negligible on both creeks.

Table D

SCE Mono Basin Reservoirs
(average for the 1941-1990 period)

Reservoirs	Storage (acre-feet)	% of Total Storage
Rush Creek Drainage		
Rush Meadows (Waugh)	4,980	22%
Gem Lake	17,060	75%
Agnew Lake	860	3%
Total Storage	22,900	100%
Lee Vining Creek Drainage		
Saddlebag Lake	11,080	86%
Tioga Lake	1,250	10%
Ellery Lake (Rhinedollar)	490	4%
Total Storage	12,820	100%
Mill Creek Drainage		
Lundy Lake	3,820	100%
Total Storage	3,820	100%

The operation of these reservoirs alters the downstream hydrographs on Lee Vining and Rush creeks. Their effect is to attenuate the natural hydrograph by dampening the high flows during the peak summer months and augmenting the lower flows during the balance of the year. Figures 10 and 11 compare the average monthly unimpaired and impaired flows (cfs) on Lee Vining Creek and Rush Creek, respectively. Similarly, the pie charts of Figures 12 and 13 compare the monthly distribution of runoff on both creeks as a percentage of total annual runoff.

Lee Vining Creek Above Intake

Hourly Flow (cfs) July 6-12, 1995

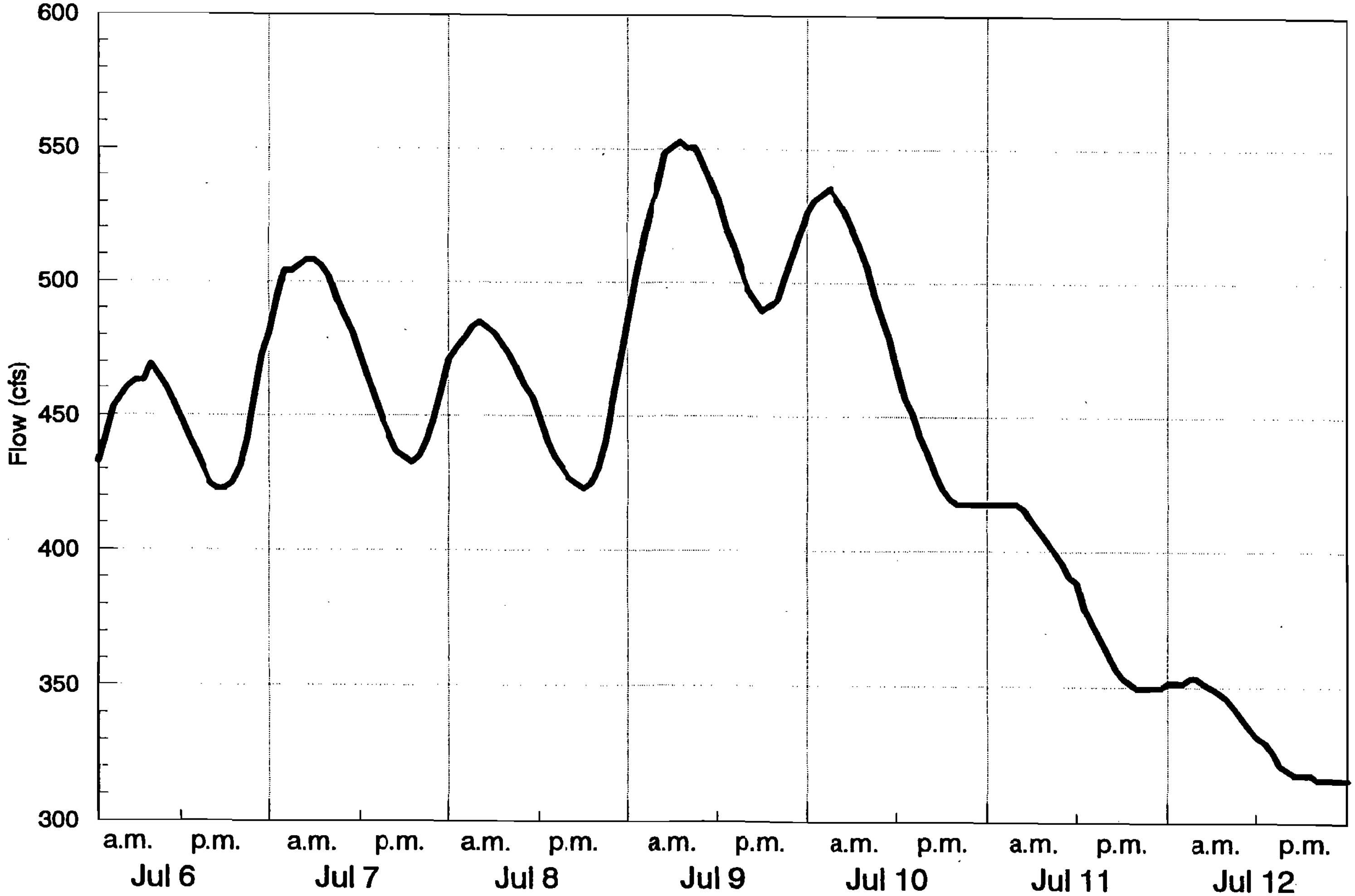


Figure 8

Rush Creek at Damsite

Hourly Flow (cfs)   July 27 - August 2, 1995

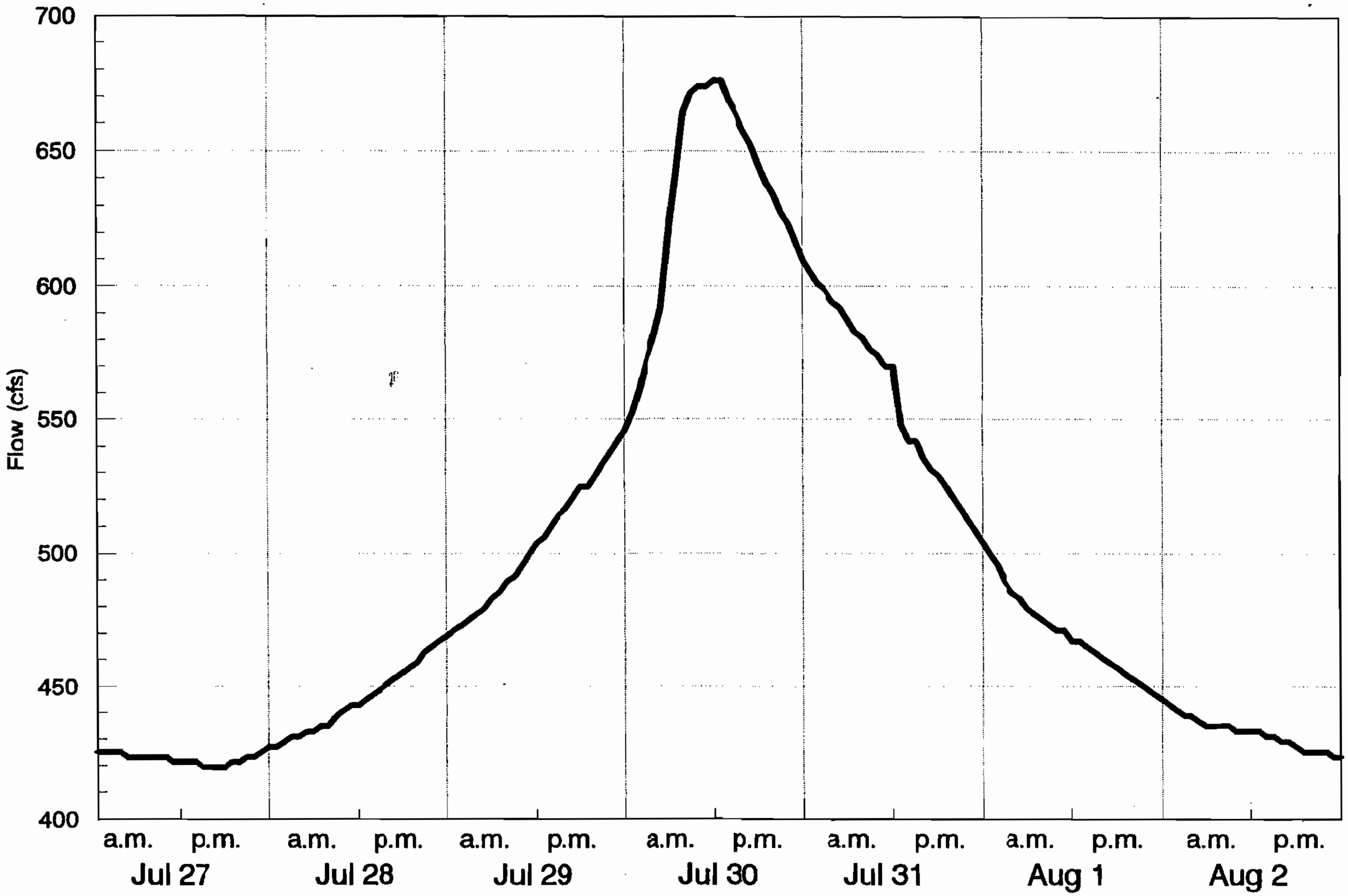


Figure 9

As shown in Table E below, the ratio of SCE's total reservoir storage capacity to average annual flow is 0.39 on Rush Creek and 0.26 on Lee Vining Creek. As indicated by these ratios, Rush Creek's storage capacity, relative to its annual flow, is 1.5 times that of Lee Vining Creek's. The additional storage capacity on Rush Creek affords SCE the ability to attenuate flows to a greater degree on Rush Creek than on Lee Vining Creek. (Compare the attenuation magnitudes in Figures 10 and 11.)

Table E

SCE Mono Basin Reservoirs
Storage to Annual Flow Ratios

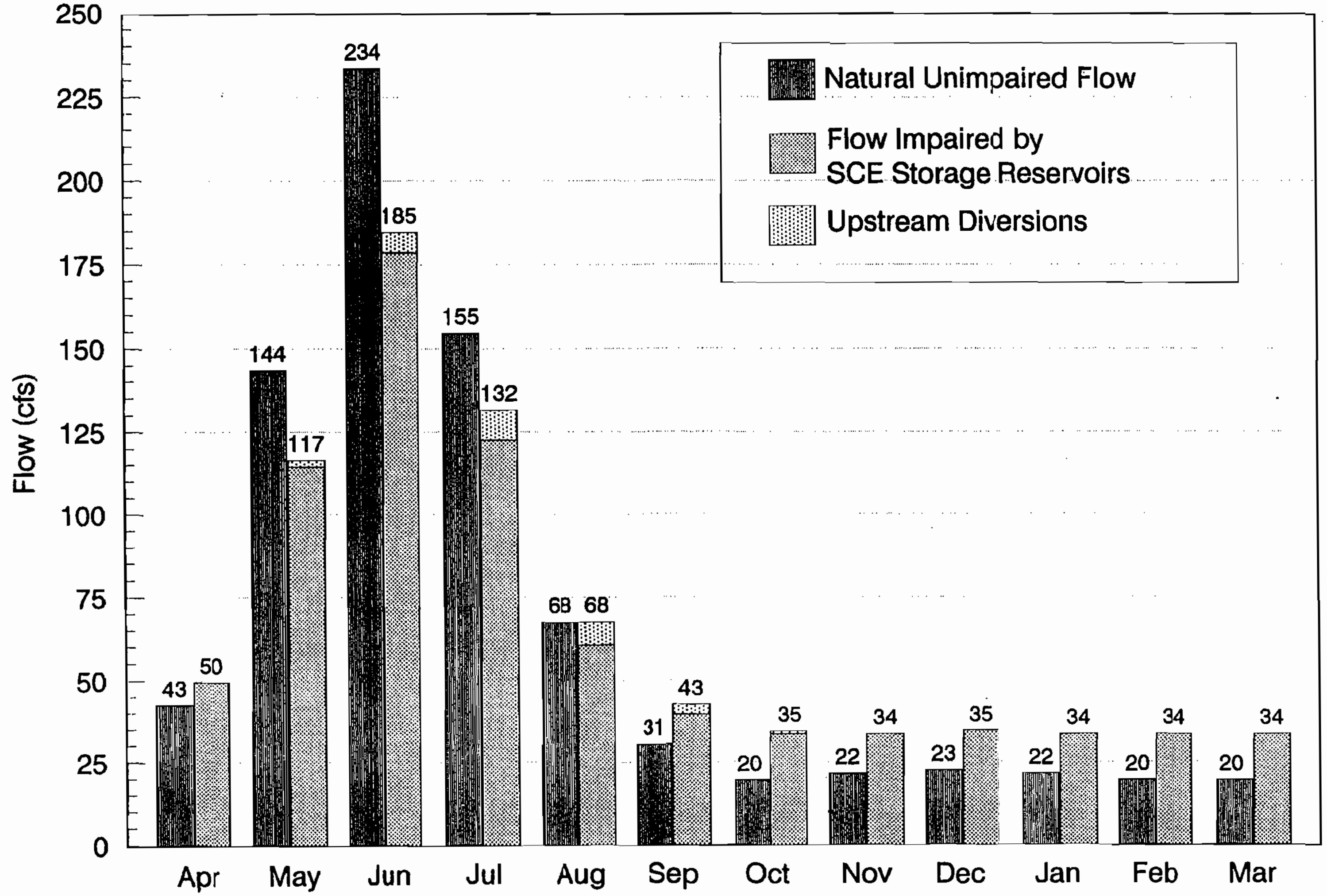
Drainage	Storage (acre-feet)	Annual Runoff (acre-feet)	Ratio
Rush Creek Drainage	22,900	59,234	0.39
Lee Vining Creek Drainage	12,820	48,472	0.26
Mill Creek Drainage	3,820	21,200	0.18

Upstream Diversions Effect on Flows

Flow in Lee Vining Creek and Parker Creek is also affected by upstream irrigation diversions. On Lee Vining Creek, water is diverted at three locations upstream of the Lee Vining Conduit intake. O Ditch, a diversion used by the U.S. Forest Service, is used to divert water from Lee Vining Creek to supply the Lee Vining Ranger Station. This diversion averages 700 acre-feet/year. The other two irrigation diversions are from Gibbs Creeks, a tributary to Lee Vining Creek; they are the Farrington diversion, and the Horse Meadow diversion. Combined, these diversions average 1,000 acre-feet/year.

On Parker Creek, water is diverted for irrigation at three locations upstream of the Lee Vining Conduit. These diversions are Parker Creek Diversion #1, #2, and #3. The impact of these diversions on Lee Vining and Parker creeks is shown in Figures 10 and 14, respectively. Currently, Rush Creek and Walker Creek are not diverted for irrigation although Rush Creek supplies water to the community of June Lake and a small amount of Walker Creek water is stored in Walker reservoir.

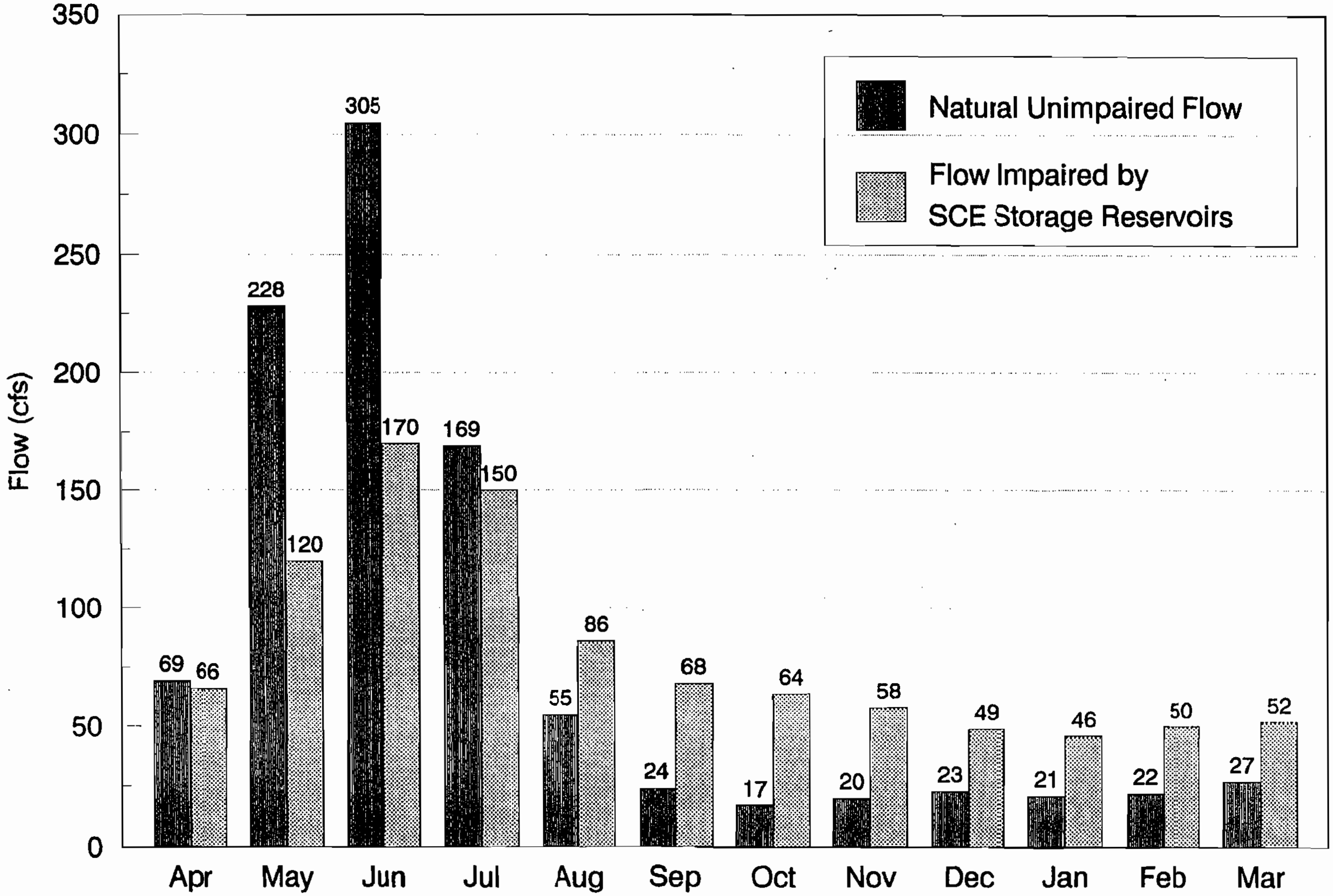
LEE VINING CREEK AVERAGE MONTHLY FLOW



Note: Average based on the 50 year period 1941-1990.

Figure 10

RUSH CREEK AVERAGE MONTHLY FLOW

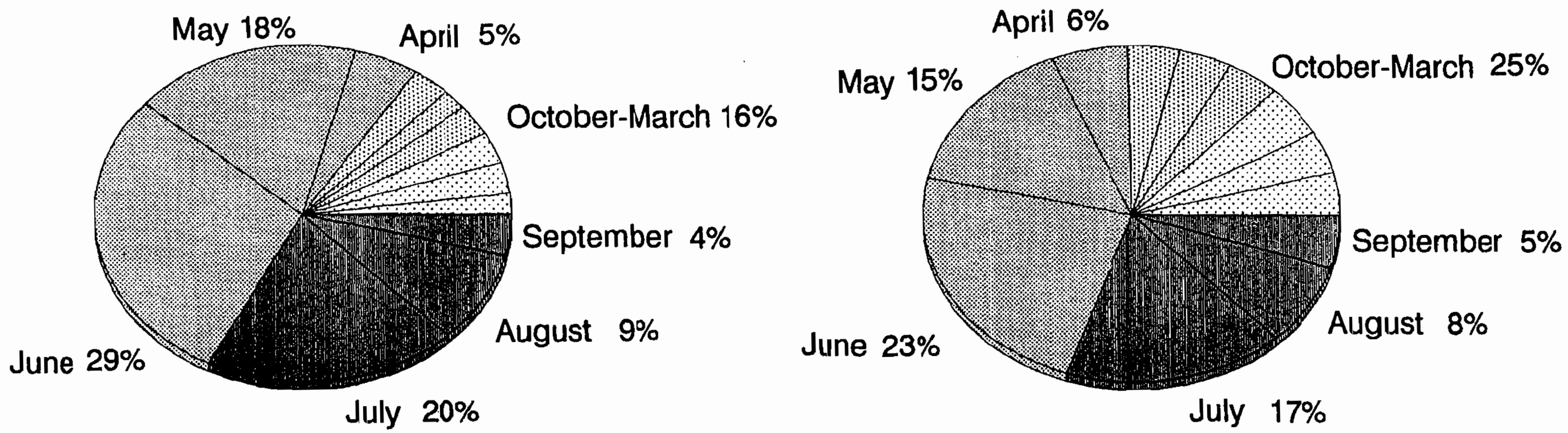


Note: Average based on the 50 year period 1941-1990.

Figure 11

LEE VINING CREEK RUNOFF

MONTHLY DISTRIBUTION



NATURAL UNIMPAIRED FLOW

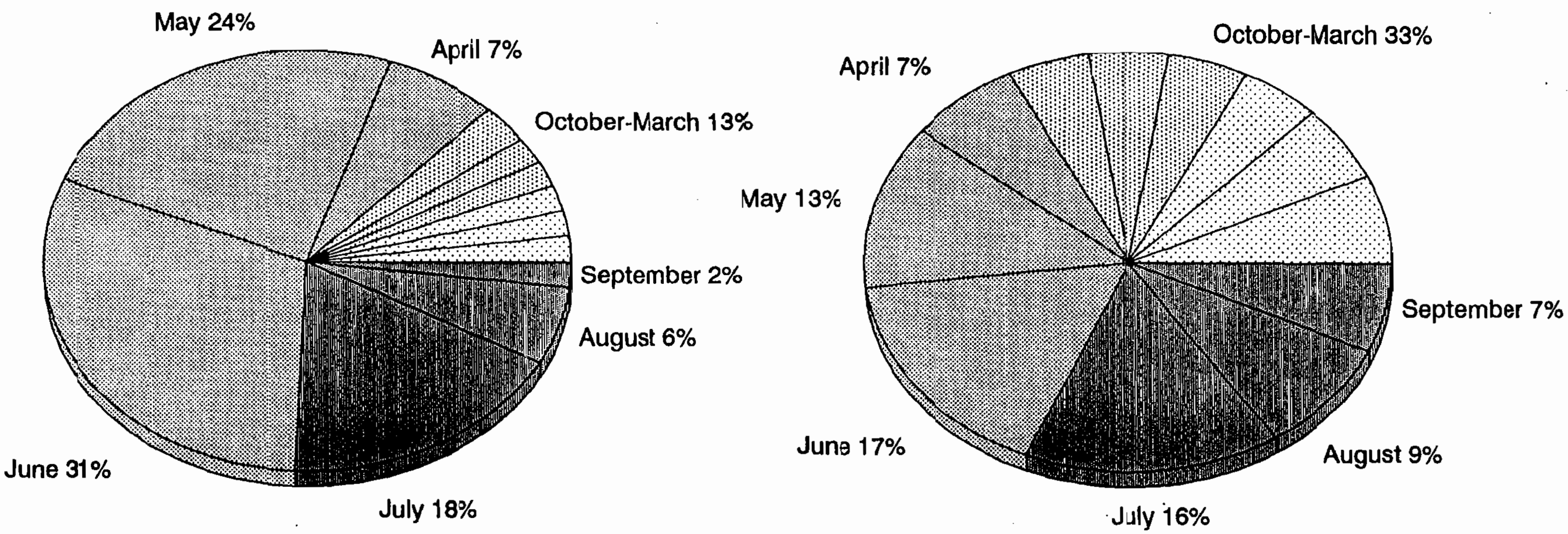
FLOW IMPAIRED BY SCE STORAGE RESERVOIRS

Note: Average distribution based on the 50 year period 1941-1990.

Figure 12

RUSH CREEK RUNOFF

MONTHLY DISTRIBUTION



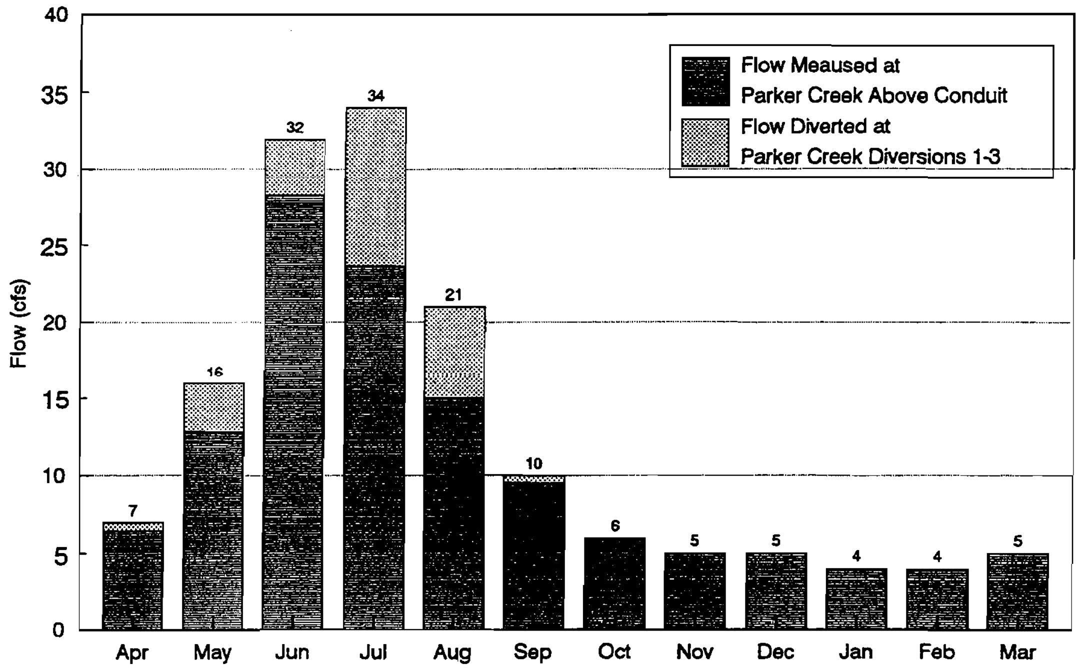
NATURAL UNIMPAIRED FLOW

FLOW IMPAIRED BY
SCE STORAGE RESERVOIRS

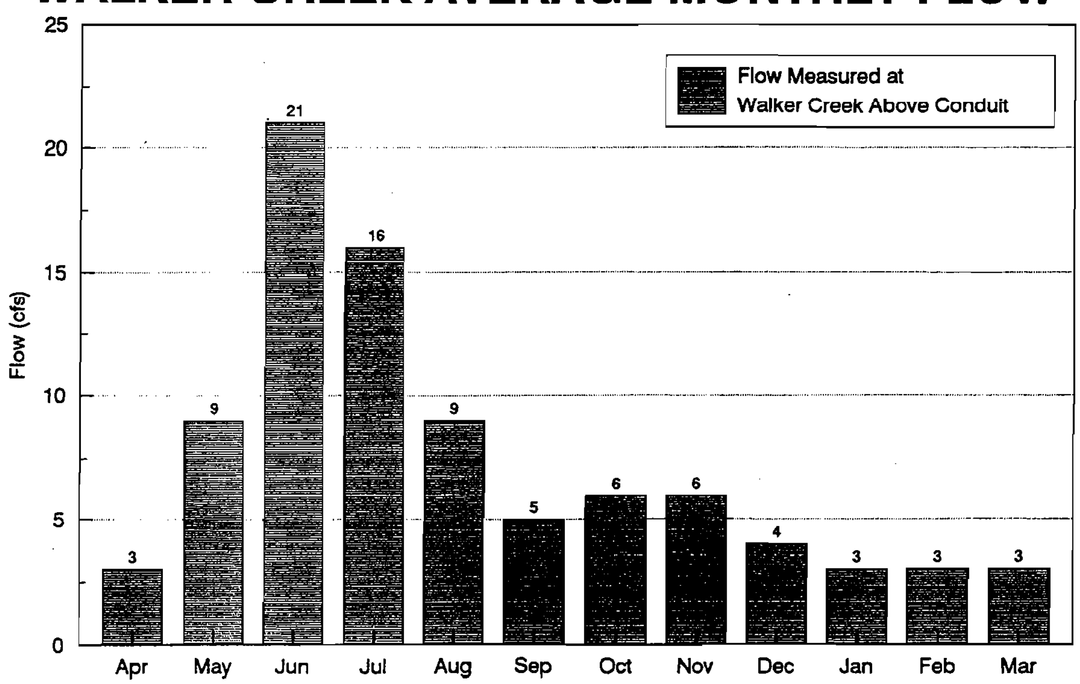
Note: Average distribution based on the 50 year period 1941-1990.

Figure 13

PARKER CREEK AVERAGE MONTHLY FLOW



WALKER CREEK AVERAGE MONTHLY FLOW



Note: Averages based on the 50 year period 1941-1990.

Figure 14

Mono Lake Elevation

January 1940 - February 1996

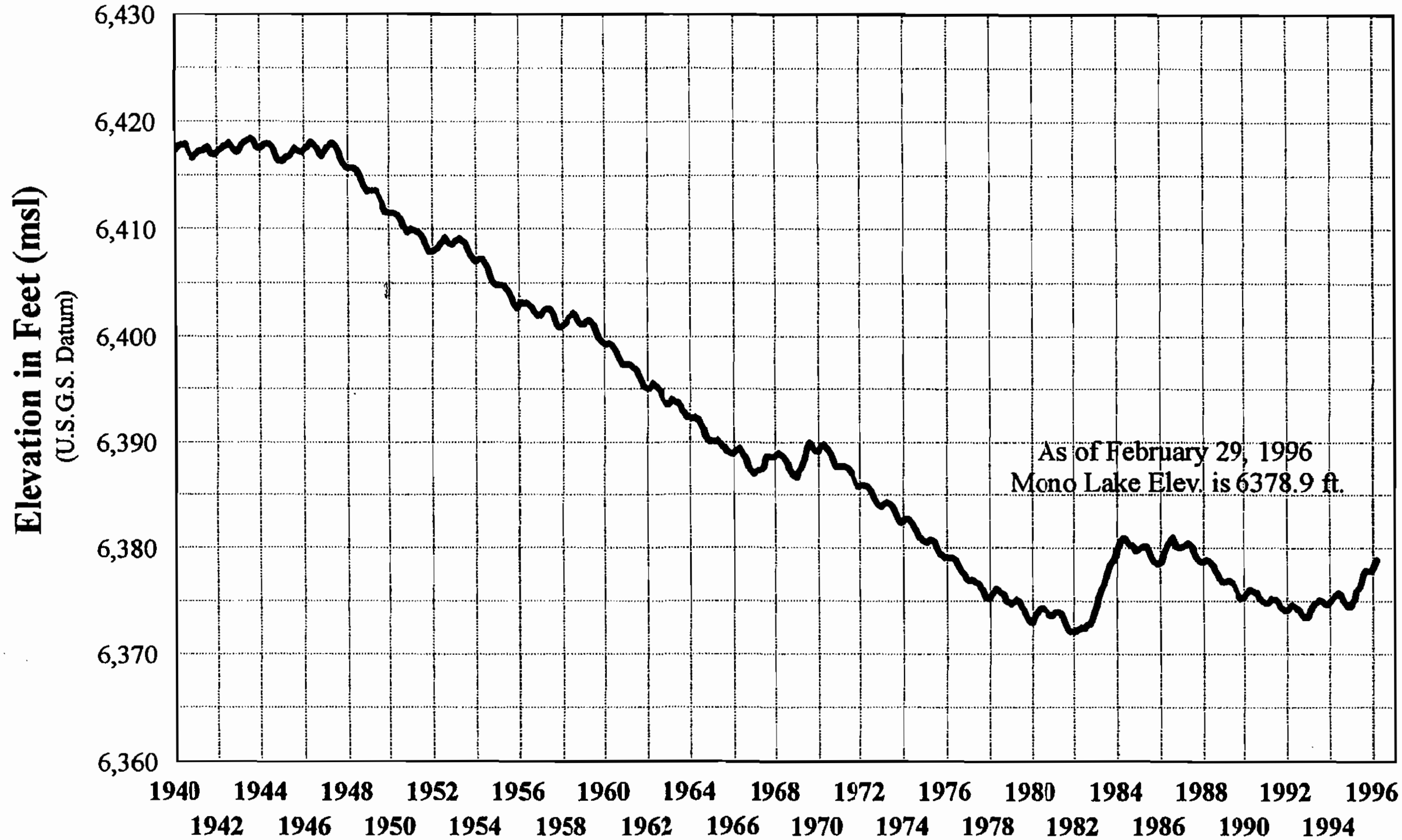


Figure 15

Upper Owens River

Annual Runoff

Unlike most of the eastern Sierra Nevada streams, surface water runoff in the upper Owens River is primarily spring driven. Annual runoff in the upper Owens River during the 1941-90 period averaged 42,100 acre-feet. Figure 15 is a histogram of annual upper Owens River runoff for the 1940-1995 period.

Characteristic of a spring-fed system, the variability of total runoff volume from year to year is less pronounced than in a snow or rain driven system. This is due to the damping or "lag" effect that carryover aquifer storage has on surface water runoff. Because groundwater moves at a much slower rate than surface water, the hydrograph of a spring-fed system is characteristically more steady from year to year. This characteristic is evident when comparing the annual Mono Basin runoff histogram with that of the upper Owens River. (Compare Figure 1 and Figure 15)

Peak Flow Magnitude and Frequencies

Like the Mono Basin, runoff in the upper Owens River generally peaks in June or July, although the peak can come as early as May. Unlike the Mono Basin, however, there is not a notable peak of significant magnitude in most dry years on the upper Owens River. The magnitude and frequency of peak flows in the upper Owens River are graphically shown in Figure 16. This magnitude/frequency relationships was developed using the peak flows of the 31-year period, 1964-1994[3].

The strong baseflow component of the upper Owens River, evident in annual data, is also prominent in monthly data and peak flow data. Figure 17 shows the average monthly distribution of runoff in the upper Owens River for the 1941-1990 period. Similarly, the pie chart in Figure 18 shows the average monthly distribution of runoff as a percent of the average total annual runoff. As evident in these two figures, peak flows during the peak runoff months of May-July contribute a much smaller percentage of the annual runoff than do peak flows on most other eastern Sierra Nevada creeks. In the Mono Basin, peak runoff in May-July contributes 68 percent of the annual runoff while in the upper Owens River peak runoff in May-July only contributes 32 percent.

[3] The 1964-1994 period is used because the Owens River Below East Portal station was constructed in 1964.

Daily Flow Pattern

Similar to the creeks in the Mono Basin, the upper Owens River also experiences a diurnal fluctuation during peak runoff. The magnitude of the fluctuation is much smaller, however. Figure ~~19~~ 20 shows the natural[4] flow of the upper Owens River during the peak runoff period of 1995. Runoff peaked on July 10 at 165 cfs. During the one week period shown in Figure ~~19~~ 20, the daily diurnal fluctuation averaged approximately 10 cfs with a peak fluctuation of 17 cfs on July 9.

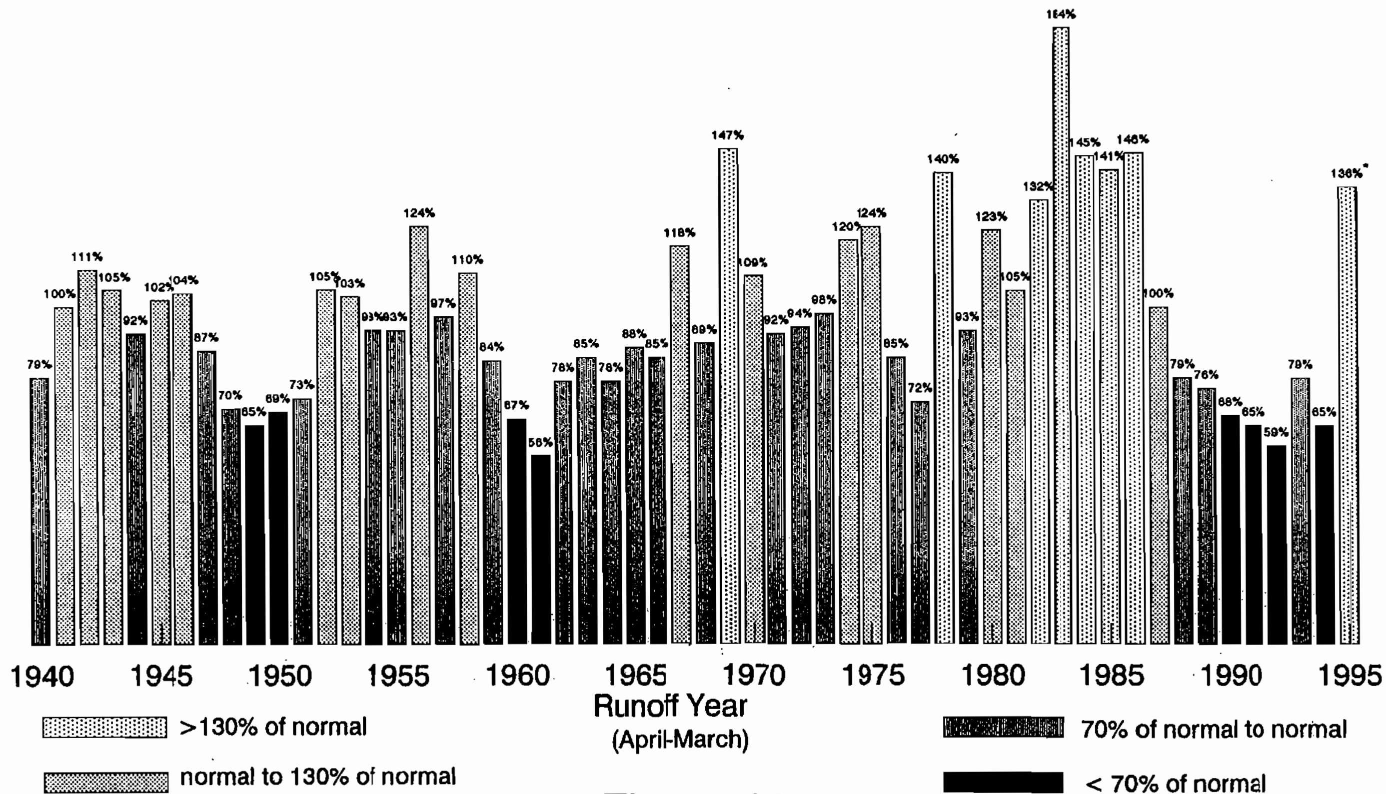
[4] Natural flow on the upper Owens River is a calculated value, the difference of the flow measured at Owens River Below East Portal and Mono Tunnel at East Portal.

UPPER OWENS RIVER RUNOFF

(Above East Portal)

Percent of Normal

The 1941-1990 normal = 42,107 acre-feet.



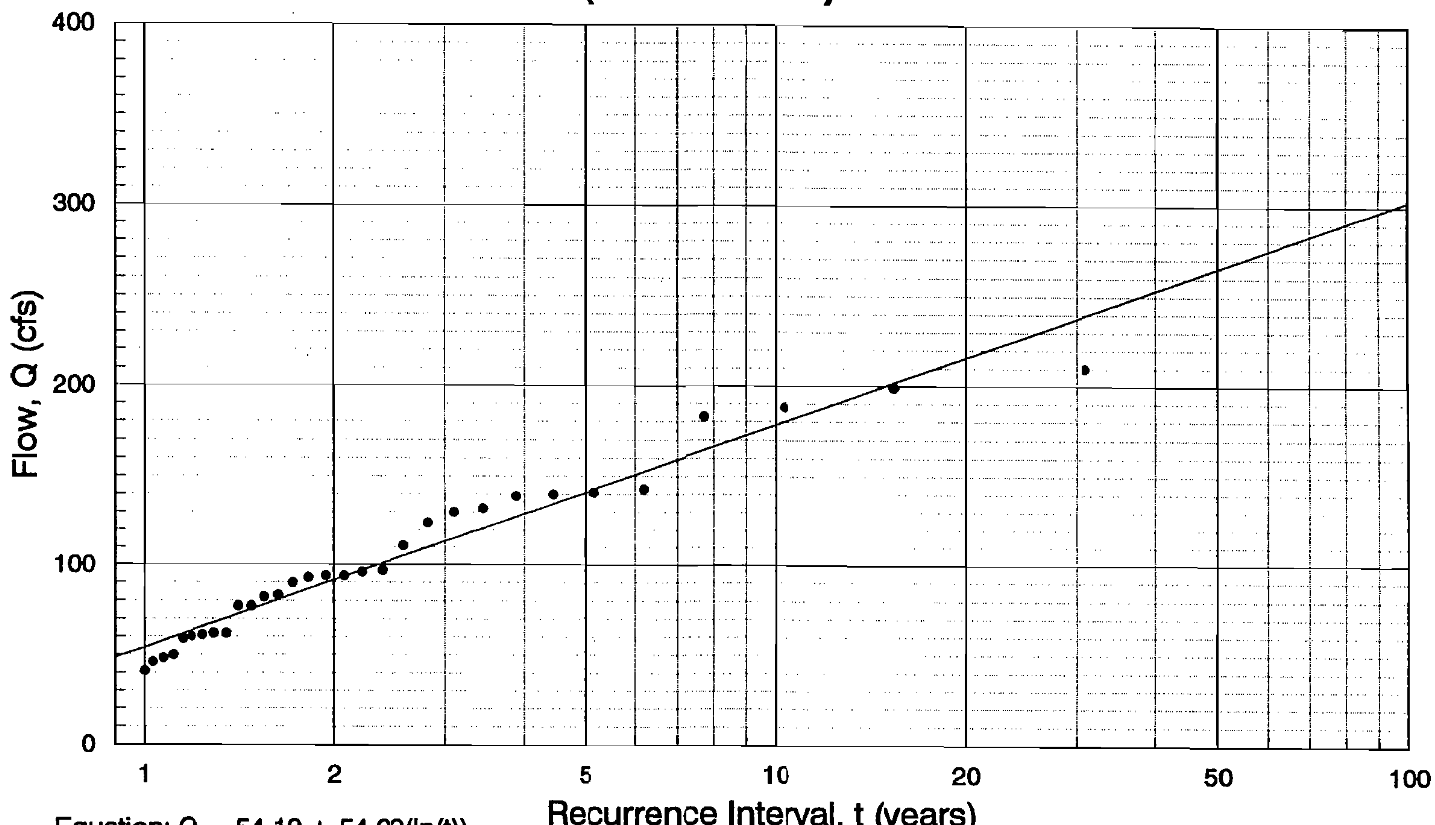
* May 1, 1995 Forecast

Figure 16

UPPER OWENS RIVER PEAK FLOWS

Owens River Above East Portal

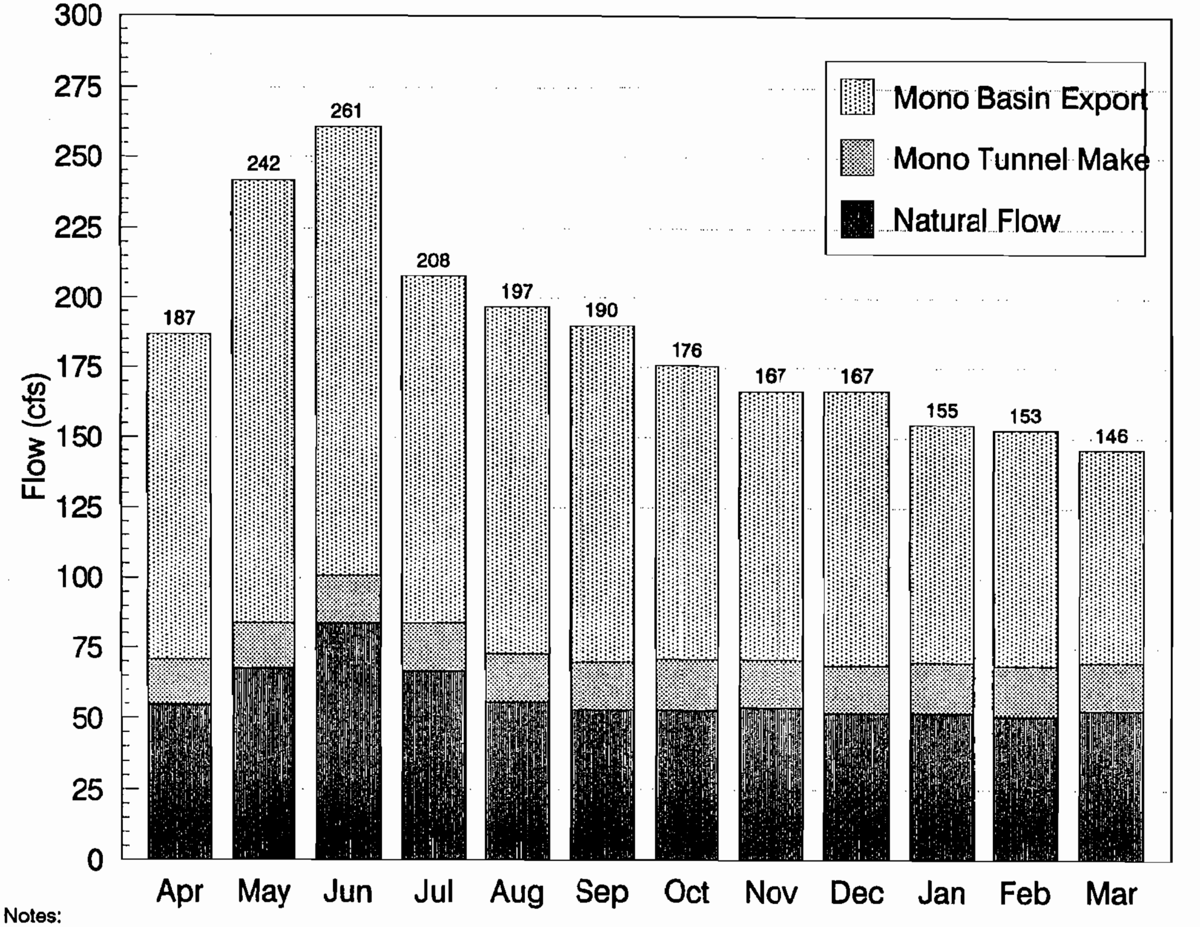
(1964-1994)



Equation: Q = 54.19 + 54.02(ln(t))
R^2 = 0.96

Figure 17

UPPER OWENS RIVER AVERAGE MONTHLY FLOW



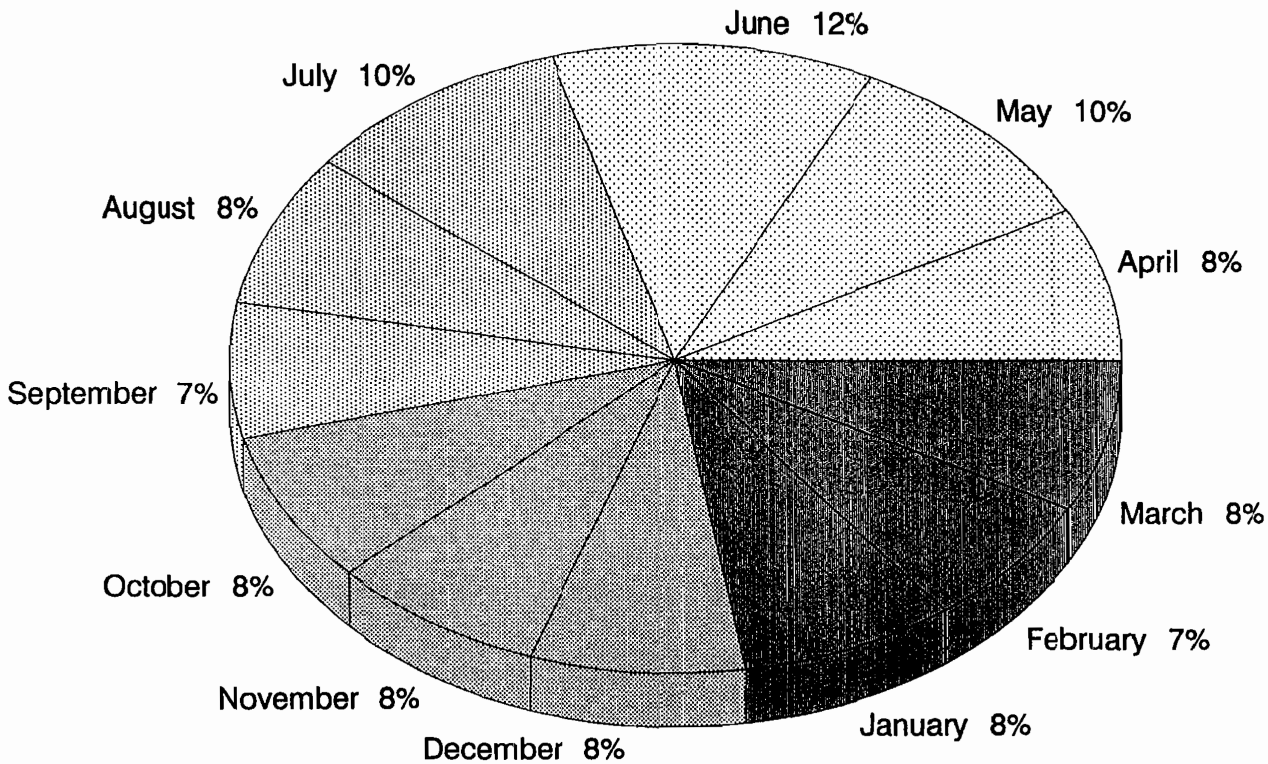
Notes:

Natural flow = Owens River above East Portal.
Natural Flow and Mono Tunnel Make: Average based on the 50 year period 1941-1990.
Mono Basin Export: Average based on the 1970-1989 period.
Mono Basin export was increased following the completion of the 2nd LA Aqueduct in 1970.

Figure 18

UPPER OWENS RIVER RUNOFF

MONTHLY DISTRIBUTION



Notes:
Based on the period of record 1941-1990.
Distribution for the Owens River above East Portal.

Figure 19

Owens River Above East Portal

Hourly Flow (cfs) July 7-13, 1995

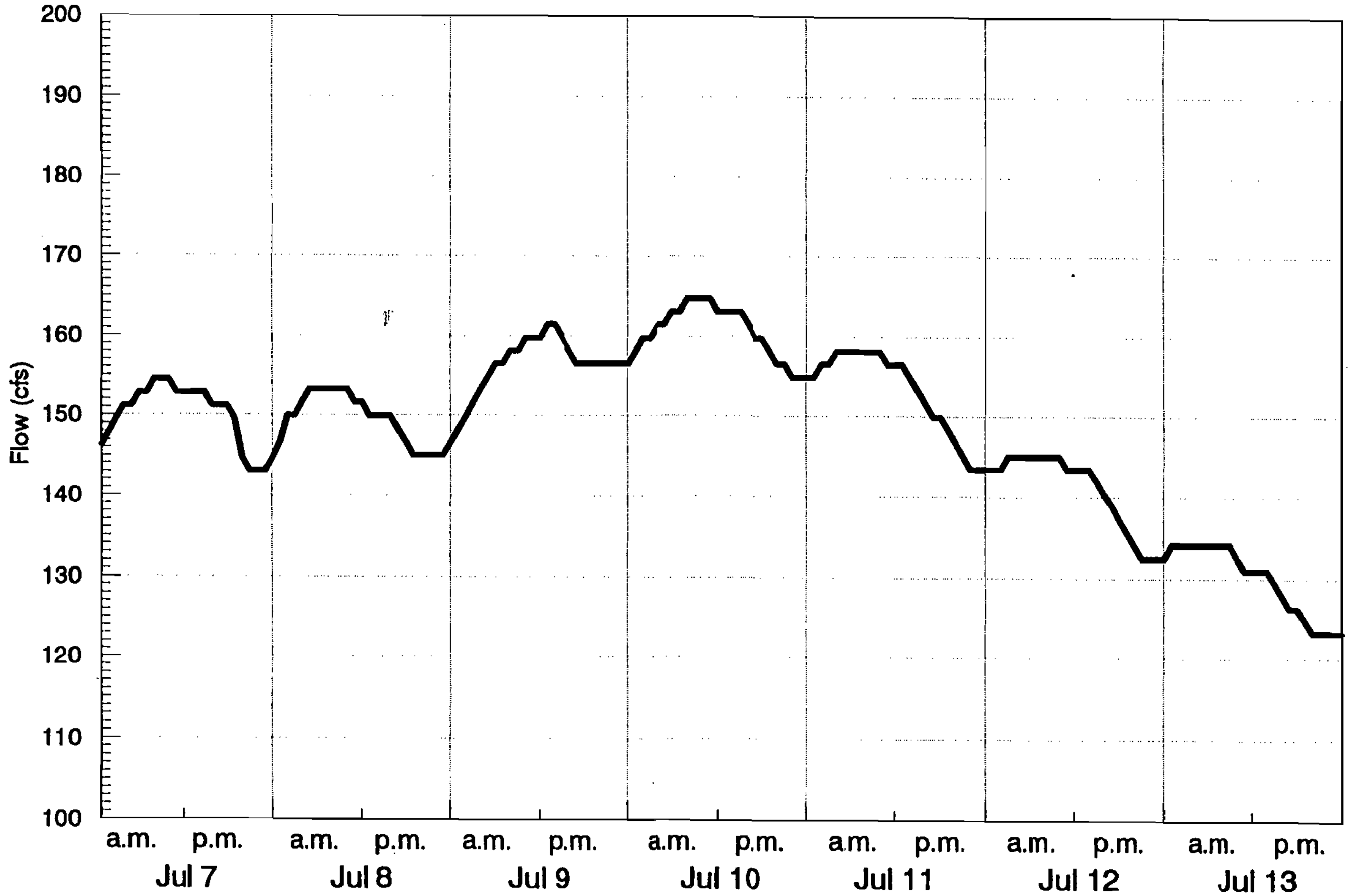


Figure 20

IV. LADWP Facilities in the Mono Basin and Upper Owens River

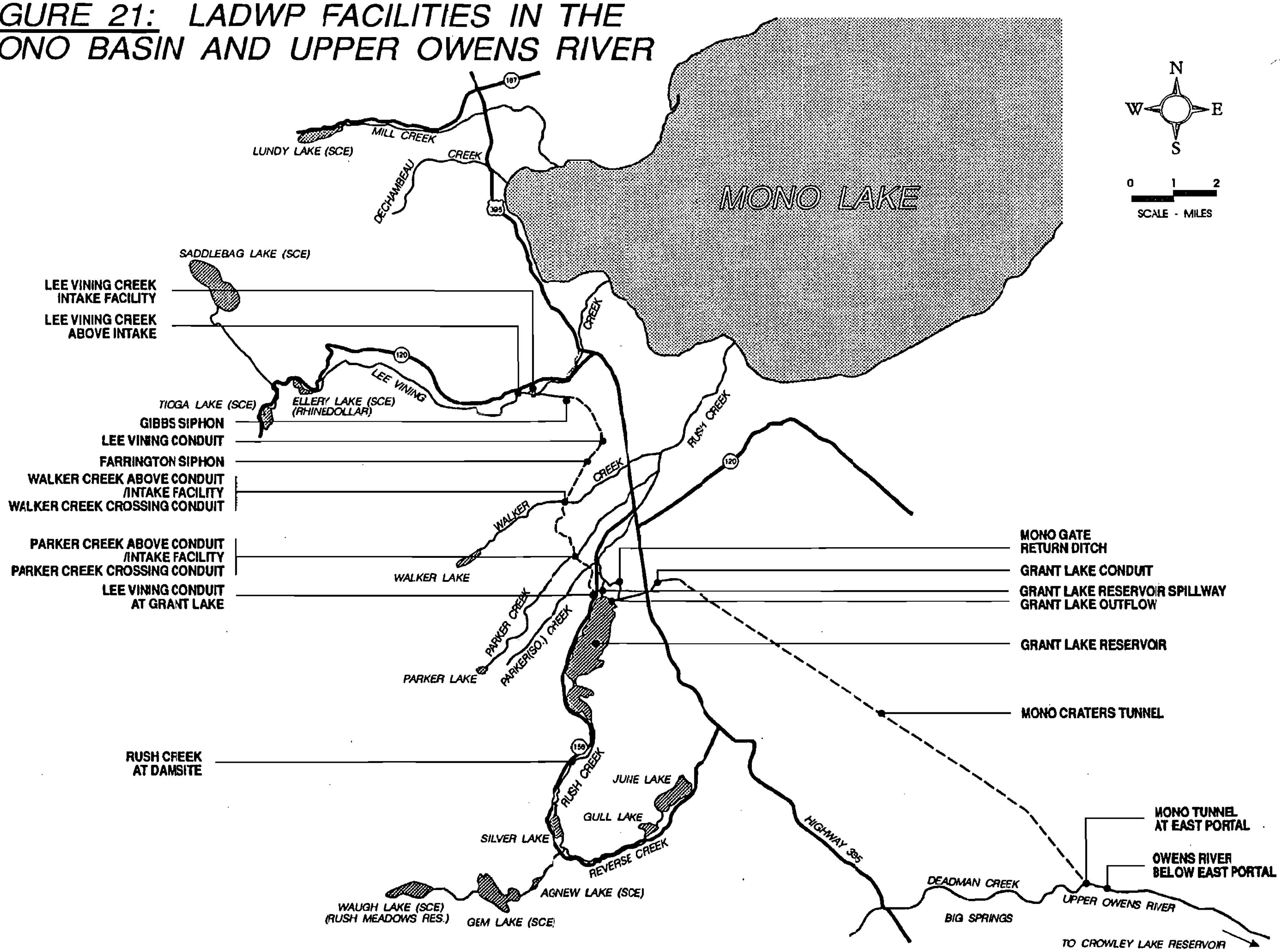
Description of Mono Basin Project

In 1940, the LADWP completed construction of the Mono Basin Project, an extension to the Los Angeles Aqueduct system. The Mono Basin Project was built to gather the waters of Lee Vining, Walker, Parker, and Rush creeks and divert them to the upper Owens River, the northernmost point of the Los Angeles Aqueduct system prior to 1940.

Like the rest of the Los Angeles Aqueduct system, the Mono Basin Project is strictly a gravity flow system. Figure 21 is a map of the Mono Basin depicting the relative location of the major LADWP Mono Basin facilities listed below.

- **Diversion Dams and Appurtenant Headworks**
  - Lee Vining Creek Intake Facility
  - Walker Creek Intake Facility
  - Parker Creek Intake Facility
- **Storage Reservoirs**
  - Grant Lake Reservoir
  - Crowley Lake Reservoir (in Long Valley)
- **Water Conveyance Facilities**
  - Lee Vining Conduit
  - Grant Lake Conduit
  - Mono Craters Tunnel
  - Mono Gate Return Ditch
- **Inverted Siphons**
  - Gibbs Siphon (Lee Vining Conduit)
  - Farrington Siphon (Lee Vining Conduit)
- **Major Flow Measuring Devices**
  - **Venturis**
    - Lee Vining Conduit at Grant Lake
    - Grant Lake Outflow
  - **Parshall Flumes**
    - Lee Vining Creek Above Intake
    - Rush Creek at Damsite
    - Mono Tunnel at East Portal
    - Owens River Below East Portal
    - Walker Creek Above Conduit
    - Walker Creek Crossing Conduit
    - Parker Creek Above Conduit
    - Parker Creek Crossing Conduit
  - **Weirs**
    - Lee Vining Creek Spill (Upper and Lower)
  - **Meter Sections**
    - Lee Vining Conduit Below Intake
    - Mono Gate Return Ditch
    - Grant Lake Spillway

FIGURE 21: LADWP FACILITIES IN THE MONO BASIN AND UPPER OWENS RIVER



Capacities of Mono Basin Facilities

The capacities of major Mono Basin storage and conveyance facilities are given below in Table F.

Table F

Mono Basin/Upper Owens River Facility Capacities

Storage Reservoirs	Design Capacity[5]	Observed Capacity[6]	Date Observed
Grant Lake reservoir	47,575 acre-feet	51,777 acre-feet	7/67
Crowley Lake reservoir (in Long Valley)	183,250 acre-feet	186,656 acre-feet	2/52

Water Conveyance Conduits	Design Capacity	Observed Capacity[7]	Date Observed
Lee Vining Conduit[8]	350 cfs	320 cfs	6/82
Grant Lake Conduit	390 cfs	394 cfs	5/80
Mono Craters Tunnel[9]	365 cfs	288 cfs	4/56
Mono Gate Return Ditch	160 cfs[10]	355 cfs	6/83

Flow Measurements

Streamflow in the Mono Basin and upper Owens River is measured at several locations with varying levels of accuracy and frequency. Table G lists the data collection method for each major flow measuring site in the Mono Basin and upper Owens River and the frequency at which flows are measured. In general the accuracy of flow measuring devices listed best to worst is as follows: Venturi, Parshall Flume/Weir, meter section. Of course, the accuracy is very sensitive to the amount of flow measured. A detailed description of the flow measuring devices by area is given below.

[5] Capacity at which the reservoir spills.
[6] Observed capacity of the reservoir while the reservoir was spilling.
[7] Observed capacity of the water conveyance conduits is an average monthly value.
[8] Lee Vining Conduit at Grant Lake
[9] Mono Craters Tunnel at West Portal
[10] Due to concerns regarding the structural stability of the return ditch, LADWP engineering staff has determined that the current safe operating capacity is about 160 cfs.

Table G

Frequency and Methods of Data Collection for LADWP Flow Measuring Sites

Flow Measuring Site	Method of Data Collection	Frequency
Venturis		
Lee Vining Conduit at Grant Lake	RTU	15 min.
Grant Lake Outflow	RTU	15 min.
Parshall Flumes		
Lee Vining Creek Above Intake	RTU/Data Logger/Strip Chart	1 min.
Walker Creek Above Conduit	RTU/Data Logger	15 min.
Walker Creek Crossing Conduit	Data Logger	15 min.
Parker Creek Above Conduit	RTU/Data Logger	15 min.
Parker Creek Crossing Conduit	Data Logger	15 min.
Rush Creek at Damsite	RTU/Data Logger	15 min.
Mono Tunnel at East Portal	RTU/Data Logger	15 min.
Owens River Below East Portal	RTU/Data Logger	15 min.
Weirs		
Lee Vining Creek Spill	RTU / Data Logger/Strip Chart	1 min.
Meter Sections		
Lee Vining Conduit Below Intake	Data Logger	15 min.
Mono Gate Return Ditch	Data Logger	15 min.
Grant Lake Spillway	Flow metered	spot read

Lee Vining Creek

LADWP measures Lee Vining Creek flow at two locations: flow immediately above the intake to the Lee Vining Creek Conduit, *Lee Vining Creek above Intake*, and the flow passing through the diversion structure (the spill over the diversion dam), *Lee Vining Creek Spill at Intake*. Additionally, flow is immediately measured after entering the Lee Vining Conduit at a site called *Lee Vining Conduit Below Intake*. Likewise, the diversions from Lee Vining Creek upstream of the intake are also measured. These diversion are: *Gibbs Creek Diversions above Station*, an irrigation diversion, and *O Ditch ¼ Mile below Intake*, a diversion used by the U.S. Forest Service to supply the Lee Vining Ranger Station. Unimpaired Lee Vining Creek runoff is a calculated value. It is the sum of *Lee Vining Creek above Intake*, net storage change in the SCE reservoirs, and total upstream diversions.

Walker Creek

The LADWP measures flow on Walker Creek at two locations also: flow immediately upstream of the Lee Vining Conduit, *Walker Creek above Conduit* and flow crossing the Conduit, *Walker Creek Crossing Conduit*. Upstream of the conduit, Walker Creek flow is impounded in Walker Lake reservoir for irrigation purposes. Because flow through conditions are quickly reached in the spring, the small 150 acre-foot reservoir has relatively no impact on the creek except to momentarily impound water during the spring while the reservoir fills and add a small spike to the hydrograph each fall when the reservoir is drained. Unimpaired runoff on Walker Creek is not a calculated value, but the same as Walker Creek above Conduit.

Parker Creek

Similar to Walker Creek, LADWP measures flow on Parker Creek at two locations as well: flow immediately upstream of the Lee Vining Conduit, *Parker Creek above Conduit*, and flow crossing the Conduit, *Parker Creek Crossing Conduit*. Upstream of the Conduit there is a small natural lake , (Parker Lake) on Parker Creek. Because there is not a dam, the lake does not generally affect the flow of Parker Creek. There are three irrigation diversions, however, that due affect flow. They are: *Parker Creek Diversions #1, #2, #3*. Parker Creek runoff is a calculated value, the sum of *Parker Creek above Conduit* and the three irrigation diversions.

Rush Creek and Grant Lake Reservoir Complex

The LADWP measures flow on Rush Creek and within the Grant Lake reservoir complex at five locations. Above Grant Lake, the LADWP measures flow on Rush Creek at one location, *Rush Creek at Damsite*. Unimpaired Rush Creek runoff is the sum of *Rush Creek at Damsite* and the net storage change in the three SCE reservoirs upstream -- Waugh Lake, Gem Lake, and Agnew Lake.

There are two sources of measured inflow into Grant Lake, both measured by the LADWP. In addition to the flow measured at *Rush Creek at Damsite*, the flow in the Lee Vining Conduit (when flowing) is also measured just upstream of the outlet at *Lee Vining Conduit at Grant Lake*.

Grant Lake outflow is measured by LADWP at two locations: the controlled release through the reservoir outlet structure, *Grant Lake Outflow*, and in wet years such as 1995, the uncontrolled spill over the Grant Lake spillway, *Grant Lake Spillway*. Flow released from Grant Lake through the reservoir outlet structure can either be returned to lower Rush Creek through the Mono Gate Return Ditch or exported to the upper Owens River through the Mono Craters Tunnel. Water spilled over the Grant Lake spillway flows directly to the confluence of the return ditch and lower Rush Creek.

Upper Owens River

The LADWP measures flow at two locations on the upper Owens River: the flow exiting the Mono Crater Tunnel, *Mono Tunnel at East Portal,* and the flow of the Owens River immediately below the confluence of the tunnel flow and the Owens River, *Owens River Below East Portal.* Unimpaired upper Owens River runoff is a calculated value; the difference of *Owens River Below East Portal* and *Mono Tunnel at East Portal.*

Telemetry in the Mono Basin

Several of the key system operations and flow monitoring sites in the Mono Basin and the upper Owens River are telemetered. Real-time data at these sites is monitored and transmitted using an on-site remote terminal unit (RTU). The data is transmitted to a master control unit located at the LADWP Bishop office. Here, the collected data is processed. Future plans include the installation of additional RTU's at lower priority monitoring sites in the Mono Basin and Owens Valley. Sites currently telemetered in the Mono Basin and upper Owens River are listed below.

Telemetered Sites

1. Lee Vining Creek above Intake
2. Lee Vining Creek Spill
3. Lee Vining Conduit @ Grant Lake
4. Walker Creek above Conduit
5. Parker Creek above Conduit
6. Rush Creek @ Damsite
7. Grant Lake Outflow
8. Mono Tunnel @ East Portal
9. Owens River Below East Portal

V. Historic Operations of Mono Basin Facilities

Grant Lake Reservoir Storage Levels

As part of the Mono Basin Project, LADWP built a new Grant Lake dam. The new dam increased the storage capacity of Grant Lake reservoir to 47,600 acre feet, enough storage to hold 80 percent of the average annual flow of Rush Creek. During the 1970-1989 period[11], average reservoir storage fluctuated on a yearly basis between a low of 21,500 acre-feet and a high of 35,100 acre-feet. During the same period, storage reached a minimum of 6,300 acre-feet in May 1977 and spilled on three separate occasions--spills occurred in 1980, 1982, and 1984.

[11] The second L.A. Aqueduct came on-line in 1970 and Mono Basin exports were suspended in 1989. Operations of the reservoir were fairly consistent during this 20 year period.

Export to the Upper Owens River:

LADWP Mono Basin exports averaged 54,800 acre-feet annually during the 1940-1969 period. The completion of the second Los Angeles Aqueduct in 1970, increased the capacity of the Los Angeles Aqueduct system by nearly 70 percent. As a direct result, exports from the Mono Basin also increased. During the 1971-84 period, the period of peak exports prior to any restrictions[12], water exports from the Mono Basin averaged 91,000 acre-feet annually. The average monthly export during this period is shown below in Table H.

Table H

Average Monthly Mono Basin Export (acre-feet)
(1970-1984)

Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
7,700	10,850	10,980	9,290	9,150	7,820	7,000	6,290	6,780	5,280	4,870	5,210

Operational Planning

For operational planning purposes, LADWP staff track snow accumulation, precipitation, and streamflow in the eastern Sierra Nevada watersheds tributary to the Mono Basin and Owens Valley. Using these data, LADWP staff forecast runoff for the upcoming runoff year (April-March). The runoff forecast is then used to plan reservoir and aqueduct operations for the same period.

Runoff Forecasting

Monitoring the Snowpack

LADWP staff monitor several snow courses and snow sensors at remote sites in the eastern Sierra Nevada. Within the Mono Basin, SCE maintains six snow courses -- three in the Rush Creek drainage and three in the Lee Vining Creek drainage. To forecast Mono Basin and Long Valley (upper Owens River) runoff, LADWP staff use data from several of these snow courses and data from the LADWP's nearby Mammoth Pass and Rock Creek snow courses. Between snow course surveys, LADWP staff track daily snowpack changes by monitoring five snow sensors in the area: Gem Pass, Mammoth Pass and Rock Creek snow sensors maintained by LADWP staff, Agnew Pass snow sensor

[12] A temporary restraining order in late 1984 required a minimum instream flow of 19 cfs in lower Rush Creek, reducing the amount of water available for export.

maintained by SCE, and Dana Meadows snow sensor maintained by the National Park Service.

Snowmelt Runoff Forecasts

In conjunction with scheduled snow course surveys, the LADWP makes four official runoff forecasts each year. The first forecast of the season is made February 1, and subsequent forecasts are made the first of each month through May 1, when the final forecast of the season is issued.

Each forecast made during the forecast season contains the following information: (1) a forecast of the most probable[13] runoff volume expected during the upcoming April-September and April-March periods and the expected monthly distribution of runoff during these same periods, (2) a reasonable range[14] of expected variance in the most probable forecasted runoff mostly due to the uncertainty of future weather conditions but also due in part to model accuracy. As expected, this uncertainty range, which is quite large on February 1, is much narrower by May 1 when relatively little uncertainty regarding future weather remains -- the five remaining months of the water year (May-September) only contribute 18 percent of the annual average precipitation in the eastern Sierra Nevada.

To make the forecasting process more manageable and increase the accuracy of forecasting large, diverse basins, LADWP staff have sub-divided the Mono Basin into four forecast regions and the Owens Valley into five regions. In the Mono Basin, individual runoff forecasts are made for Lee Vining Creek, Walker Creek, Parker Creek, and Rush Creek. The runoff forecast for the Basin as a whole is a summation of these four individual forecasts. Likewise, LADWP staff forecast runoff in the Long Valley region (all creeks tributary to the upper Owens River and Long Valley reservoir), the northernmost forecast region in the Owens Valley.

Runoff Forecast Model

The process for forecasting runoff is: (1) collect the hydrologic input data, (2) forecast April-September and April-March runoff, and, (3) using the April-September and April-March runoff forecasts, forecast the monthly distribution of runoff. For a more detailed description of the runoff forecasting process, refer to the report entitled "Development of a Runoff Forecast Model for the Mono Basin and Owens Valley".

[13] Most probable is defined as that runoff which is expected if median precipitation occurs after the forecast date.

[14] The reasonable range is defined as the range bound by an upper limit called the reasonable maximum and a lower limit called the reasonable minimum. The reasonable maximum is that runoff which is expected if precipitation subsequent to the forecast is equal to the amount which is exceeded on the average once in 10 years. Likewise the reasonable minimum is that runoff which is expected if precipitation subsequent to the forecast is equal to the amount which is exceeded on the average 9 out of 10 years.

LADWP staff forecasts April-September and April-March runoff using a set of multiple-regression equations. The equations were developed using historical data and model runoff as a function of snow water content, precipitation, and streamflow. (See Input Data Section below.)

Two methods are used to model the monthly runoff distribution. For the peak runoff period of April-September, when runoff volumes vary greatly month to month, the historical monthly runoff distribution is used as a model. Equations for each month were developed by regressing the historical runoff for the specific month against historical runoff for the entire April-September period. Likewise the historical runoff distribution is used for the October-March period. However, because runoff is relatively constant during the October-March period, monthly runoff for this period is simply distributed uniformly on a percentage basis. For example, if runoff is forecasted to be 110 percent of normal for the October-March period, the monthly distribution will be a 110 percent of normal for each month of the period.

To automate the forecast process, LADWP staff have developed a spreadsheet-based model called the Runoff Forecast Model (RFM). Using the regression equations discussed above, the RFM processes the hydrologic input data and generates a runoff forecast for each of the nine forecast regions.

Input Data for the Runoff Forecast Model

The RFM uses three types of input data. They are: (1) snow survey data (water content), (2) precipitation data --divided into winter (October-March) and summer (April-September) periods--and (3) antecedent streamflow data (the October-March period immediately preceding the forecast period).

Reservoir Storage Planning

LADWP Reservoir Storage

There are eight storage reservoirs along the Los Angeles Aqueduct system. Total system storage capacity is approximately 314,000 acre-feet with a storage to average annual runoff ration of 0.59. Table I below lists the reservoirs geographically from north to south.

Table I

Los Angeles Aqueduct System Reservoirs
(listed from North to South)

Reservoir	**Capacity (acre-feet)**	**% of Total Storage**
Grant Lake	47,575	15%
Crowley Lake	183,249	58%
Pleasant Valley	2,989	1%
Tinemaha	6,306	2%
North Haiwee	11,533	4%
South Haiwee	27,774	9%
Fairmont	491	0%
Bouquet	33,767	11%
Total Storage	**313,684**	**100%**

As shown in Table I, most of the Aqueduct system's storage capacity is in the northernmost portion of the system . Combined, the two northernmost reservoirs, Grant Lake and Crowley Lake, comprise 73% of total system storage. Storage at South Haiwee reservoir and Bouquet reservoir make up the bulk of the remaining system storage capacity (20%).

Planning Process

Every six months, around March and September, LADWP staff prepare an operational plan for the Los Angeles Aqueduct system based on the supply of available water as determined by the runoff forecast. The operational plan serves as a general guideline for operations during the coming six months. Operational adjustments are made on a monthly and daily basis, however, as conditions change. Many of the factors considered in developing the semi-annual operational plan are listed below.

Factors Considered in Planning Aqueduct Operations

- Forecasted Runoff
- Fishery Flow Requirements
- Reservoir Storage
- Aqueduct Operational Capacities
- Seasonal Water Demand in Los Angeles
- Planned Maintenance Activities
- Transit Losses/Gains

- Operation of SCE Reservoirs
- Irrigation and Stockwater Demands
- Spreading for Groundwater Recharge
- Groundwater Pumping Rates

LADWP staff attempt to operate reservoirs according to established first of month target storage levels. Due to the limited amount of storage in the system, LADWP staff prefer to keep reservoirs as full as possible while still maintaining room for operational flexibility. As a result, net storage change during the year is relatively small. In extreme dry cycles, however, storage is often reduced. This storage deficit is then replenished during the wet cycle that always accompanies the end of a drought.

Moreover, because most of the storage capacity is located on the northern end of the Aqueduct, late spring and summer water demands are generally met using water collected south of Long Valley. During these same peak runoff months (May-August), Grant Lake and Crowley lake are filled. Once runoff tapers off in the fall and winter, storage in these reservoirs is used to supply downstream water demands.

Planning Models

LADWP staff have developed two models for planning purposes -- the Los Angeles Aqueduct Simulation Model (LAASM) and the Grant Lake Operations Model (GLOM). The LAASM model analyzes long-term (several years) effects of the different operational criteria, while the GLOM is a daily model analyzing flows within a single year. (The LAASM model is similar to the SWRCB's Los Angeles Aqueduct Monthly Planning "LAAMP" model. Modifications were made to the LAASM model so that it could more accurately simulate the requirements of Decision 1631 and the flow recommendations of the stream scientists. The LAAMP model was created before Decision 1631 was finalized and does not have the capability to model the fishery flow requirements listed in the Decision 1631.).

VI. Physical and Operational Limitations

In Decision 1631 the SWRCB outlined specific instream flow requirements and ramping rates for each of the Mono Basin streams. After carefully reviewing these requirements, LADWP staff has concluded that operational limitations make certain requirements impractical, particularly the ramping rates, under all flow regimes. Although it is LADWP's intention to fully meet these flow requirements when feasible, certain physical and operational limitations hinder LADWP's ability to meet the requirements at all times. These limitations are addressed below.

Physical Limitations

Each of the LADWP diversion facilities on the four diverted Mono Basin creeks has certain physical limitations that do not allow for a precise regulation of flows. This is particularly true when ramping from one flow rate to another using the ramping rates specified in the decision (see Table A). The physical limitations of each facility are discussed on a creek by creek basis below.

Rush Creek

Grant Lake reservoir on Rush Creek was designed to collect and store the water diverted from the four Mono Basin creeks. The two means of releasing water from the reservoir are (1) releasing water through the Grant Lake outlet structure or (2) overtopping the spillway. Water released through the outlet structure flows down the Grant Lake conduit to the Mono Gate. At the Mono Gate flow can either be released to lower Rush Creek through the Mono Gate No. 1 Return Ditch, or exported to the upper Owens River through the Mono Craters tunnel. Stop logs, located inside the Mono Gate, are used to split the flow. The stop logs transect the conduit and are used to control the flow that enters the Mono Craters Tunnel. Water overtopping the spillway flows into lower Rush Creek.

Flow in Rush Creek is more easily controlled or regulated than flow in the other Mono Basin creeks. This is due to two important factors: the ability to store water immediately upstream of the diversion point in Grant Lake and the ability to set the Grant Lake reservoir outlet gate to a specific outflow.

During periods when no water is being exported (all of the water is being released to the Return Ditch through the Mono Gate) outflow can be regulated fairly accurately using the reservoir outlet gate (one of the more accurate devices within the system). During periods of export, however, when flow must be split at the Mono Gate, the ability to accurately regulate flow diminishes. This is because the operator must use both the outlet gate and the stop logs (a device with limited accuracy), to regulate the split flow. The operator can accurately release 56 cfs from Grant Lake reservoir, but splitting the flow so that 31 cfs flow through the return ditch and 25 cfs is exported is more of a challenge. To successfully do this requires some initial trial and error by the operator. This is due to the limited precision of the stop logs as a regulating device. Using these facilities to ramp flows at the prescribed ramping rates is an even bigger challenge. Table K lists the estimated precision of both Rush Creek flow regulating devices. Due to the practical (physical) limitations of these devices, LADWP proposes to ramp Rush Creek flow using the greater of either the Decision 1631 specified ramping rates or a multiple of the incremental precision (i.e., 3, 6, 9... or 10, 20, 30...) of the Rush Creek flow regulating devices as outlined in Table K for the three given flow regimes.

Lee Vining Creek

The diversion facility on Lee Vining Creek is different from that on Rush Creek. The diversion facility consists of the diversion dam and the Lee Vining Conduit inlet structure. (The Lee Vining Conduit, which terminates at Grant Lake, originates at the Lee Vining Creek diversion structure.) At the diversion facility, flow can either be taken into the conduit or spilled over the dam and continue down the creek. A roller gate regulates the flow entering the conduit. Flow entering the conduit is immediately measured downstream of the inlet at the *Lee Vining Conduit Below Intake* site.

Unlike Rush Creek, there is no significant storage reservoir immediately upstream of the diversion facility, so the diversion facility receives the runoff directly. During much of the year, the flow in Lee Vining Creek is relatively constant. During the spring and summer, however, flow in Lee Vining Creek abruptly changes on a daily and sometimes hourly basis due to the melting and cooling of the snowpack. This makes it extremely difficult to precisely regulate flows.

During the period of high flows (April-September) specific flow rates down one path or the other can not be easily set as they can be at the Grant Lake outlet. When the flow rate of the creek above the diversion facility changes, both the flow spilling over the dam and the flow entering the conduit change as well. As a result, it is particularly difficult to precisely ramp flows. The difficulty of ramping peak flows is compounded by the daily diurnal fluctuation of flow in this creek which is not present on Rush Creek. (During the peak flows of 1995, the diurnal on Lee Vining Creek was routinely 50 cfs.) Therefore, the operation of this facility requires close monitoring and more adjustments. Table K lists the estimated precision of the roller gate at the Lee Vining Conduit inlet. Due to the practical (physical) limitations of this device, LADWP proposes to ramp Lee Vining Creek flow using the greater of either the Decision 1631 specified ramping rates or a multiple of the incremental precision of the Lee Vining Creek control devices as outlined in Table K for the three given flow regimes.

Parker and Walker Creeks

The diversion facilities on both Parker and Walker creeks are similar to the diversion facilities on Lee Vining Creek in many respects. Similar to the Lee Vining Conduit inlet on Lee Vining Creek, water is ponded by a diversion dam and a roller gate regulates the flow entering the conduit on both creeks. Because both creeks cross the Lee Vining Conduit, the conduit acts as a diversion dam for both creeks. Table J shows the average annual flow of both creeks.

Table J

Average Monthly Flow
for Parker and Walker Creeks (cfs)
(1941-1990)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Parker Creek	7	16	32	34	21	10	6	5	5	4	4	5
Walker Creek	3	9	21	16	9	5	6	6	4	3	3	3

The same difficulties expressed above regarding the regulation of flows on Lee Vining Creek are also experienced on Parker and Walker creeks. The regulation of flow on these creeks, however, is also subject to another factor peculiar to only these two creeks. Because the annual runoff of Parker and Walker creek is relatively small compared to Rush and Lee Vining creeks, the difficulty in realistically regulating the Decision 1631 specified 10 percent ramping rates is more acute on these two creeks.

For example, as indicated in Table J, the peak average monthly flow on Parker Creek occurs in July (34 cfs). Ramping this magnitude of a flow, using the required 10 percent ramping rate, would require ramping flows with a precision of less than 5 cfs (3.4 cfs on Parker Creek in July, the wettest month). This degree of precision, however, is infeasible using the Parker Creek radial gate which at best can regulate flows to the nearest 5 cfs in a "normal" type flow regime. This is even more pronounced on Walker Creek where the peak average monthly flow is only 21 cfs in June.

Due to the practical (physical) limitations of these control devices, LADWP proposes to ramp Parker and Walker creeks using the greater of either the Decision 1631 specified ramping rates or a multiple of the incremental precision of each control device as outlined in Table K for the three given flow regimes.

Table K

Estimated Incremental Precision of Flow Regulating Devices
in the Mono Basin under Differing Flow Conditions

	Incremental Precision (cfs)		
Regulating Device	**Low**	**Normal**	**High**
Lee Vining Creek Radial Gate	10	15	25
Parker Creek Radial Gate	3	5	10
Walker Creek Radial Gate	3	5	10
Grant Lake Outflow	3	3	3
Mono Tunnel Stop Logs	10	10	10

Operational Limitations

In additional to the physical limitations of the Mono Basin flow regulating devices, LADWP's ability to regulate flow also has several operational limitations. These include the limitations of LADWP forecasting models and the limitations of manually operating flow regulating devices.

Limitations of LADWP Forecast Models

LADWP staff issue the final Mono Basin runoff forecast for the season on or around May 1 each year. Based on this final forecast and the April 1 surface elevation of Mono Lake, instream flow requirements for the year are determined and preliminary reservoir operations are planned by LADWP staff. Because the May 1 runoff forecast incorporates a range of uncertainty due to both the future weather and model error, actual runoff during the coming runoff year differs from the forecasted amount. As shown in Table L, which lists the error due to uncertainty, sometimes the forecast is low and other times it is high. In both cases, operations during the year must be adjusted to accommodate the difference. During periods when Mono Lake falls below the 6391 foot level, the adjustment will impact the amount of water released to the Lake. During period when Mono Lake is above the 6391 foot level, the adjustment will impact the amount of water available for export.

LADWP staff also forecasts the magnitude and timing of peak flows each year on Rush and Lee Vining creeks. These forecasts help LADWP staff plan the proper timing to release channel maintenance flows. Once again, due to the uncertainty of future weather and the inability to forecast temperatures on a long-range basis, it is difficult to pin point the magnitude and timing of peak runoff. The key, therefore, to implementing channel maintenance flows, is flexibility. No matter what flow schedule one attempts to attain, the actual release will be different. LADWP operators will make a reasonable effort to maintain a ramping schedule, but flexibility is required to allow for unforeseen natural changes in flow.

Table L

Difference Between Forecasted and Actual Runoff
Mono Basin year-Type Classifications

Year	April 1 Runoff Forecast		May 1 Runoff Forecast		Actual Runoff April-March		April Forecast Error	May Forecast Error
1950	82.3%	Dry-Normal	84.2%	Normal	91.7%	Normal	9.4%	7.5%
1951	94.2%	Normal	96.1%	Normal	91.4%	Normal	-2.8%	-4.7%
1952	152.3%	Wet	151.6%	Wet	143.5%	Wet	-8.8%	-8.1%
1953	78.8%	Dry-Normal	80.8%	Dry-Normal	78.1%	Dry-Normal	-0.7%	-2.7%
1954	86.6%	Normal	83.8%	Normal	68.6%	Dry-Normal	-18.0%	-15.2%
1955	69.8%	Dry-Normal	72.3%	Dry-Normal	81.3%	Dry-Normal	11.5%	9.0%
1956	138.8%	Wet	141.4%	Wet	137.5%	Wet	-1.3%	-3.9%
1957	77.8%	Dry-Normal	77.8%	Dry-Normal	85.6%	Normal	7.8%	7.8%
1958	132.0%	Wet-Normal	133.9%	Wet-Normal	129.4%	Wet-Normal	-2.6%	-4.5%
1959	67.6%	Dry	66.1%	Dry	60.7%	Dry	-6.9%	-5.4%
1960	68.6%	Dry-Normal	66.5%	Dry	58.1%	Dry	-10.5%	-8.4%
1961	55.9%	Dry	55.3%	Dry	59.5%	Dry	3.6%	4.2%
1962	113.1%	Wet-Normal	110.0%	Wet-Normal	108.4%	Wet-Normal	-4.7%	-1.6%
1963	96.2%	Normal	103.5%	Normal	112.5%	Wet-Normal	16.3%	9.0%
1964	58.6%	Dry	59.0%	Dry	69.5%	Dry-Normal	10.9%	10.5%
1965	107.8%	Wet-Normal	108.5%	Wet-Normal	116.8%	Wet-Normal	9.0%	8.3%
1966	84.8%	Normal	83.1%	Normal	77.2%	Dry-Normal	-7.6%	-5.9%
1967	133.7%	Wet-Normal	141.8%	Wet	162.9%	Extreme	29.2%	21.1%
1968	69.7%	Dry-Normal	66.7%	Dry	67.5%	Dry	-2.2%	0.8%
1969	175.4%	Extreme	174.2%	Extreme	174.7%	Extreme	-0.7%	0.5%
1970	92.2%	Normal	90.7%	Normal	85.7%	Normal	-6.5%	-5.0%
1971	88.2%	Normal	86.4%	Normal	93.2%	Normal	5.0%	6.8%
1972	72.0%	Dry-Normal	73.8%	Dry-Normal	74.9%	Dry-Normal	2.9%	1.1%
1973	111.0%	Wet-Normal	108.2%	Wet-Normal	108.8%	Wet-Normal	-2.2%	0.6%
1974	113.1%	Wet-Normal	113.6%	Wet-Normal	108.3%	Wet-Normal	-4.8%	-5.3%
1975	97.3%	Normal	100.6%	Normal	98.9%	Normal	1.6%	-1.7%
1976	44.5%	Dry	43.3%	Dry	44.8%	Dry	0.3%	1.5%
1977	35.9%	Dry	32.3%	Dry	42.7%	Dry	6.8%	10.4%
1978	141.6%	Wet	145.8%	Wet	146.6%	Wet	5.0%	0.8%
1979	109.0%	Wet-Normal	107.5%	Wet-Normal	100.4%	Normal	-8.6%	-7.1%
1980	146.1%	Wet	146.9%	Wet	139.2%	Wet	-6.9%	-7.7%
1981	82.5%	Normal	80.1%	Dry-Normal	81.9%	Normal	-0.6%	1.8%
1982	144.9%	Wet	158.4%	Wet	173.8%	Extreme	28.9%	15.4%
1983	184.5%	Extreme	186.4%	Extreme	196.1%	Extreme	11.6%	9.7%
1984	118.5%	Wet-Normal	119.0%	Wet-Normal	121.0%	Wet-Normal	2.5%	2.0%
1985	88.8%	Normal	85.9%	Normal	88.3%	Normal	-0.5%	2.4%
1986	155.1%	Wet	153.2%	Wet	139.8%	Wet	-15.3%	-13.4%
1987	57.0%	Dry	54.5%	Dry	55.6%	Dry	-1.4%	1.1%
1988	57.3%	Dry	56.7%	Dry	57.3%	Dry	0.0%	0.6%
1989	80.5%	Dry-Normal	79.2%	Dry-Normal	73.5%	Dry-Normal	-7.0%	-5.7%
1990	55.3%	Dry	54.1%	Dry	49.0%	Dry	-6.3%	-5.1%

Limitations of Manually Operating Flow Regulating Devices

All of the LADWP flow regulating devices within the Mono Basin are manually operated. Due to this limitation, for practical purposes, flow adjustments need to conform to an operation schedule. The operator makes necessary flow adjustment in the Mono Basin on a bi-weekly/or as needed basis during most of the year. Flow adjustment, however, are scheduled on a more frequent basis during the critical peak runoff months. During the spring runoff period the operator will make flow changes on a daily basis. Flows will be set at about 9:00 a.m. daily. Due to the diurnal effect, flows will vary throughout the subsequent 24 hour period, however, it has been found that the 9:00 a.m. reading approximates the daily average.

VII. Factors Considered in Developing the Grant Lake Operations and Management Plan

Before the Grant Lake Operations and Management Plan was drafted, many factors that would be affected by the plan were considered. These considerations were obtained through the public meeting, TAG meetings, written comments received, the stream restoration scientists' report, and other information available. The factors considered were as follows.

Alternatives Considered in Developing the Final Proposal

1. Abandon Walker and Parker creek diversion facilities, making up lost water from Rush and Lee Vining creeks.
2. During the 4,500 acre-foot export scenario, divert flows solely from Rush Creek, allowing Lee Vining, Walker, and Parker creeks to be in a flow-through condition.
3. Maintain Grant Lake reservoir at a different storage level.
4. Increase capacity of Grant Lake outflow to lower Rush Creek.
5. Change the Grant Lake outflow release pattern.
6. Alter minimum flows, flushing flows, or ramping rates on the Mono Basin creeks (different from Decision 1631).
7. Change the number of year-types.
8. Change the export pattern (including timing, duration, magnitude, and ramping rate) to the upper Owens River.

9. Change the export allotment between the 4,500 acre-foot and 16,000 acre-foot scenarios, and between the pre and post-transition periods (i.e., phase in higher exports).

Management of Grant Lake Reservoir

Grant Lake reservoir is an important recreational site in the Mono Basin. Fishing is a popular activity from April through September. A marina which offers boat rentals is located a few miles upstream from Grant Lake dam. Grant Lake is the first lake on the June Lake loop if a motorist enters from the north. This year, Grant Lake filled for the first time in nearly a decade. Grant Lake is also important for the fishery of Rush Creek, as it can allow for cold water releases during the warm summer months.

The following are some of the specific considerations regarding the management of Grant Lake reservoir that were received during the development of the Grant Lake Operations and Management Plan:

- Recreation on the reservoir is important from the end of April through October
- At lower reservoir levels, predation of trout increases in the upper reaches of the reservoir during migration, due to lack of cover
- At lower reservoir levels, "back bay" is dry and dust blows off the surface
- In late 1994, the Grant Lake Marina lost all ability to launch boats
- In 1992, the boat ramp was extended 75 feet and cannot be extended further
- The high point of the reservoir in 1993 (31,600 acre-feet) was satisfactory for boating, but higher levels are preferable
- Boating safety is of concern at low reservoir levels
- For Marina operators, the minimum desired level would be 4 or 5 feet in the "back bay". Ideally, the reservoir would be at least 7,125 feet msl (41,800 acre-feet)
- Higher reservoir levels keep lower Rush Creek temperature lower, particularly during the July through September period
- During 1994's record warm summer, algae blooms were noticed in the reservoir
- From a fishery standpoint, it is desirable to not increase the reservoir levels during the October through December spawning season
- Recreationalists occasionally drive across "the upper bay" and become trapped in mud. It may be desirable to eliminate vehicular access into the region.
- Spilling the reservoir during wet years provides beneficial high flows for lower Rush Creek

- Grant Lake was not considered to be a preferable location to implement waterfowl habitat restoration work
- Higher initial reservoir levels increased reliability of exports during drought periods

Water Exports to the Upper Owens River

The upper Owens River has proven to be one of the premier fishing streams in the eastern Sierra Nevada. Trout which grow in Crowley Lake swim up the river to spawn. The upper Owens River is unique in the area because of the large springflow at the headwaters of the river. In recent years, however, the landowners of the area agree that the fishing has not been as productive as it has in the past. While the exact cause of the decline in large fish is unknown, the landowners agree that the sudden cessation of diversions from the Mono Basin in 1989 has negatively impacted the fishery.

The following are some of the specific considerations about the water exports to the upper Owens River that were received during the development of the Grant Lake Operations and Management Plan:

- Since the cessation of diversions, all Owens River landowners agreed that the quantity and quality of fishing have declined
- The upper Owens River land is important for both recreation and grazing uses
- Most irrigation diversions occur during June through August
- The are no official irrigation records, but the average irrigation rate is about 4 acre-feet per acre
- If the flow in the Owens River drops below 75 cfs, irrigation is limited
- The avian predation of trout in the upper Owens River apparently has increased over the last 2 to 3 years
- When diversions occur, careful ramping of flows is critical, especially when ramping flows down
- Constant exports are desirable, but in general, the flows should mimic the natural hydrograph
- During the initial phases of export, an annual evaluation of flows should be completed
- The municipal demand for water is highest during July, August, and September

Water Releases in Mono Lake Tributary Streams

Decision 1631 lists the minimum flow requirements for the Mono Basin streams, but allows for discretion in the releases of water above and beyond the minimum flows. Water in addition to the minimum must be released to satisfy the Mono Lake maintenance requirements. The Stream and Stream Channel Restoration Plan includes a discussion of the different patterns which can be used to release this additional water. Some recommendations received require releasing water above and beyond that which maintains Mono Lake at 6,392 feet. These recommendations would affect Grant Lake reservoir and the export of water to the upper Owens River. A detailed analysis of Mono Basin streamflow management alternatives is provided next.

VIII. Mono Basin Streamflow Management

The LADWP has long held the position that effective streamflow management and land management are the most effective techniques to rehabilitate the Mono Basin streams. The methods proposed in LADWP's Stream and Stream Channel Restoration Plan are designed to facilitate natural stream processes and functions, and thereby accelerate both short-term and long-term recovery of the riparian and aquatic systems. The applied flow regime is the fundamental component of a restoration program, strongly influencing responses of fishery and vegetation components.

Before presenting an analysis of the Mono Basin streamflow management plan, it is important to analyze the flow scenario which will occur under Decision 1631. The SWRCB decision includes both minimum instream flow requirements, including channel maintenance flows, and export restrictions based on the level of Mono Lake. These two major diversion restrictions are closely linked. As instream flows increase, the ultimate level of Mono Lake also increases. Similarly, the maintenance level of Mono Lake ultimately effects the flow in the Mono Basin streams. Because the minimum flow requirements established in Decision 1631 will not maintain a level of Mono Lake at 6,392 feet, additional water above the minimum flows will have to be released into Mono Lake.

When analyzing the flow regime of Decision 1631, however, there have been many misconceptions of what the expected flows would be. Appendix II states some of the common misconceptions and clarifies them by quantifying the expected flow scenarios under Decision 1631. The following is a summary of the conclusions of Appendix II:

1. **Once Mono Lake has reached 6,392 feet, the flows released into the Mono Lake tributaries will be 20% higher than the minimum flows listed in Decision 1631.**

The requirement to maintain Mono Lake at 6,392 feet and the operational restrictions that limit export in wet years significantly increases the Mono Basin streamflow above the minimums listed in the SWRCB's decision.

2. **Once Mono Lake reaches 6,392 feet, diversions from the basin will increase, but their increase will only reduce the average volume of water released in the Mono Basin streams by less than 15%.**

   The idea that there is little impact to the Mono Basin streamflow during the transition period and a much larger impact to the streamflow after the transition period does not take into account that after transition, Mono Lake diversions will often be limited to 10,000 acre-feet. During about 25% of the years, there will be more restrictions placed on Mono Basin export after Mono Lake reaches equilibrium than during the transition period.

3. **The minimum flow requirements in Lee Vining Creek and Rush Creek are equally proportional for both creeks.**

   Despite the fact that the gross instream flow requirements for Lee Vining Creek are often higher than that of Rush Creek, the net effect of the flow requirements is that 57% of the average flow in Lee Vining Creek must remain in the creek and 55% of the average flow of Rush Creek must be released into lower Rush Creek. (These figures do not include flushing flow requirements.) These nearly identical percentages show that the SWRCB was effective in equally dividing the allowable diversions from each creek.

4. **The unimpaired streamflows would not maintain the fish in the Mono Basin in good condition.**

   This point is not part of the Decision 1631 analysis, but it is important to note that the median unimpaired (or natural) streamflows in Rush and Lee Vining creeks are far below that flow required in the SWRCB's decision during the fall and winter period. The median unimpaired flow on Rush Creek during November, for example, is 17 cfs -- less than half of the minimum flow required in Decision 1631 for a dry year, which is 36 cfs. The fish that Decision 1631 is protecting are not native to the Mono Basin and, therefore, do not necessarily thrive best under natural conditions.

According to Appendix II, the streamflow requirements listed in Decision 1631 would result in a long-term average release requirement to the Mono Basin streams of about 76,000 acre-feet per year. In order to raise and then maintain the level of Mono Lake at the target elevation of 6,392 feet, additional water will have to be released. During the transition period, on average an additional 30,000 acre-feet above and beyond the minimum streamflow requirements will be released into the Mono Basin creeks, while an additional 16,000 acre-feet per year on average will be released once Mono Lake reaches 6,392 feet.

The water released to Mono Lake in addition to the streamflow requirements can be released in several ways. It can be released in different creeks, at different times of the year, or at different flow magnitudes. For example, the 16,000 acre-feet of allowable export during the transition period could all be diverted from Rush Creek with none diverted from Lee Vining Creek. This would give Lee Vining Creek more of the additional Mono Lake maintenance flow than Rush Creek would have, since all of the diversions are occurring from Rush Creek. A fundamental question which needs to be addressed before a streamflow plan is determined is:

> **"What is the most beneficial flow pattern for releasing water which has to be released above and beyond the minimum streamflow requirements listed in Decision 1631?"**

Sample Year: 1979 During the Transition Period

As an example of the different release patterns for the Mono Basin creeks, the 1979 runoff year is used as a sample year. This year was chosen to represent a typical year because the runoff in 1979 was 100% of normal, putting it in the "normal" year-type classification. The hydrograph for Lee Vining and Rush creeks are shown in Figures 22 and 23, along with the required minimum streamflows of Decision 1631. In a normal year, the channel maintenance flow requirement in Lee Vining Creek is 160 cfs for 3 days, while in Rush Creek it is 200 cfs for 5 days. The following table compares the amount of runoff in each creek with the minimum flow requirements of Decision 1631.

Table M

Total Runoff vs. Decision 1631 Minimum
Rush and Lee Vining Creeks

	Lee Vining Creek	Rush Creek
Total runoff for the year (1979):	44,100 acre-feet	59,800 acre-feet
Water required for fishery flows for year:	- 30,200 acre-feet	- 37,600 acre-feet
Available water above fishery flows:	13,900 acre-feet	22,200 acre-feet

The table above shows that 13,900 acre-feet in Lee Vining Creek and 22,200 acre-feet in Rush Creek are available for diversion or additional release into the creeks, and thus total available water from the two creeks is 36,100 acre-feet. For simplicity, Walker and Parker creeks are not considered in this analysis. During the transition period when Mono Lake is above 6,380 feet, the maximum export allowed in any one year is 16,000 acre-feet, with about 20,000 acre-feet released down Lee Vining and Rush creeks in addition to the requirements above.

Figure 22: LEE VINING CREEK 1979 HYDROGRAPH
Comparison of Measured Streamflow and
D 1631 Minimum Flow Requirements

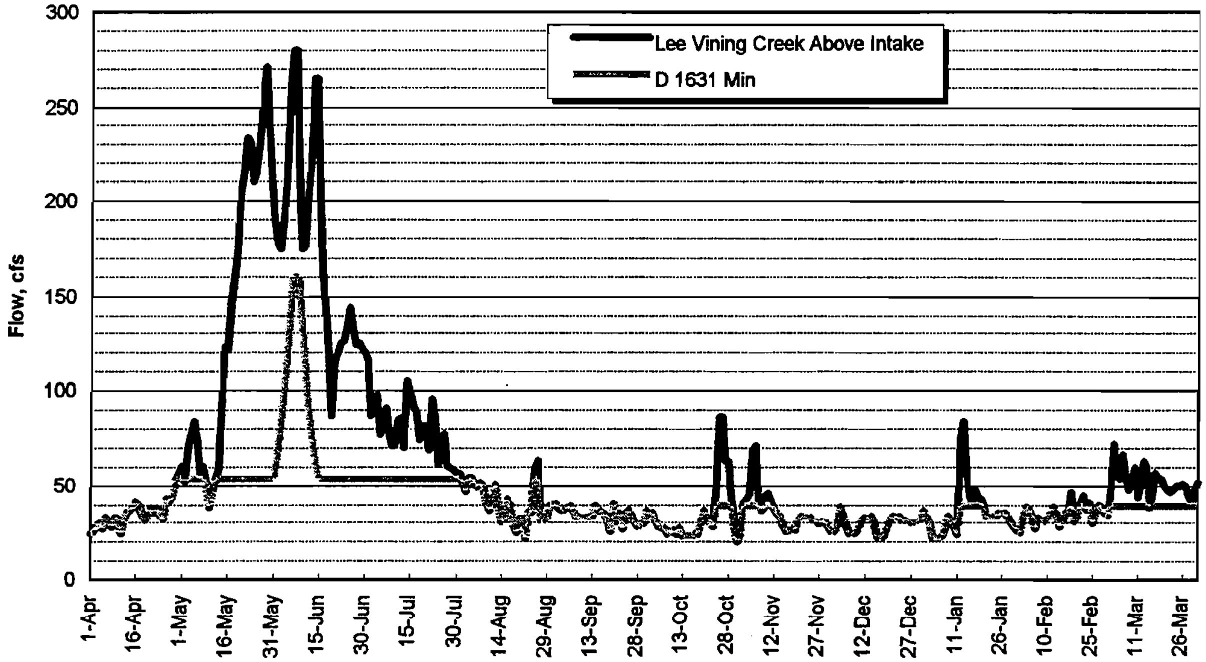
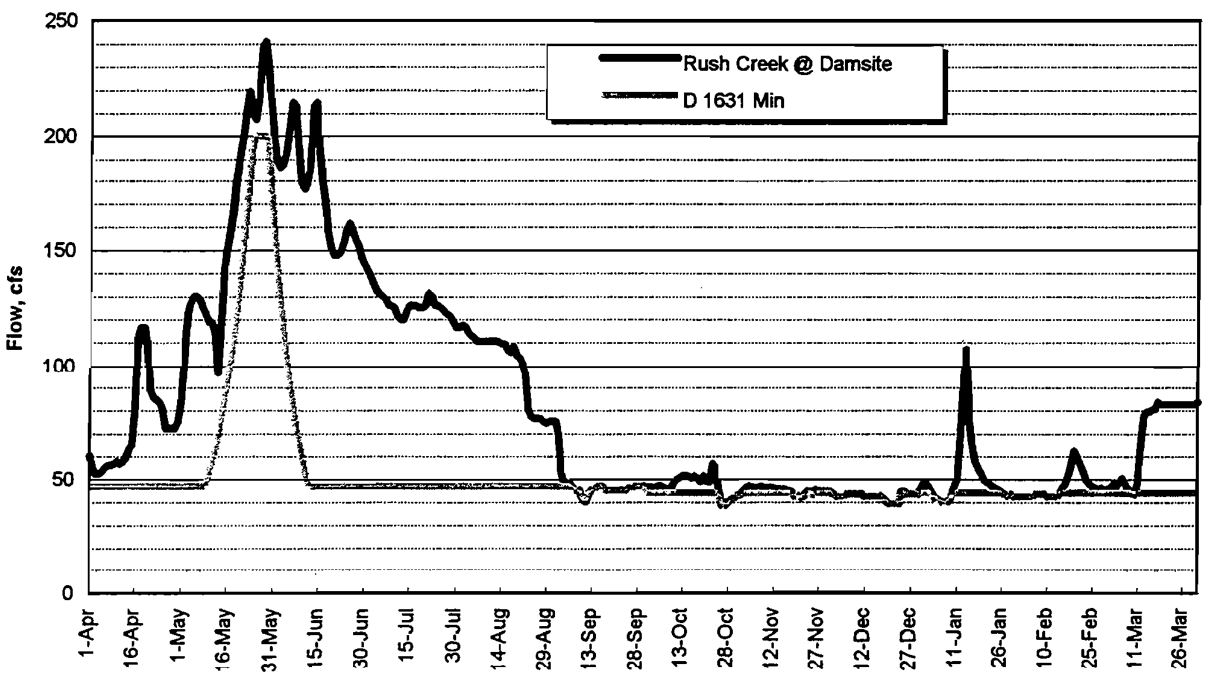


Figure 23: RUSH CREEK 1979 HYDROGRAPH
Comparison of Measured Streamflow and
D 1631 Minimum Flow Requirements



If the 16,000 acre-foot export allotment is based on the relative size of each creek, then the goal would be to export about 6,000 acre-feet from Lee Vining Creek and about 10,000 acre-feet from Rush Creek. Because Lee Vining Creek has 13,900 acre-feet of water available for diversion and the goal is to divert 6,000 acre-feet, about 8,000 acre-feet of water would have to be released down Lee Vining Creek in addition to the requirements above. Likewise, Rush Creek releases would have to increase by about 12,000 acre-feet beyond the requirements listed above if only about 10,000 acre-feet were diverted from that creek.

Alternative Release Patterns

At this point it is important to address the fundamental question listed previously, "What is the most beneficial flow pattern for releasing water which has to be released above and beyond the minimum streamflow requirements listed in Decision 1631?" There are two principle ways in which this water can be released. They are:

- Additional water can be released so as to maximize both the magnitude and duration of the peak flows in the streams; or
- Additional water can be released so as to sustain higher base flows throughout the summer season or throughout the year.

Another way of stating the two streamflow patterns is to either add the additional water to increase the channel maintenance flow or to increase the monthly base flows. The more water that is dedicated to one pattern leaves less water available for the other. As water is increased to the channel maintenance flows, less water can be added to the base flows for the rest of the year. If more water is added to the base flows, there is less available to increase the peak flows. There is a finite amount of water available to the streams, and, therefore, allocating water for one purpose precludes its use for another. Figures 24 through 29 show different possible flow regimes for releasing water in excess of minimum flow requirements for Lee Vining and Rush creeks.

Lee Vining Creek

On Lee Vining Creek, because there is no reservoir at the diversion facility, the ability to affect the flow pattern is limited. As Figure 22 indicates, the flow in the creek is below the minimum requirement during the majority of the year. The only time of the year that additional water can be released is during May, June, and July, except for a few instances in the fall and winter. Three flow options for diverting 6,000 acre-feet from Lee Vining Creek are shown in Figures 24 through 27. In Figure 24, diversions are constant during the higher runoff period. The shape of the hydrograph is maintained, but the peak is lower. In Figure 25, the water is diverted before the peak runoff occurs and then no further diversions are made. In Figure 26, water is diverted after the peak flows have occurred. Finally, in Figure 27, water is diverted on both the ascending and descending limb of the peak. In the latter three scenarios, the highest peak flow is maintained, but the water volume of the ascending and descending limbs of the hydrograph is reduced. Each of the diversion schemes shown export a similar amount of water from Lee Vining Creek.

Rush Creek

On Rush Creek, Grant Lake allows much more flexibility in releasing water into lower Rush Creek. The peak flows can be stored and released at anytime of the year. On the other hand, the peak flows can be increased beyond what is in the creek upstream by releasing water from storage. Two options are shown for diverting 10,000 acre-feet from Rush Creek in Figures 28 and 29. In Figure 28, the same channel maintenance flow as that in Decision 1631 is used, but the base flows are increased. During May, June, and July, the base flows are 100 cfs and gradually decrease through the fall season. In Figure 29, the peak flow is increased to the capacity of the Mono Gate Return Ditch (350) cfs, and maintained 15 days. The peak flow is much higher than the inflow to the reservoir, so water must be taken out of storage to meet this outflow. In order to achieve this high magnitude flow for about one-half of a month, the releases must remain at the minimum for the rest of the year. Either of the release patterns shown would allow a similar amount of export from Rush Creek without significantly affecting the annual storage of Grant Lake.

Using 1979 as a sample year, it is easy to see that there are a number of different flow regimes possible for the Mono Basin streams while following Decision 1631 requirements and diverting 16,000 acre-feet per year from the Mono Basin. Water for Mono Lake maintenance which must be released to the Mono Basin streams in addition to the minimum requirements of Decision 1631 can be added to the base flows, the channel maintenance flows, or both. All of the flow scenarios discussed in this section can be achieved while fully complying with the requirements listed in Decision 1631.

Figure 24: LEE VINING CREEK 1979 HYDROGRAPH

Comparison of Measured Streamflow and
Case A Export Scenario

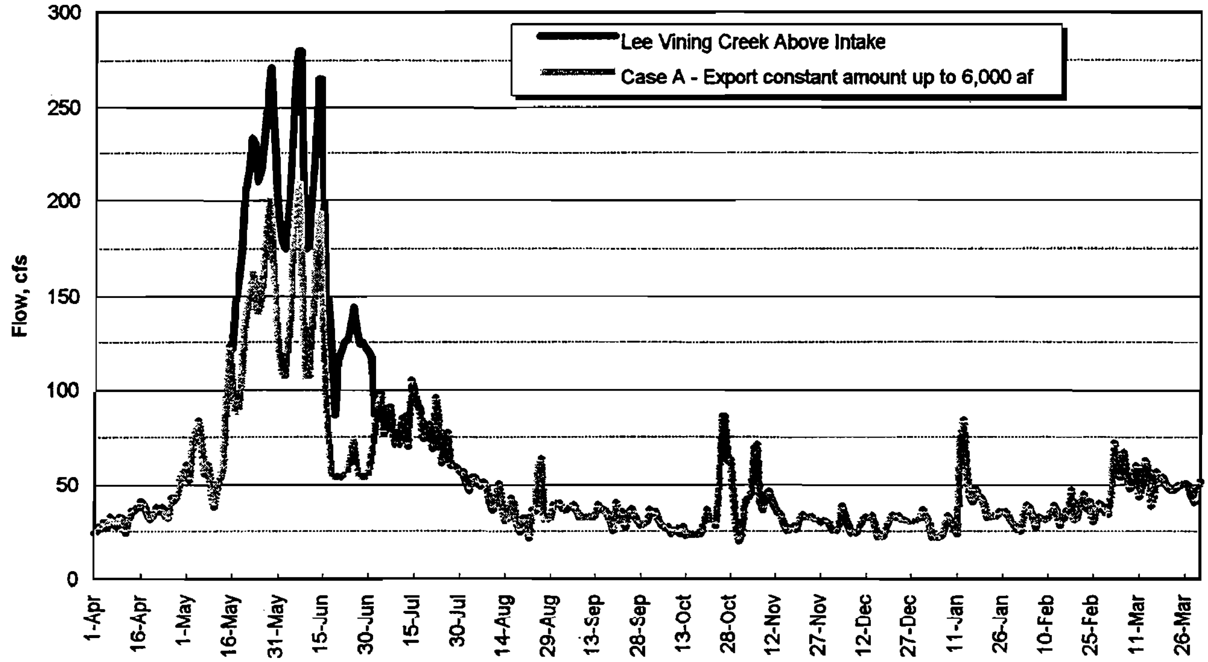


Figure 25: LEE VINING CREEK 1979 HYDROGRAPH

Comparison of Measured Streamflow and
Case B Export Scenario

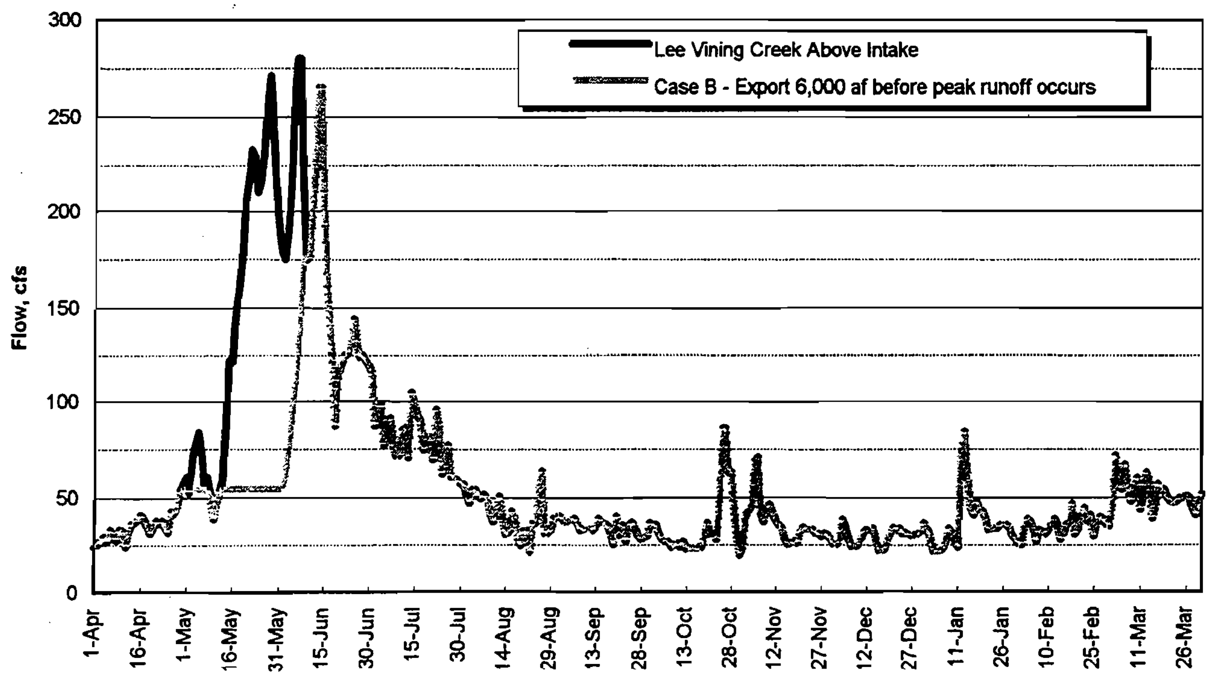


Figure 26: LEE VINING CREEK 1979 HYDROGRAPH

Comparison of Measured Streamflow and
Case C Export Scenario

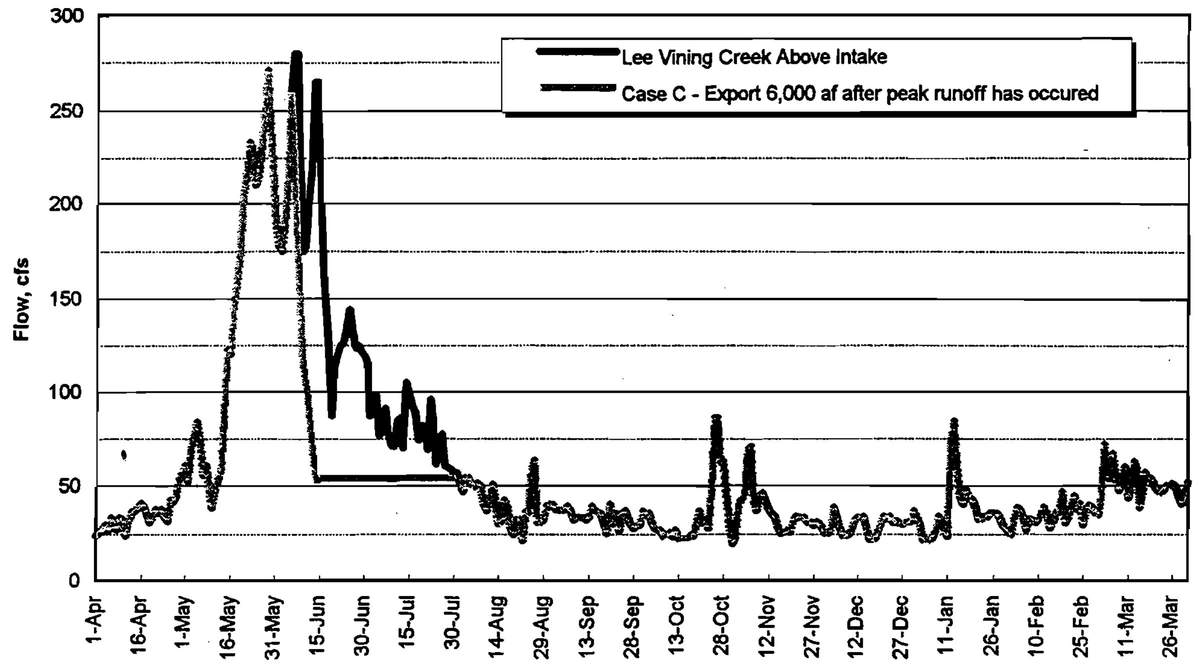


Figure 27: LEE VINING CREEK 1979 HYDROGRAPH

Comparison of Measured Streamflow and
Case D Export Scenario

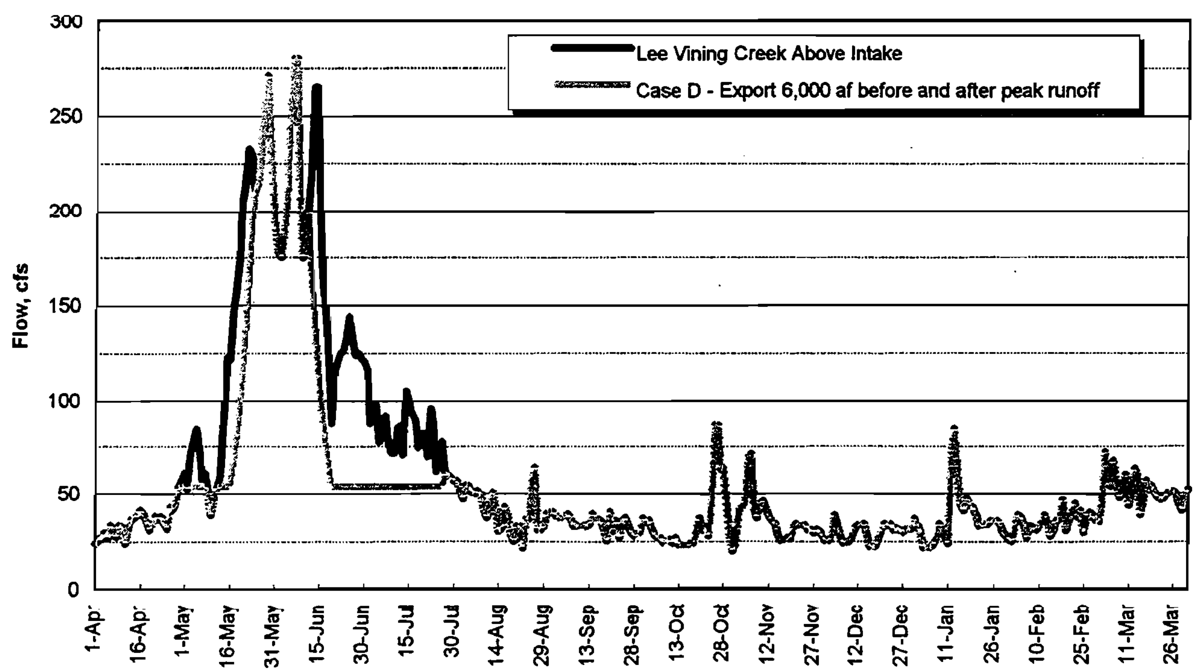


Figure 28: RUSH CREEK 1979 HYDROGRAPH
Comparison of Measured Streamflow and
Case E Export Scenario

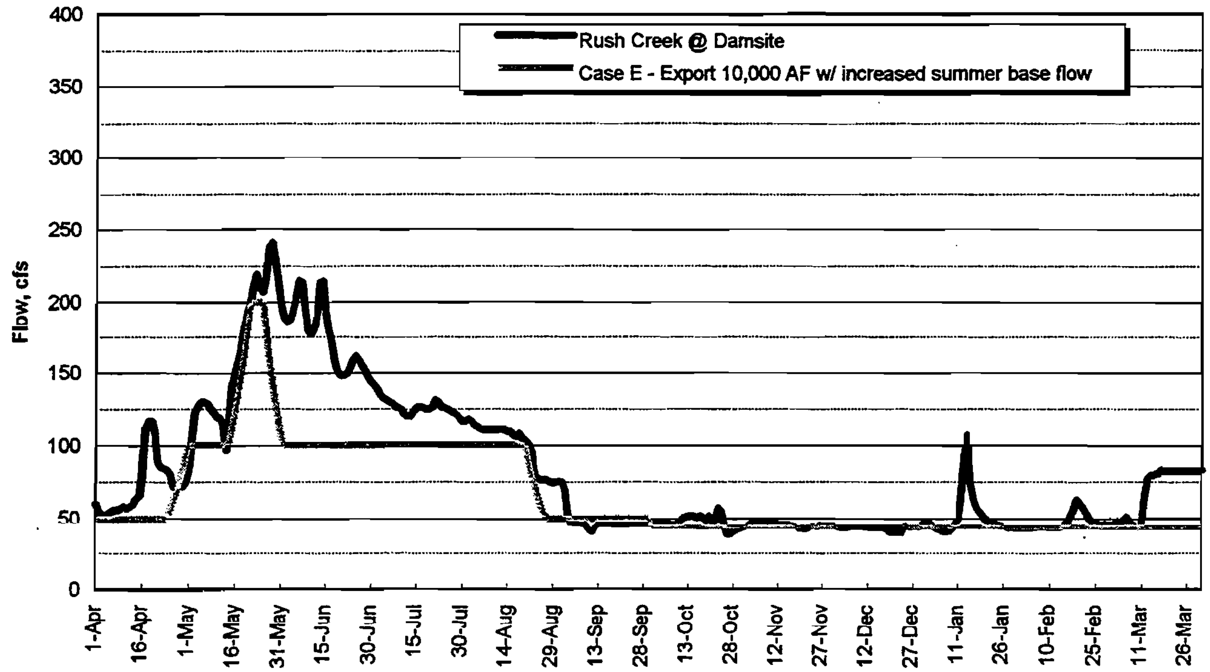
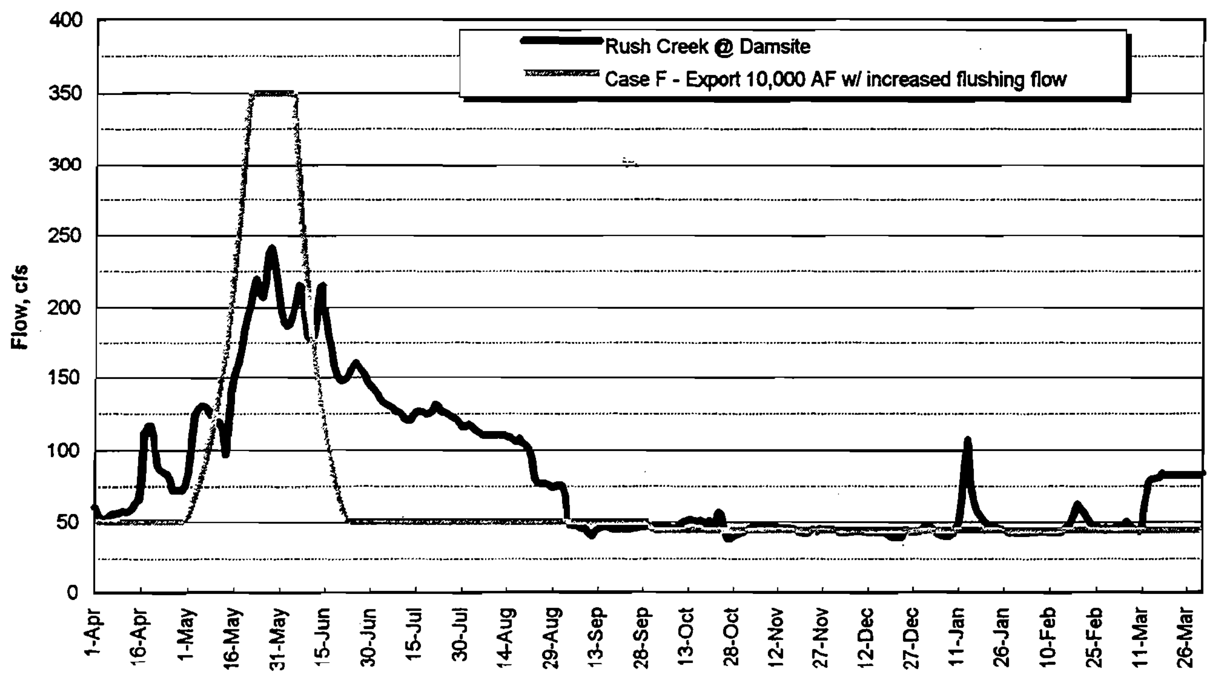


Figure 29: RUSH CREEK 1979 HYDROGRAPH
Comparison of Measured Streamflow and
Case F Export Scenario



Flow Regimes Considered in Developing the Mono Basin Streamflows

Throughout the development of the Grant Lake Operations and Management Plan there was discussion of different flow regimes possible for releasing water into the Mono Basin streams. For years in which exports are limited by Mono Lake requirements (this applies both during the transition period and times when Mono Lake is below 6,391 feet after transition), the proposed flow releases were to match as closely as feasible the monthly average inflow totals for a given year-type. For example, in a normal year the average flow in Rush Creek above Grant Lake is 117 cfs. The proposal in the 4,500 acre-foot export scenario was to release 100 cfs in May and store the remainder for export. In each month, the releases from Grant Lake would closely match the average inflow, except for a small amount of water needed for export during lake level maintenance years.

On October 4, 1995, Dr. Richard Ridenhour, Mr. Hunter, and Dr. Trush (stream scientists) completed a final draft of their restoration report entitled, *Work Plan -- Mono Basin Stream Restoration (Rush Creek, Lee Vining Creek, Walker Creek, and Parker Creek)*. Their report includes flow recommendations for base flow, channel maintenance flow, and ramping rate recommendations they believe are necessary restore Mono Basin streams to their 1941 conditions.

After examining the benefits of this year's high flows, the stream scientists concluded that releases higher than the streamflows normally observed above the LADWP facilities would be beneficial to Rush and Lee Vining creeks. Southern California Edison attenuates the peak flows in each of those two creeks, and releases above the attenuated amount, the stream scientists argued, would be the most beneficial pattern. Other flow recommendations were made late in the process of developing the Grant Lake Operations and Management Plan. The following is a list of most of the different flow alternatives considered in developing the streamflow management plan.

Mono Basin Streamflow Management Alternatives Considered

- *LADWP's July 1995 Flow Proposal* -- Attempts to release water for Mono Lake maintenance in a pattern similar to flow above LADWP's facilities.
- *Stream Scientists' October 1995 Proposal* -- Requires significant increases in channel maintenance flows.
- *California Department of Fish and Game 1993 Proposal to SWRCB* -- Increases base flows on all creeks while using Decision 1631 channel maintenance flows.
- *Stream Scientists & CDFG Combination* -- Combines stream scientists channel maintenance flows with CDFG base flow recommendations.
- *Maximize Peak Flows within D-1631 Parameters* -- Releases water for Mono Lake maintenance with highest peaks possible, as shown in Figure 29.

- *Maximize Base Flow Increase with D-1631 Parameters* -- Release water for Mono Lake maintenance with increasing year-round base flows, as shown in Figure 28.
- *Increase both Peak Flows and Base Flows within D-1631 Parameters* -- Release water for Mono Lake maintenance, increasing both components of streamflow.

In addition to the flow management alternatives listed above, a question discussed at the stream TAG meetings was whether or not to attenuate the peak flows on the creeks. It was felt that the Mono Basin creeks are in a state of restoration and might not be capable of adequately sustaining high flow events. One of the guidelines for the Restoration Technical Committee (RTC) established by the El Dorado County Superior Court, was that "it may be appropriate to recommend actions to attenuate high flows until the streams' ability to beneficially accommodate high flows is restored."

Analysis of Mono Basin Streamflow Management Alternatives

The Mono Basin streamflow management alternatives were consolidated and evaluated. The alternatives were consolidated into the following scenarios: the stream scientists' recommended flows as described in their October 4, 1995 draft Work Plan; the Department of Fish and Game's recommended flows as described in Decision 1631; and a flow scenario which uses Decision 1631 minimum flows and apportions the Mono Lake maintenance water to both increase the peak flows and base flows. The following section analyzes the different alternatives.

Stream Scientists' Recommended Flows

The stream scientists' flow recommendations are listed on pages 161 and 162 of their Mono Basin Restoration Work Plan. Included in their proposal are changes in the Decision 1631 base flows, ramping rates, and channel maintenance flows. When the SWRCB prepared Decision 1631, they adopted the channel maintenance flows and ramping rates as proposed by the California Department of Fish and Game. The concept behind the stream scientists' proposal is that the minimum channel maintenance flows in Decision 1631, they argue, are inadequate for meeting a restoration policy that relies on natural stream processes. (Scientists 143) The main change they are recommending to Decision 1631 is a significant increase in the magnitude of channel maintenance flows; in some cases, they have more than doubled the required flow. In order to help achieve higher flows, they recommend less stringent ramping rates on flows, which allows the streams to achieve higher flows more quickly.

The following is a critique of the stream scientists' recommended flows:

1. **The Work Plan evaluates the minimum flow requirements of Decision 1631 but does not consider the lake maintenance water which must be released above and beyond the minimum base flows and channel maintenance flows.**

   The Work Plan states that the SWRCB flow regime is inadequate, but the plan did not evaluate the SWRCB flow regime -- only the minimum flows. The SWRCB was well aware that additional water above the minimum must be released, with occasional flows well in excess of the minimum channel maintenance flows. (SWRCB 193)

2. **The recommended peak flows in the Work Plan are higher than the typical peak flows in the streams above LADWP's facilities.**

   Southern California Edison attenuates peak flows on Rush and Lee Vining creeks in order to maximize the generation of hydro-electric power. Because of their operations, the peak flows are significantly damped in the creeks. The only way to achieve the magnitudes of flows in the work plan would be to have SCE change their operations and to draw down Grant Lake reservoir to achieve the flows. Using Grant Lake reservoir would, in essence, have the reservoir make up for the attenuation in flow caused by SCE.

   On Lee Vining Creek, SCE would lose power generation potential if it changed its operation to achieve higher flows. The capacity of the power generating facilities is about 100 cfs, so water would have to be spilled instead of being used to generate power, to achieve higher flows. On Rush Creek, SCE could likely achieve higher flows in wet years without losing power, but SCE has other considerations, such as flooding concerns in the community above Silver Lake. While SCE could increase the flows on both creeks, it is not clear that whether they could increase the flows sufficiently to meet the work plan's recommendation.

3. **To achieve the peak flows recommended in the Work Plan on Rush Creek, a new and higher capacity outlet from Grant Lake reservoir would be needed.**

   The historic capacity of Grant Lake outflow to lower Rush Creek is about 350 cfs. Plans to restore that capacity have been submitted to the SWRCB. To achieve flows of 600 cfs, Grant Lake reservoir would have to spill or a new outlet constructed. If Grant Lake reservoir were maintained near capacity and allowed to spill, the inflow to the reservoir would not be sufficient to meet the recommended maintenance flows (both in magnitude and duration) in almost every year. Only by building a new and costly outlet could the flows be met on a regular basis. This would require releasing additional water from storage in Grant Lake reservoir to meet the maintenance flows.

4. **Attempting to meet the flows in the Work Plan would result in a higher level of Mono Lake, lower flows in the upper Owens River, and reduce the municipal supply of water from Los Angeles Aqueduct.**

   If the stream recommendations in the Work Plan were met as closely as the hydrology provides, then water in excess of the amount to maintain Mono Lake at 6,392 feet would have to be released into the Mono Basin streams. The Los Angeles Aqueduct Simulation Model (LAASM) indicates that this would raise the ultimate average level on Mono Lake to about 6,395 feet. Once Mono Lake reaches 6,392 feet, exports would be reduced by about 4,000 acre-feet from what Decision 1631 provides.

Page 173 of the Work Plan includes a list of possible alterations in the recommended flows to reduce the total volume of water required. These changes would increase the amount of water available for export, but would not change the critiques 1 through 3 mentioned above.

<u>*California Department of Fish and Game 1993-4 Recommended Flows*</u>

During the Mono Basin Water Right Hearing in 1993 and 1994, the California Department of Fish and Game presented their recommended flows for the Mono Basin streams to the SWRCB. While these flows are not necessarily the current recommendation of the DFG, a DFG representative asked that the flow recommendations be considered as an alternative in the stream restoration plan. The flow recommendations include monthly minimum instream flows, channel maintenance flows, and ramping rates. In Decision 1631, the SWRCB adopted the DFG's channel maintenance flows and ramping rates verbatim. The SWRCB also adopted the DFG's flow recommendations on Walker and Parker creeks, and the flow recommendations on Lee Vining Creek for dry and normal runoff years. The only difference between Decision 1631 flows and the DFG recommendations is a change in the monthly minimum instream flows for wet years on Lee Vining Creek and for all runoff year-types on Rush Creek. On Rush Creek, the DFG minimum flows are much higher than those of Decision 1631, particularly in normal and wet runoff years. Adoption of the DFG recommended flows would require a slight modification to Decision 1631 base flows.

The following is a critique of the Department of Fish and Game's recommended flows:

1. **The DFG recommended flows further attenuates Rush Creek.**

   As previously mentioned in this plan, the flows on Rush Creek are attenuated by SCE, resulting in lower peak flows in May, June, and July, and higher base flows beginning in the late summer. The DFG recommended flows would further attenuate flows by increasing the required releases from Grant Lake into lower Rush Creek during the late summer. For example, the minimum Decision 1631 dry year flow requirement in July, August, and September is 31 cfs, while the minimum

DFG dry year flows are 45, 42, and 40 cfs for the same months. These flows are higher than the actual flow in Rush Creek during most of the dry years and, therefore, require flow augmentation from Grant Lake reservoir.

2. **The DFG flow regime limits the ability to release higher peak flows when desired.**

   The DFG recommended flows ultimately maintain Mono Lake close to the target in Decision 1631 of 6,392 feet. This means that there is virtually no additional Mono Lake level maintenance that would be released in addition to the base flows and channel maintenance flows. All of the water in the Mono Basin would be released to the streams exactly as specified in the DFG flow regime with virtually no variation, except in the wettest years. If flow increases during the peak runoff season were desired, those flows could only occur at the expense of water exports, because of the large amount of water that must be dedicated to maintain the higher base flows throughout the year.

3. **The DFG flow regime would limit exports to the upper Owens River.**

   The DFG recommended flows would reduce the export of water to the upper Owens River. The DFG instreams base flows by themselves would maintain Mono Lake at a similar elevation as Decision 1631, but the combination of DFG flows and Decision 1631 Mono Lake maintenance requirement would increase Mono Basin streamflow and reduce the long-term exports by about 3,000 to 4,000 acre-feet per year.

Proposal to Increase flows within Decision 1631 Parameters

The main goal of the stream scientists' flow recommendation is to increase the peak flows above Decision 1631 minimum channel maintenance flows. The 1993-94 DFG proposed flows, however, are consistent with the Decision 1631 channel maintenance flows, but would increase the SWRCB's base flow requirements. Neither of the two proposals, however, consider the effects on Mono Lake, the upper Owens River, Grant Lake reservoir, or the flow of water to Los Angeles. This proposal works within the Decision 1631 parameters and uses the Mono Lake maintenance water to both increase the channel maintenance flows and the base flows during much of the year. As stated previously, the Mono Basin streamflows during transition will be about 40% greater than the Decision 1631 minimum flows, while after transition they will be about 20% larger than those in the decision.

The following is a critique of the proposal to work within Decision 1631 parameters:

1. **Because Decision 1631 does not prescribe the manner in which the Mono Lake maintenance water is to be released, it could potentially be released in a manner that is harmful to the Mono Basin streams.**

Decision 1631 acknowledges that water in addition to the minimum flows must be released into the Mono Basin creeks. The decision, however, does not place conditions on the LADWP as to how the water should be released. It is for this reason that the restoration plan is addressing flow management in the Grant Lake Operations and Management Plan.

2. **Decision 1631 does not take into account new information that was obtained by the high flows of 1995.**

   The high flows of 1995 provided additional information that was not available during the Mono Basin Water Right Hearings. On the other hand, there is much information about the effects of different flow regimes that is still unknown. Because Decision 1631 allows for flexibility in the pattern of release of Mono Lake maintenance water, future changes in flow patterns can easily be made in response to new information.

Comparison of Mono Basin Streamflow Management Alternatives

The flow regimes of four different flow management alternatives were compared, including the streamflow hydrographs and amount of water diversions to the upper Owens River. The four management alternatives compared are the three listed above plus another which combines the stream scientists' channel maintenance flows with the DFG base flows. (This scenario is considered at the request of a DFG staff TAG member.)

The flow scenarios above can be summarized in the following way:

- The stream scientists' flows increase the required channel maintenance flows as described in Decision 1631;
- The 1993-94 DFG recommended flows increase the required base flows during most of the months on Rush Creek as in wet years on Lee Vining Creek from Decision 1631;
- The LADWP proposal to manage Mono Lake maintenance water to both increase the magnitude of channel maintenance flows and base flows during certain months;
- The combination scientists/DFG proposal significantly increases both the required channel maintenance flows and the required base flows.

The different flow scenarios are shown graphically in Figure 30, which shows the releases from Grant Lake reservoir into lower Rush Creek of the first three proposals. The year shown is 1975, which is a normal runoff year-type, during the transition period when 16,000 acre-feet can be exported. In this scenario, 10,000 acre-feet are diverted from Rush Creek. After diverting 10,000 acre-feet, the flow requirements of both the stream scientists' flows and the DFG flows apportion all of the remaining water available. There is no flexibility in changing the release pattern. The stream scientists' flows generate a large spike in June and low base flows for the remainder of the year. The DFG flows, by contrast, have higher base flows than Decision 1631 during most of the runoff season.

The parameters within Decision 1631 allow discretion on how to release the water above the minimum flows. In the "LADWP Recommended", scenario shown on Figure 30, the channel maintenance flow was increased from the required minimum of 200 cfs to 380 cfs. The peak flow shown is higher than the inflow of Rush Creek. Additionally, the base flow was increased from 47 cfs to 75 cfs from May through August. To a certain extent, the LADWP pattern shown on Figure 30 is arbitrary. Working within Decision 1631 parameters, the base flows can be increased longer and 10,000 acre-feet of water could still be exported from the creek. It is important to point out that as the base flow increases, the corresponding peak flow must decrease to release the same amount of water. Figure 31 provides additional information for the three different flow scenarios for the 1980 runoff year, which corresponds to a wet year. The same arguments regarding base flows, peak flow, and exports apply. Essentially, LADWP's flow pattern shown combines aspects of both the stream scientists' recommended flows and the DFG recommended flows.

In the sample years shown in Figures 30 and 31, it is possible to export 16,000 acre-feet under any of the flow alternatives shown. In many other year types, however, this is not the case. Because of the requirement for increased flows, during the drier years 16,000 acre-feet of export would not be possible. Additionally, once Mono Lake reaches 6,391 feet the stream scientists' and the DFG flow requirements would reduce export from that allowed in Decision 1631 further, thus resulting in a higher Mono Lake elevation.

The LAASM model and the GLOM were used to analyze the flows above. Tables N and O summarize the long-term effects of the streamflow proposals listed above during both the transition period and after Mono Lake has reached 6,392 feet, respectively.

Several computer runs were made with the GLOM model to compare the expected streamflows of the different management proposals. Appendix III contains the GLOM runs for LADWP's proposed streamflow management plan. Appendix IV contains the GLOM runs for the stream scientists, the DFG, and the scientists and DFG combination.

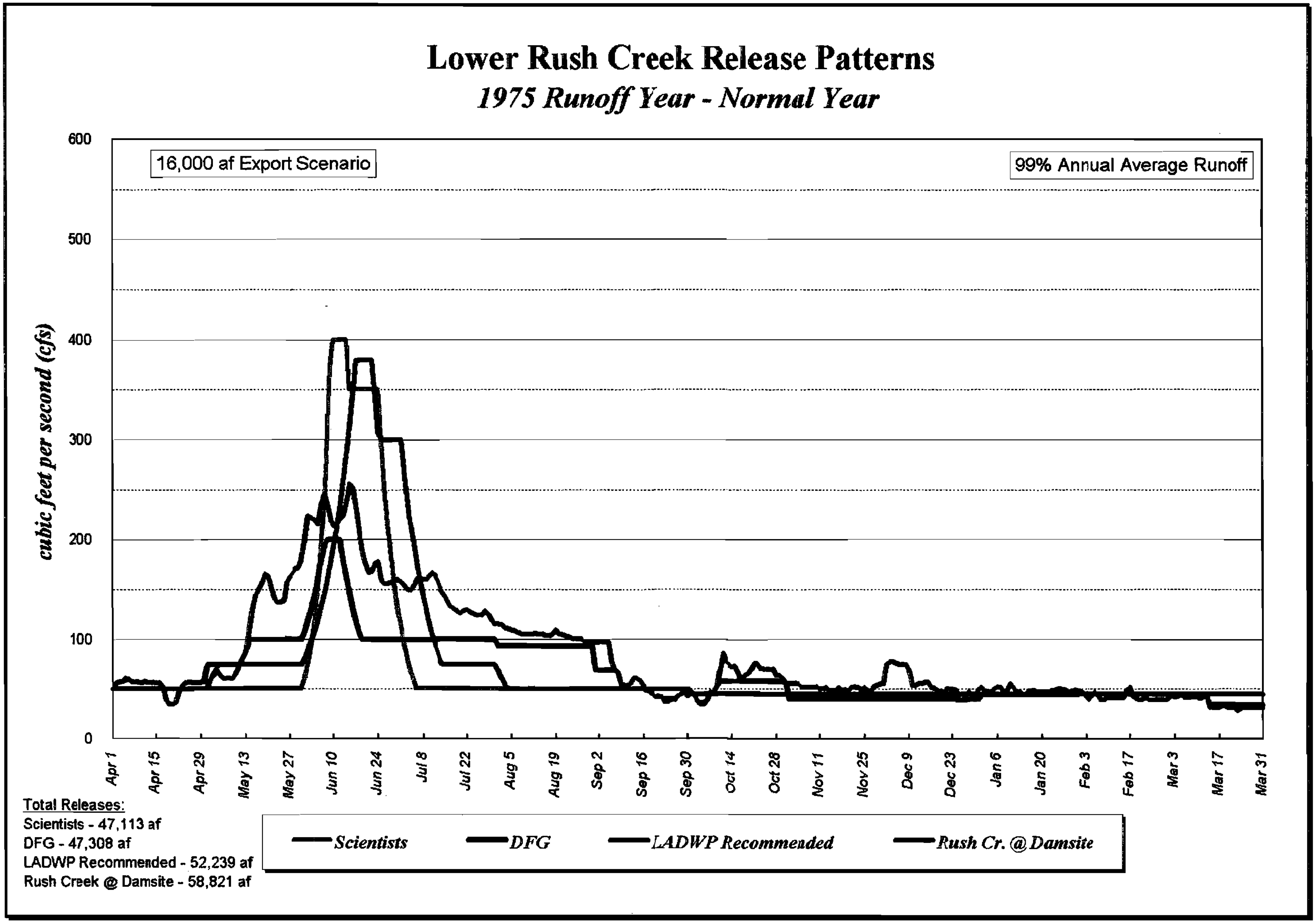

Lower Rush Creek Release Patterns
1975 Runoff Year - Normal Year
16,000 af Export Scenario
99% Annual Average Runoff
cubic feet per second (cfs)
600
500
400
300
200
100
0
Apr 1
Apr 15
Apr 29
May 13
May 27
Jun 10
Jun 24
Jul 8
Jul 22
Aug 5
Aug 19
Sep 2
Sep 16
Sep 30
Oct 14
Oct 28
Nov 11
Nov 25
Dec 9
Dec 23
Jan 6
Jan 20
Feb 3
Feb 17
Mar 3
Mar 17
Mar 31
Total Releases:
Scientists - 47,113 af
DFG - 47,308 af
LADWP Recommended - 52,239 af
Rush Creek @ Damsite - 58,821 af
Scientists
DFG
LADWP Recommended
Rush Cr. @ Damsite

Figure 30

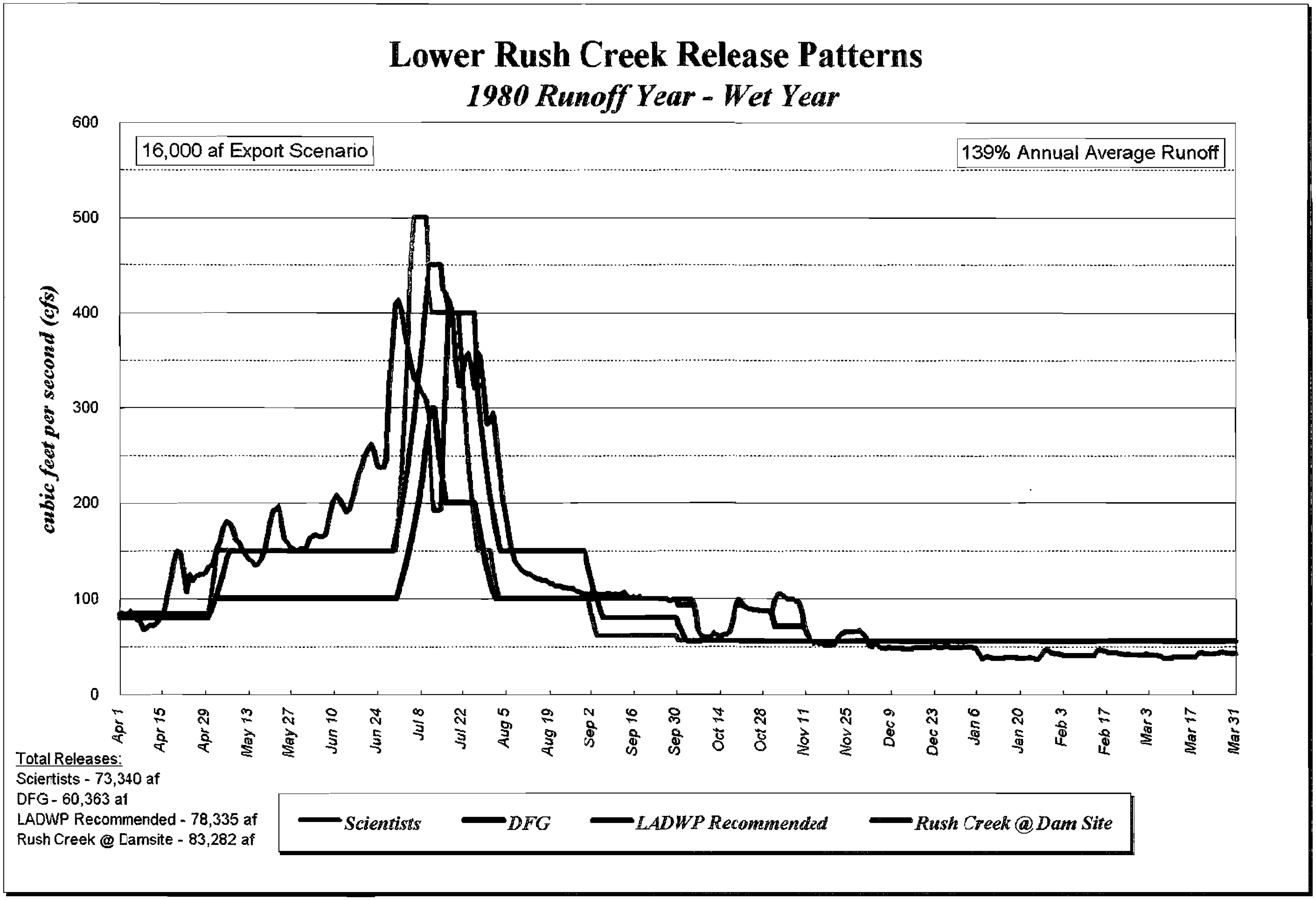

Lower Rush Creek Release Patterns
1980 Runoff Year - Wet Year
16,000 af Export Scenario
139% Annual Average Runoff
cubic feet per second (cfs)
600
500
400
300
200
100
0
Apr 1
Apr 15
Apr 29
May 13
May 27
Jun 10
Jun 24
Jul 8
Jul 22
Aug 5
Aug 19
Sep 2
Sep 16
Sep 30
Oct 14
Oct 28
Nov 11
Nov 25
Dec 9
Dec 23
Jan 6
Jan 20
Feb 3
Feb 17
Mar 3
Mar 17
Mar 31
Total Releases:
Scientists - 73,340 af
DFG - 60,363 af
LADWP Recommended - 78,335 af
Rush Creek @ Damsite - 83,282 af
Scientists
DFG
LADWP Recommended
Rush Creek @ Dam Site

Figure 31

Table N

LAASM Comparison of Various Flow Management Scenarios
Before Mono Lake Reaches the 6,391 feet Elevation[1,2]

	Average Mono Lake Release[3] (acre-feet)	Time to Reach 6391 feet (years)	Average Mono Basin Export[4] (acre-feet)
Decision 1631 Requirements	100,000	27	15,600
Decision 1631 Lake Level Requirements w/ LADWP Transition Proposal	106,000	27	15,300
Decision 1631 Lake Level Requirements w/ *Revised* Scientists' Streamflow Recommendations	107,000	27	13,700
Decision 1631 Lake Level Requirements w/ DFG 1994 Streamflow Recommendations	103,300	27	14,200
Decision 1631 Lake Level Requirements w/ DFG's Base Flows, and Scientists' Peak flow Recommendations[8]	111,500	19	8,700

Table O

LAASM Comparison of Various Flow Management Scenarios
After Mono Lake Reaches the 6391 feet Elevation[1]

	Average Mono Lake Release[3] (acre-feet)	Average Mono Lake Level	Average Mono Basin Export[5] (acre-feet)
Decision 1631 Requirements	92,200	6,392.5	29,300[6]
Decision 1631 Lake Level Requirements w/ LADWP Transition Proposal	107,422	6,398.6	15,293
Decision 1631 Lake Level Requirements w/ *Revised* Scientists' Streamflow Recommendations	96,857	6,394.2	24,940
Decision 1631 Lake Level Requirements w/ DFG 1994 Streamflow Recommendations	95,400	6,393.6	26,200
Decision 1631 Lake Level Requirements w/ DFG's Base Flows, and Scientists' Peak flow Recommendations[7]	108,700	6,398.7	13,200

Notes on Tables N and O:

1. 1941-1990 hydrology was used for the projections.
2. Initial Mono Lake elevation of 6379.3 feet is assumed during the transition period.
3. Flushing flow releases assumed to occur in June. However, the maximum flows do not always occur in this month. Therefore, releases to Mono Lake may be underestimated, particularly with the higher streamflow requirements. If the required flow is not met, then all flows in that creek are released to Mono Lake.
4. Export quantities include when Mono Lake is both below and above the 6,380 feet level. Exports are limited to 4,500 acre-feet (when below the 6,380 feet level) and 16,000 acre-feet (when above the 6,380 feet level) during Mono Lake's rise to the 6,391 feet level. No exports are allowed if the lake level is below the 6,377 feet level.
5. Includes periods when Mono Lake is above the 6,391 feet level where no additional lake level releases are required and when Mono Lake is below the 6,391 feet level where export is limited to 10,000 acre-feet.
6. Average export is about 34,900 acre-feet when Mono Lake is above 6,391 feet. Export is limited to 10,000 acre-feet about 22% of the time.
7. Flow through conditions at Walker and Parker creeks.

Besides the reduction in exports, the stream scientists', DFG, and combination plan have the following impacts:

- The flow regimes would require the release of more water into lower Rush Creek than the total runoff in Rush Creek above Grant Lake.
- The flow regimes would require diverting Walker and Parker creeks more often than the LADWP's recommended flow regime.
- The flow regimes would result in greater fluctuations of Grant Lake reservoir than the LADWP's recommended plan.
- The flow regimes would result in an uneven amount of diversions from Rush and Lee Vining Creeks. A greater percentage of the total Lee Vining Creek inflow would be diverted than the percentage diverted form the inflow at Rush Creek above Grant lake.
- During the pre-transition period, there is only sufficient water in dry, dry-normal, and normal years to maintain the scientists' recommended baseflows and maintenance flows on lower Rush Creek, resulting in a flat hydrograph with a sharp, unnatural peak.
- The export to the upper Owens River cannot remain constant because 16,000 acre-feet of water cannot be exported each year of the transition period.

After reviewing the impacts to all of the resources in the Mono Basin and upper Owens River, considering the water supply of Los Angeles, and examining the potential to manage flows within Decision 1631 parameters, the LADWP does not accept the stream scientists' nor the DFG flow proposals. As the GLOM runs indicate, there is sufficient flexibility within Decision 1631 to operate the Mono Basin facilities to the benefit of the streams. Peak flows, well in excess of the Decision 1631 minimums, will be released. The flows during much of the summer will be higher then the required minimum. The upper Owens River will get a constant export and Grant Lake will remain fairly consistent. Finally, Los Angeles will not have to give up additional water.

Alternatives Considered but Not Incorporated into the Grant Lake Operations and Management Plan

During the Grant Lake Operations and Management Plan development, many suggestions were offered to the LADWP. Because of the suggestions, many changes and improvements were made to the Grant Lake Plan. There were other alternatives that were seriously considered but not proposed. The following is a list of the alternatives that were given consideration but, for certain reasons, were not adopted into the plan. These alternatives would require modification of Decision 1631 and, therefore, the approval of the SWRCB before any could have been implemented.

Abandon Walker and Parker Creeks Diversion Facilities, Making up Water Elsewhere

Some parties suggested that the LADWP consider abandoning its diversion facilities on Walker and Parker creeks and make up for the reduced water by increasing water diversion from Lee Vining and Rush Creek. In response to this suggestion, LADWP staff prepared a proposal and sent it to the TAG members for consideration. A copy of the proposal is included as Appendix VI.

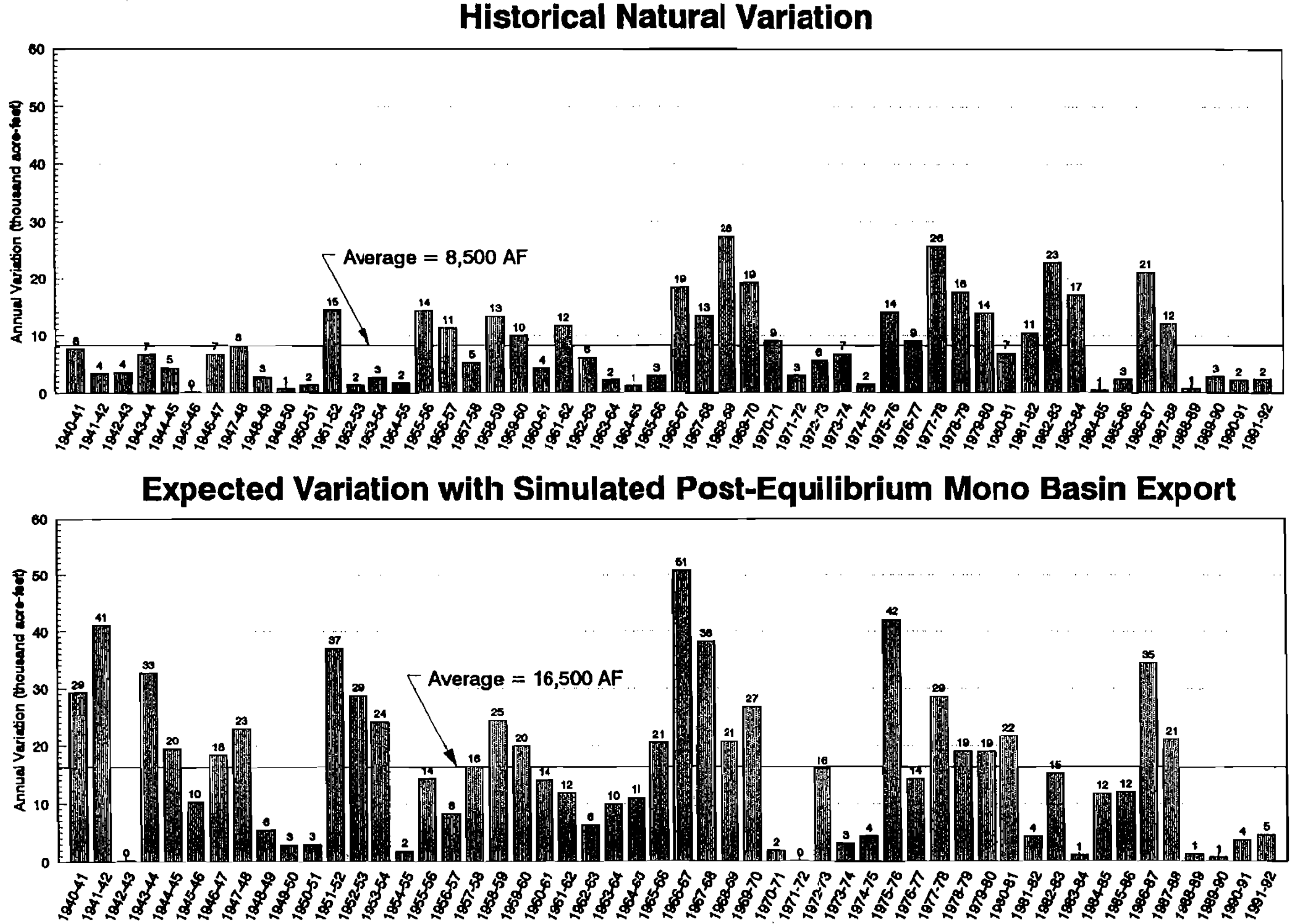
After discussions about the proposal, it was dropped from consideration. One reason is that the DFG was opposed to reducing streamflow requirements on Rush and Lee Vining creeks. Another reason is that the stream restoration scientists recommended more, not less, baseflows in all the creeks. After the scientists' recommendation, support for reducing flows on Rush and Lee Vining creeks all but disappeared.

Phase-in Higher Exports

Some of the parties were concerned about the rapid increase of exports to the upper Owens River, both when exports increase to 16,000 acre-feet per year and when Mono Lake reaches 6,391 feet and exports increase up to 50,000 acre-feet in some years. A proposal was considered to phase-in the higher exports. One possibility was to recommend changing the export pattern from the current allotment of 4,500 and 16,000 acre-feet to a schedule that increases exports by 4,000 acre-feet per year until the 16,000 level is achieved.

Another concern was the large change in annual exports when Mono Lake fluctuates around 6,391 feet. When Mono Lake is above 6,391 feet, exports average about 36,000 acre-feet per year, and when Mono Lake is below 6,391 feet, exports are limited to 10,000 acre-feet. This fluctuation will have a profound impact on the flows in the upper Owens River. Figure 32 shows the variation in the upper Owens River flows both with and without exports. There are several ways to reduce the variation in flow on the upper Owens River; however, because it would require a change in Decision 1631, and it was not possible to achieve consensus on the approach, a final proposal was not prepared. This issue will be revisited in the future as Mono Lake approaches 6,392 feet.

Annual Flow Variation in the Upper Owens River



Notes:

Simulated using LAASM and 1940-1992 actual hydrology.
Simulated using D-1631 post-equilibrium export rules.

Figure 32

Change Decision 1631 Ramping Rates

The ramping rates in Decision 1631 are designed to protect the fish in the Mono Basin creeks. They also preclude rapid flow changes to higher flow amounts. The stream restoration scientists concluded at a stream TAG meeting that the ramping rates are conservative and unnatural. Indeed, left alone the streams typically undergo much larger changes in flow than the ramping rates listed in the SWRCB decision. This is particularly true on Walker and Parker creeks where a 10% change in flow as required is immeasurable. In May of 1995, for example, the un-diverted flow in Walker Creek changed from 7 cfs to 15 cfs in one day. Under Decision 1631 ramping rates, it would take 8 days to increase the flow the same magnitude. The ramping rates are not only conservative on Walker and Parker creeks, they are unrealistic.

Changing the ramping rates on the Mono Basin streams to a more natural rate would allow the operator to release higher peak flows with the same volume of water. On Rush Creek for example, instead of slowly ramping the streamflows from the base flow of 47 cfs to the flushing flow of 300 cfs in 20 days as required, a peak flow of 350 cfs could be released with steeper ramping rates and no additional water requirements.

Although it may be beneficial to the streams to increase the ramping rates, no change is proposed at this time. Recommendations to change the ramping rates may be made in the future when the Grant Lake Operations and Management Plan is updated.

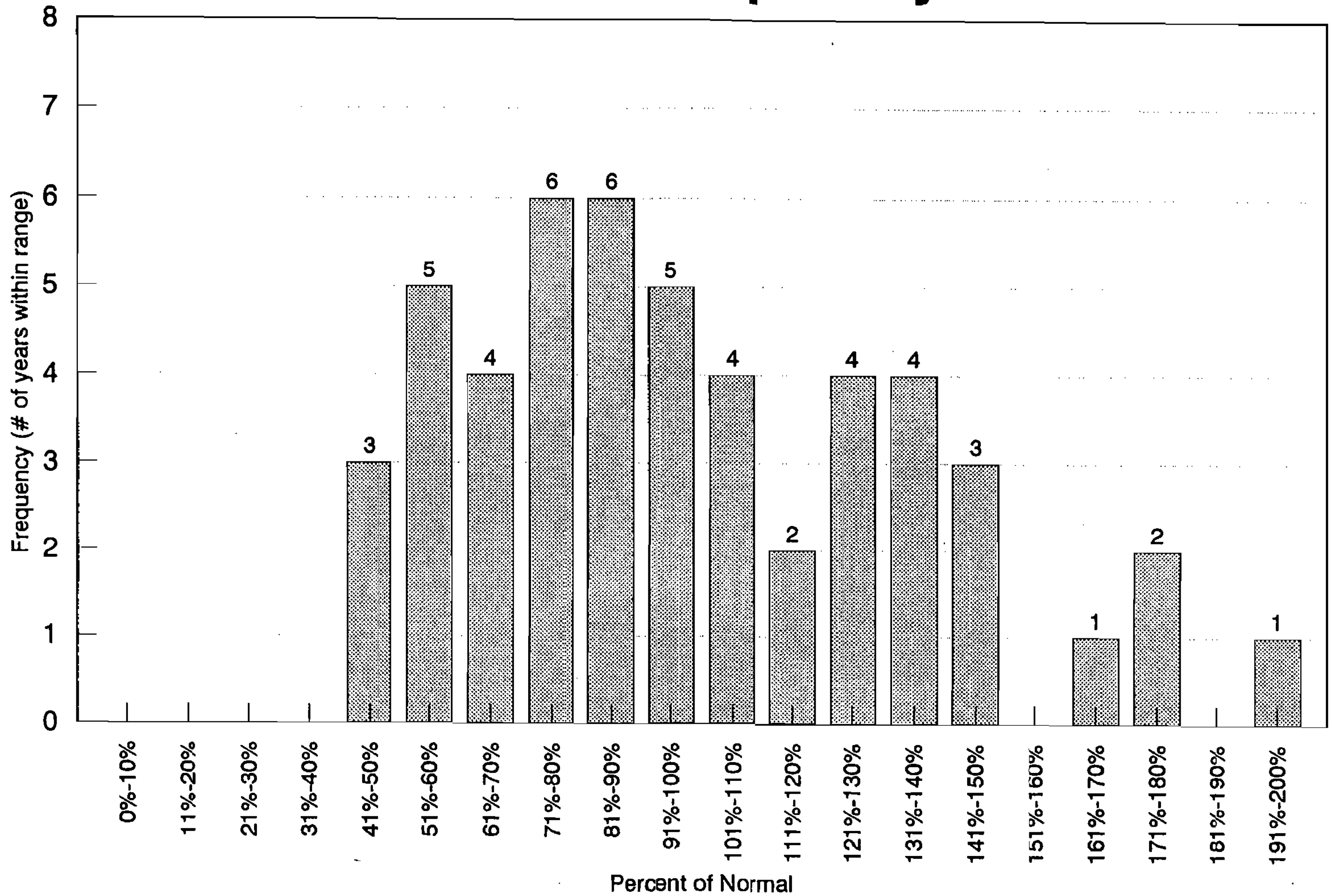
Change the Year-Type Criteria

Decision 1631 distributes the runoff years into five year-types based on the probability of exceedance for a given runoff volume. There is an even number of wet, wet-normal, normal, dry-normal, and dry year-types. In nature, however, there is not an even breakdown of runoff volumes.

In natural hydrology, the distribution of flow volume is skewed to the right. This means that there are many drier years and fewer wetter years. Lower flow volumes are the norm in the Mono Basin with occasional very high flows. In the last 50 years, for example, 60% of the years are below average runoff and 40% of the years are above average runoff. The median runoff is 87% of normal, with many years not far from the median flow. The 1983 year, on the other hand, was nearly 200% of normal and had a profound effect on the environment. Years like 1983 are extremely rare, while years slightly below normal are frequent.

Figure 33 shows the frequency distribution of runoff over the last 50 years. This chart graphically shows the number of drier years compared with the number of wetter years. The flows required by Decision 1631 do not reflect this pattern. If the runoff year-types in the decision were modified, the pattern of release to Mono Lake would mimic the natural hydrology more accurately. A recommendation on this issue may be made in the future, but no recommendation is offered now.

Mono Basin Runoff Frequency Distribution



Note: Data used is the 50 year period of record (1941-1990).
The percent of normal on an individual year basis is shown in Figure 1.

Figure 33

Adopt Stream Scientists' Flow Requirements

The stream restoration scientists recommended specific base flows, ramping rates, and channel maintenance flows for the Mono Basin creeks. Their proposal, however, would reduce diversions to the upper Owens River. Their proposal also takes all flexibility away from the release of water to Mono Lake. All of the water must be released as directed and there is no additional water to apportion as needed. Because the flows would negatively impact the diversions of water to the upper Owens River and because of the uncertainty as to the need for the flow requirements indicated, the stream scientists' proposal is not being adopted.

Modify SCE Operations

LADWP's original proposal was to provide flow through conditions for Rush Creek during extreme years. This would be accomplished by limiting Grant Lake outflow and forcing the reservoir to spill. SCE operates several reservoirs upstream of LADWP facilities on Rush and Lee Vining Creek. The effect of these reservoirs is to attenuate the natural flows which dampen the high peak flows that normally occurs in the creeks. It was believed that if LADWP requested SCE to change their operations, then higher magnitude peaks flows could be achieved. SCE is limited to releasing a maximum of 220 cfs into Rush Creek unless Gem Lake is spilling, in which case the release would equal the inflow. In order to increase the potential peak for Rush Creek, both Grant Lake and SCE reservoirs must be full when the peak arrives

LADWP analyzed this proposal for Rush Creek and found that the inflow to Grant Lake increased in some cases, while in others it did not. In those years in which the peak flow did increase, it was not to the level initially anticipated. The drawback with this type of operation is that the peak flow may occur while Gem Lake or Grant Lake is filling. This situation would essentially negate the intent of the modified operations unless the reservoirs are spilling when the peak arrives. In addition, filling Gem Lake first adds to the time it takes to fill Grant Lake, under normal operating conditions. Peak flows may occur while Gem is filling or while Grant Lake is filling. Also, peak flows may not be of the magnitude recommended by the scientists. Therefore, changing SCE operations would not necessarily increase the magnitude or frequency of peaks on Rush Creek as originally expected.

It was also suggested that changes in SCE operations on their Lee Vining Creek reservoirs may also increase the peak flows on Lee Vining Creek. However, the effects of SCE reservoirs on Lee Vining Creek peak flows are less pronounced as they are on Rush Creek. Average Lee Vining Creek monthly impaired flows are not significantly less than the unimpaired flows (compare Figures 10 and 11). Therefore, rather than relying on SCE to increase maintenance flows, LADWP will provide flow through conditions for the peak flows on Lee Vining Creek in all year types, except in dry years.

Since there are other operational alternatives for providing increased peak flows on Rush Creek, LADWP concludes it is not necessary to request SCE to modify their operations to provide peak flows in Rush and Lee Vining Creeks.

Recent Developments and Revisions to the Grant Lake Operations and Management Plan

LADWP hosted a technical advisory group (TAG) meeting on January 9, 1996. The purpose of the TAG meeting was to receive preliminary comments on LADWP's draft Stream Channel Restoration and Grant Lake Operations and Management Plans. During the January 9, 1996 TAG meeting, several comments were received regarding LADWP's stream flow management proposal. In general, the parties expressed four general comments regarding the proposed streamflow management plan. These are as follows:

- LADWP failed to consider the possibility of approaching SCE to modify their operations in order to achieve higher channel maintenance flows on Rush and Lee Vining Creeks;
- LADWP's flow regime is not clearly identified in the Grant Lake Operations and Management Plan;
- LADWP is advocating natural restoration processes but fails to adopt the stream scientists' recommended flow regime, and;
- LADWP's post-transition flow regime releases Decision 1631 minimum flows which are inadequate to maintain the creeks after restoration.

Draft Grant Lake Operations and Management Plan

LADWP revised its original proposal since the release of the draft Grant Lake Operations and Management Plan and the draft Stream Restoration Plan. The revisions were a direct result of continuing the TAG process beyond the informal comment period for the development of draft plans and are closer to the stream scientists' channel maintenance flow recommendations. LADWP's revised flow regime includes some of the recommendations of an ad hoc committee formed, at the January 9, 1996 TAG meeting, to discuss peak flows on Rush Creek for the wetter year types.

Several parties expressed concerns that LADWP did not incorporate the stream scientists' flow recommendations. Similar to the stream scientists, LADWP endorses a restoration policy that promotes natural restoration processes through proper flow and land management practices. This philosophy allows the creeks to recreate natural habitat environments without active intervention. Engineered restoration efforts are not desirable since they rely on heavy construction methods and typically do not function as well as naturally occurring changes. In addition, these methods normally require continued maintenance since they do not result in a self-sustaining ecosystem. Releasing flows that mimic the natural conditions will create favorable fish habitat environments and promote riparian recovery. LADWP's draft plan was an attempt to release flows similar to those experienced above LADWP facilities. However, many parties argued that promotion of the natural restoration processes requires LADWP to adopt the stream scientists' recommended flows. This was expressed verbally at the stream TAG meeting on January 9, 1996, and in written comments to LADWP' draft Stream Restoration and Grant Lake Operations and Management plans.

LADWP's draft plan complied with or exceeded all instream and channel maintenance flow requirements of Decision 1631. The highlights of LADWP's proposed Mono Basin creek releases are identified below:

<u>Rush Creek</u>

- Release only the instream base flows during dry years with no channel maintenance flows.
- Increase the summer base flows and channel maintenance flows above Decision 1631 requirements for the normal, wet-normal, wet, and extreme year types.
- Spill Grant Lake Reservoir in extreme years to achieve maintenance flows higher than LADWP facilities allow.

<u>Lee Vining Creek</u>

- Release instream base flows during dry years with no channel maintenance flows.
- Provide flow through conditions during peak flow events for dry-normal, normal, wet-normal year types.
- Provide flow through conditions during the entire year for extreme year types.

<u>Parker and Walker Creeks</u>

- Release instream base flows with no channel maintenance flows during dry year types.
- Flow through conditions during the entire year for all year types except dry years.

Most parties agreed with LADWP's proposed flow regimes for Lee Vining, Walker, and Parker creeks during the transition period; however, the parties expressed disagreement with the Rush Creek flow releases. Specifically, the comment was that LADWP channel maintenance flows were lower than those recommended by the stream scientists and are therefore, in their opinion, insufficient to accommodate a natural restoration process.

LADWP proposal was to increase the peak flows, above those required by Decision 1631, and also increase the summer base flows on Rush Creek. This approach was essentially a balance between the stream scientists and DFG recommendations. Unfortunately, there is an insufficient volume of water to adopt both the DFG and stream scientists recommendations and provide LADWP with 16,000 acre-feet export. There is a general agreement within the scientific community that the majority of natural restoration occurs during the peak flow events of the wetter years. However, the magnitude, frequency, and duration of flows necessary to initiate and sustain dynamic processes have not been clearly established or documented. Without clearly defined flow priorities, it is difficult to determine what minimum releases or flow reductions would continue the natural restoration process in Rush Creek. Therefore, LADWP attempted to develop a reasonable compromise working within the parameters established by Decision 1631 and within operational constraints of LADWP facilities. This resulted in a hydrograph that simulates the flows observed above Grant Lake reservoir.

Formation of the Ad Hoc Committee

During the January 9, 1996 TAG meeting, an ad hoc committee was formed to analyze various wetter year type flow scenarios for Rush Creek. The ad hoc committee was given the task to determine what level of base and channel maintenance flows are appropriate for Rush Creek. The committee members included a representative from DFG and four stream scientists, Mr. Chris Hunter, Dr. William Platts, Dr. Richard Ridenhour, and Dr. William Trush. The committee held four conference calls and LADWP provided the committee with several GLOM runs for their evaluation. The conference calls focused on channel maintenance (peak) flows in Rush Creek. Unfortunately, the ad hoc committee did not have sufficient time to address Rush Creek base flows. The committee investigated three alternatives for increasing the channel maintenance flow: increasing Grant Lake reservoir spills to include wet years, modifying SCE operations, augmenting flows from Lee Vining Creek.

Increasing Grant Lake Spills

As stated previously, LADWP's draft plan included a proposal to spill Grant Lake reservoir in extreme years to allow the peak flows to pass through the reservoir. The ad hoc committee's first alternative increased the frequency of spills to include wet year types in addition to the extreme years. Unfortunately, the GLOM runs demonstrated that the spills would not achieve the flow magnitudes or duration desired by the stream scientists. The ad hoc committee concluded that increasing operational spills of Grant Lake reservoir to include wet years will not provide adequate channel maintenance flows on a reliable basis.

Modifying SCE Operations

The committee requested LADWP to investigate the possibility of modifying SCE operations during wet years to increase peak flows above Grant Lake. This is a variation of the first alternative since it also includes spilling Grant Lake to achieve the high maintenance flows. LADWP completed a GLOM analysis for this alternative, based on historic SCE operational data, and presented the findings to the committee. In summary, higher peaks could be released in lower Rush Creek in some years while in others they could not. To achieve the higher peaks, both SCE reservoirs and Grant Lake must be full when the peak flows occur. The unpredictable nature of peak flows precluded the committee from supporting this type of operation. A detailed discussion regarding SCE operations was presented previously under the heading "Alternatives Considered but Not Incorporated into the Grant Lake Operations and Management Plan".

Augmentation from Lee Vining Creek

The last alternative, evaluated by the ad hoc committee, was to increase flows in Rush Creek without spilling Grant Lake reservoir. This alternative consists of diverting Lee Vining Creek and releasing the water directly into Rush Creek. LADWP prefers this alternative since it does not rely on Grant Lake spills or changes in SCE operations to release peak flows to Rush Creek.

To ascertain the reliability of this proposal, LADWP investigated the duration of flows available after the peak occurs on Lee Vining Creek. Table P lists the number of days, immediately following and seven days after the peak, that Lee Vining Creek exceeded the indicated flow. The intervals selected for each year type satisfy both minimum instream releases for Lee Vining Creek and the additional water required to increase Rush Creek channel maintenance flows. There appears to be a marginal window of opportunity for the 1982 extreme year. Although the flows fell below 200 cfs to a minimum of 194 cfs during a six day period, flows in excess of 200 cfs resumed for an additional 23 days following the slight reduction. Diverting more water from Lee Vining Creek to achieve even higher flows on Rush Creek is possible but, would compromise the reliability of this operation.

In extreme years, higher channel maintenance flows could be achieved by spilling Grant Lake reservoir in conjunction with the Lee Vining Creek augmentation. LADWP provided the ad hoc committee with GLOM runs for this alternative and the response was generally favorable. The ad hoc committee summarized their recommendations for this alternative in a memorandum which is included in Appendix VII. A detailed discussion regarding the operations for this alternative are discussed below in the section titled "Operations of the Rush Creek Augmentation".

Table P

Lee Vining Creek Flow Available for Rush Creek Augmentation

Magnitude and Duration after Peak Flow Occurs[1]

Extreme Year (Runoff > 160%)

Runoff Year	Peak Flow (cfs)	Date	Consecutive days above 200cfs: Immediately after peak	Consecutive days above 200cfs: 7 days after peak	Consecutive days above 100cfs: Immediately after peak	Consecutive days above 100cfs: 7 days after peak
1967 (163%)	520	7/4/67	16	9	34	27
1969 (175%)	417	6/4/69	53	46	77	70
1982 (174%)	377	6/18/82	13	6	>43	>36
1983 (196%)	469	6/18/83	>43	>36	>43	>36
1995 (172%)[2]	236	6/27/95	20	13	52	45

Wet Year (136.5% < Runoff < 170%)

Runoff Year	Peak Flow (cfs)	Date	Consecutive days above 150cfs: Immediately after peak	Consecutive days above 150cfs: 7 days after peak	Consecutive days above 100cfs: Immediately after peak	Consecutive days above 100cfs: 7 days after peak
1941 (150%)	389	6/16/41	45	38	47	40
1952 (144%)	380	6/8/52	54	47	64	57
1956 (138%)	368	6/29/56	33	26	34	25
1978 (147%)	328	6/9/78	52	22	52	22
1980 (139%)	447	7/1/80	>30	>23	>30	>23
1986 (186%)	455	6/1/86	46	39	46	39

Wet-Normal Year (107% < Runoff < 136.5%)

Runoff Year	Peak Flow (cfs)	Date	Consecutive days above 100cfs: Immediately after peak	Consecutive days above 100cfs: 7 days after peak
1942 (136%)	345	6/19/42	59	52
1943 (124%)	501	6/1/43	67	60
1945 (121%)	293	6/30/45	44	37
1958 (129%)	327	6/24/58	54	47
1962 (108%)	258	6/14/62	39	32
1963 (113%)	399	6/18/63	37	30
1965 (117%)	297	7/7/65	26	19
1973 (109%)	293	6/9/73	28	21
1974 (108%)	314	6/7/74	34	27
1984 (121%)	290	5/31/84	>61	>54
1984 (121%)	402	7/19/84	>12	>5

Notes:

[1] Flow records prior to 1973 are based on Lee Vining Creek 2.5 mi. above Ranger Station and flow records after 1973 are based on Lee Vining Creek above Intake.

[2] Runoff based on May 1, 1995 forecast.

Revisions to Streamflow Proposal

Subsequent to receiving the ac hoc committee recommendations, LADWP revised its flow management proposal to include the operational scenario for diverting Lee Vining Creek water to increase channel maintenance flows for Rush Creek. LADWP final flow management proposal incorporates the ad hoc committee's recommended maintenance flows during the extreme, wet, and wet-normal years, and for a portion of the normal years. LADWP did not adopt the ad hoc committee's flow recommendations for the lower end of the normal year and in the dry-normal and dry years since the Rush Creek channel maintenance flow recommendations will result in reduced exports to Los Angeles. The flow adjustments made to the drier year types are consistent with some of the stream scientists recommendation for reducing the volume of peak flow.

Opinions differ within the scientific community regarding the effectiveness of channel maintenance flows in the drier year types. Some believe that channel maintenance flows during dry years are unnecessary and question the benefits for providing such flows. This is demonstrated by the stream scientists since they identify elimination of the dry year maintenance flow requirements as an alternative for reducing the total volume of water (Scientists 174). As stated earlier, there is scientific agreement that the majority of natural restoration occurs during the peak flows in wetter years. Decision 1631 acknowledges this since Rush Creek channel maintenance flows are not required in dry and dry-normal years.

Changes to LADWP's flow management reflect some of the recommendations provided by the ad hoc committee regarding channel maintenance flows. The ad hoc committee did not provide recommendations regarding base flow for Rush Creek except for a brief discussion for the dry years. Regardless, LADWP's final proposal, provides high maintenance flows and increases summer base flows in normal, wet-normal, wet, and extreme years to more closely imitate the inflow to Grant Lake reservoir (Rush Creek at Damsite).

IX. Grant Lake Operations Plan

In order to assist in analyzing proposals for operating Grant Lake reservoir, and the impacts to Grant Lake reservoir storage, Mono Basin creeks, and exports to the upper Owens River, the LADWP developed the Grant Lake Operations Model (GLOM). GLOM is a computer spreadsheet model which can simulate Mono Basin operations on an annual basis. The first series of GLOM runs were completed and distributed to interested parties in July 1995. After developing the initial streamflow proposal, the proposal went through several iterations based on input from the parties and stream restoration scientists.

The final streamflow proposal considered all the information, input, and concerns of the parties and stream restoration scientists. In general, the proposal recommends a general streamflow release pattern that offers flexibility and that can be fined tuned each year based on the projected runoff and operational constraints. During the transition period, the proposal recommends higher baseflows and flushing flows than mandated in Decision 1631.

The assumptions and goals of the final proposal are listed below. Also listed are the various alternatives, based on input from the parties, considered in the development of the final proposal.

Assumptions Regarding Grant Lake Operations and Management

1. Decision 1631 minimum streamflow requirements, flushing flows, and ramping rates are in effect for each Mono Basin creek, and the upper Owens River.
2. In the no export scenario, no streamflows will be diverted from Lee Vining, Walker, or Parker creeks.
3. In the 4,500 acre-foot export scenario, no streamflows will be diverted from Walker or Parker creeks.
4. In dry years, Grant Lake reservoir storage may be reduced to meet minimum streamflow requirements, and in wet and extreme years, Grant Lake reservoir storage may be increased.
5. Maximum Grant Lake outflow to lower Rush Creek is about 350 cfs (via the Mono Gate No. 1 Return Ditch).
6. A maximum of 150 cfs (in extreme years) may be diverted from Lee Vining Creek to augment peak flows on lower Rush Creek
7. The October through March Grant Lake outflow into lower Rush Creek will be constant in a given year, but will not necessarily be the same for each year within a year-type classification.
8. The maximum Grant Lake outflow to lower Rush Creek will be about 100 cfs from the October through March period. This would only occur in extreme years.

Operations of the Rush Creek Augmentation

Due to the limited capacity to release water from Grant Lake, LADWP will implement an operational program to release peak flows to lower Rush Creek that approximate the flows recommended by the stream scientists. The goal for this mode of operation will be to maintain the peak flows on Lee Vining Creek while at the same time maximizing the peak flows on lower Rush Creek. Unlike Lee Vining Creek releases, Grant Lake storage provides flexibility to release peak flows on Rush Creek at any time. This method of operation consists of diverting Lee Vining Creek to augment Mono Gate Return Ditch flows. Flows would be released to Rush Creek through the Lee Vining Conduit spillway. To maintain peak flows in Lee Vining Creek, diversions would commence at least 7 days after the peak occurs. LADWP determined that such a release is operationally feasible with existing facilities and the procedure would occur as follows:

1. Close the check gate at the terminus of the Lee Vining Conduit (at Grant Lake Reservoir). Closing this gate will cause diverted water to backup inside the Lee Vining Conduit and eventually reaching the conduit spillway structure immediately upstream of Sand Trap #5.
2. Begin diverting Lee Vining Creek 7 days following its peak. The diversions will cause the water elevation in the conduit to rise until the water surface elevation exceeds the spillway elevation.
3. Spilling will commence via the spillway structure. Similar to a reservoir filled to capacity, releases from the spillway will essentially equal the amount diverted. The conduit spillway empties into a channel which then conveys the water to the confluence of Rush Creek, Mono Gate Return Ditch, and Grant Lake spillway where it would directly contribute to Rush Creek flows. Spills can be ramped by regulating the diversions from Lee Vining Creek.
4. Continue diversions to satisfy Rush Creek peak flow requirements as outlined in LADWP's revised flow management proposal.
5. Cease diversions from Lee Vining Creek and resume flow through conditions.
6. Open the check gate to drain the remaining water in the conduit to Grant Lake reservoir.

The augmentation would only occur during wet-normal, wet, and extreme year types and requires the rehabilitation of Mono Gate Return Ditch capacity of 380 cfs. Table Q summarizes the amount of water required from Lee Vining Creek to augment Rush Creek peak flows to the magnitude indicated. Rush Creek will peak approximately 2 weeks after the peak on Lee Vining Creek under this type of operation. The entire augmentation cycle, including ramping, would span approximately 20 days.

Table Q

Lee Vining Creek Water Requirements for Rush Creek Peak Flow Augmentation

Year Type	Lee Vining Creek Diversions[1] (for Rush Creek Augmentation)	Rush Creek Channel Maintenance Flows
Wet-Normal	50 cfs for 5 days	400 cfs for 5 days and 350 cfs for 10 days
Wet	100 cfs for 5 days and 50 cfs for 10 days	450 cfs for 5 days and 400 cfs for 10 days
Extreme	150 cfs for 5 days and 100 cfs for 10 days	500 cfs for 5 days and 400 cfs for 10 days

Note:
[1] Diversions will commence approximately 7 days after peak flow occurs.

Grant Lake Operations and Management Goals

Decision 1631 allows LADWP to export 16,000 acre-feet in the transition period when Mono Lake elevation is between 6380 ft and 6391 ft. The 16,000 acre-feet export and the minimum instream flow requirements required by Decision 1631 account for approximately 92,000 acre-feet. The average runoff for Rush, Lee Vining, Walker, and Parker creeks is approximately 122,000 acre feet based on the 1941-1990 period. As such, LADWP is required to release an additional 30,000 acre-feet to raise the Mono Lake. This additional water is termed "Mono Lake maintenance water", since it must be released above and beyond the instream flow requirements specifically for lake purposes. One function of the Grant Lake Operations and Management Plan is to illustrate how LADWP will manage and apportion this additional lake level maintenance water.

LADWP's proposed stream flow plan supports the philosophy of providing natural restoration processes as presented in the Stream and Stream Channel Restoration Plan. The restoration processes result from releasing stream flows which hydrologically mimic natural flow characteristics. Details regarding specific operations are outlined in the "Operational Guidelines" Section.

The Grant Lake Operations and Management Plan addresses four separate, but interrelated, operational components. These components include Grant Lake Reservoir storages, Lee Vining Conduit diversions, Mono Basin exports to the upper Owens River, and Mono Basin stream flows. The operational guidelines were developed using Decision 1631 as the base. Other details of the plan were developed from comments and recommendations received from interested parties, governmental agencies, scientific experts, and the general public. The guidelines contain goals and targets and as such, they should not be construed as absolute operational requirements.

In addition, LADWP established operating targets and goals for Mono Basin exports, Lee Vining Conduit diversions, and Grant Lake Reservoir storage. All these guidelines and goals will be used as the starting point for planning Mono Basin operations at the beginning of each runoff year.

Grant Lake Reservoir

The target Grant Lake Reservoir storage for the beginning and ending of each runoff year will be between 30,000 and 35,000 acre-feet. This storage level will provide the opportunity to spill Grant Lake in extreme years, resulting in peak flows in excess of 500 cfs. Additional benefits for maintaining Grant Lake at this storage includes maintaining a popular fishery, providing better boating conditions, keeping lower Rush Creek temperatures lower, providing protection for migrating fish in the upper reaches of Grant Lake, deterring vehicular access to the lake shore, and reliability of exports during drought periods. As can be expected, significant decreases or increases from the target storage level occur only after extremely dry or wet years, respectively. Annual fluctuations of Grant Lake storage during most year types will average approximately 10,000 acre-feet. Finally, the minimum operating level for Grant Lake Reservoir storage will be approximately 12,000 acre-feet.

Mono Basin Exports / Upper Owens River Releases

Decision 1631 established three different export scenarios for the transition period when Mono Lake elevation is rising to 6392 feet. The April 1 Mono Lake elevation dictates available export. The goal is to provide a beneficial pattern of release to the upper Owens River. Typical operations for each export scenario is provided below:

- No exports permitted -- Mono Lake elevation below 6377 ft
- 4,500 acre-feet of export -- Mono Lake elevation between 6377 ft and 6380 ft

  The goal during the 4,500 acre-feet export scenario will be to release 25 cfs to the upper Owens River for a 90 day period. Similar to 1995, the 90-day period will typically begin in August and extend through October. The purpose of this pattern of release is to extend the peak flows on the upper Owens River.

- 16,000 acre-feet of export -- Mono Lake elevation between 6380 ft and 6391 ft

  The goal during the 16,000 acre-feet export scenario will be to release 22 cfs to the upper Owens River for the entire year. This pattern minimizes fluctuations and simulates the natural spring fed patterns of the upper Owens River.

During normal year types, LADWP is proposing to release the capacity of the Grant Lake outflow, approximately 380 cfs for a 5 day period, directly into lower Rush Creek. Accordingly, this release requires termination of Mono Basin exports for 5 days. Taking into consideration the ramping rates, the entire operation should take approximately 15 days to complete - 10 days of ramping and 5 days of peak flow. Due to the slight reduction and brief termination of exports, the goal will be to continuously release 23 cfs to the upper Owens River in normal years.

LADWP recommends ramping rates of 20% ascending and 10% descending for the flow changes in the upper Owens River; however, facility constraints at Mono Gate #1 limit the ramping to approximately 10 cfs increments. Therefore, ramping of Mono Basin exports will occur at the recommended ramping rates or at incremental changes of 10 cfs, whichever is greater. See the section entitled "Physical Limitations" under the heading of "Operational Constrains" for a detailed discussion regarding limitations of ramping rates.

Lee Vining Conduit Diversions

During the 4,500 acre-foot export scenario, Rush and Lee Vining creeks will be equally diverted, to the extent practical, in dry, dry-normal, and normal years. In wet-normal, wet, and extreme years, flows will be solely diverted from Rush Creek.

During the 16,000 acre-feet export scenario, the annual target for Lee Vining conduit diversions is 6,000 acre-feet in all year types, except extreme years. Diversions will primarily come from Lee Vining Creek; however, in dry years, Walker and Parker creeks will contribute approximately 1,500 acre-feet to the 6,000 acre-feet target. In wet-normal, wet, and extreme years, Lee Vining Creek will be diverted to augment Rush Creek peak flows. The additional water for augmentation does not apply towards exports since the water remains in the Mono Basin and is released to Mono Lake.

Mono Basin Streamflow Management

LADWP's streamflow management proposal is consistent with the philosophy of allowing the creeks to provide the energy for restoration. This plan is also consistent with the stream scientists recommendations for providing high channel maintenance flows to the Mono Basin creeks. Significant goals of LADWP's stream flow management, as they pertain to stream channel and riparian restoration, include:

- Lee Vining Creek will experience its natural peak flow in all years, except in dry years.

- Lee Vining Creek diversions will occur on the ascending and/or descending limb of peak flows.
- Rush Creek will experience peak flows in excess of the impaired flows in the wetter year types.
- Walker and Parker Creeks will experience their natural flow for the entire year, except in dry years.

Tables R and S below summarize LADWP's proposed streamflow management plan for instream base and channel maintenance flows, respectively.

Table R

LADWP Proposed Base Flow Releases for Mono Basin Creeks

(all values in cfs)

		Decision 1631[2]		LADWP Proposed[3]						
Creek	Year-Type[1]	Apr-Sept	Oct-Mar	Apr	May	June	July	Aug	Sept	Oct-Mar
Rush	Dry	31	36	31	31	31	31	31	31	36
	Dry-Normal	47	44	47	47	47	47	47	47	44
	Normal	47	44	50	75	75	75	50	50	45
	Wet-Normal	47	44	50	100	100	100	50	50	45
	Wet	68	52	80	150	150	150	80	80	55
	Extreme	68	52	80	150	150	150	150	100	100
Lee Vining	Dry	37	25	37	37	37	37	37	37	25
	Normal & Wet	54	40	54	54	54	54	54	54	40
	Extreme	54	40	Flow through conditions for the entire year						
Parker	Dry	9	6	9	9	9	9	9	9	6
	Normal, Wet, & Extreme	9	6	Flow Through conditions for the entire year						
Walker	Dry	6	4.5	6	6	6	6	6	6	4.5
	Normal, Wet, & Extreme	6	4.5	Flow through conditions for the entire year						

Notes:

[1] Year Types are based on 1941-1990 average runoff of 122,124 acre-feet and are defined as follows:

Dry	less than 68.5% of average runoff	
Normal	Dry-Normal	between 68.5% and 82.5% of average runoff
	Mid-Normal	between 82.5% and 107% of average runoff
	Wet-Normal	between 107% and 136.5% of average runoff
Wet	between 136.5% and 160% of average runoff	
Extreme	greater than 160% of average runoff	

[2] Decision 1631 instream flows are minim requirements.

[3] Adjustments to LADWP proposed instream flows may occur during the runoff year.

Table S

LADWP Proposed Channel Maintenance Flows for Mono Basin Creeks

Creek	Year-Type[1]	Channel Maintenance Flows	
		Decision 1631[2]	LADWP Proposed[3]
Rush	Dry	None	None
	Dry-Normal	None	100 cfs for 5 days
	Normal	200 cfs for 5 days	250 cfs for 5 days *or* 380 cfs for 5 days & 300 cfs for 7 days
	Wet Normal	300 cfs for 2 days & 200 cfs for 10 days	400 cfs for 5 days & 350 cfs for 10 days
	Wet	300 cfs for 2 days & 200 cfs for 10 days	450 cfs for 5 days & 400 cfs for 10 days
	Extreme	300 cfs for 2 days & 200 cfs for 10 days	500 cfs for 5 days & 400 cfs for 10 days
Lee Vining	Dry	None	None
	Normal	160 cfs for 3 days	Allow peak flows to pass
	Wet	160 cfs for 30 days	Allow peak flows to pass
	Extreme	160 cfs for 30 days	Flow through conditions
Parker	Dry	None	None
	Normal, Wet, & Extreme	25-40 cfs for 1-4 days	Flow through conditions
Walker	Dry	None	None
	Normal, Wet, & Extreme	15-30 cfs for 1-4 days	Flow through conditions

Notes:
[1] Year Types are based on 1941-1990 average runoff of 122,124 acre-feet and are defined as follows:

Dry	less than 68.5% of average runoff	
Normal	Dry-Normal	between 68.5% and 82.5% of average runoff
	Mid-Normal	between 82.5% and 107% of average runoff
	Wet-Normal	between 107% and 136.5% of average runoff
Wet	between 136.5% and 160% of average runoff	
Extreme	greater than 160% of average runoff	

[2] Decision 1631 channel maintenance flows are minim requirements.
[3] Channel maintenance flows will be augmented with Lee Vining Creek diversions in wet-normal, wet, and extreme years.

Year Type Designations

Year type designations for the Mono Basin creek releases are a function of the runoff forecast. LADWP developed seven operational planning guidelines for the Mono Basin creeks corresponding to the different year types identified by Decision 1631. The 1941-1990 period will serve as the base period for the average runoff. Normal runoff for the base period is 122,124 acre-feet for Rush, Lee Vining, Walker, and Parker creeks. LADWP's May 1 runoff forecast will provide an expected volume of runoff for the Mono Basin. Based on the forecast results, LADWP will prepare a proposed release using the corresponding operational guideline. Preliminary base flows for Rush and Lee Vining creeks will be established on the April 1 forecast. These base flows will be adjusted after the final May 1 forecast is issued. In addition to incorporating the year types defined by the SWRCB, LADWP created one additional year type, the extreme year, and divided the normal year into two subsets of normal year established by the SWRCB. The proposed flows meet or exceed all Decision 1631 instream and channel maintenance flow requirements. Table T below will be used to determine which operational planning guideline to follow based on the year type designation.

Table T

Year Type Designations based on Runoff Forecast

% of Normal Runoff[1]	May 1 Forecast Volume of Runoff (acre-feet)	Year Type Designation	Planning Guideline
≤ 68.5%	≤ 83,655	Dry	A
68.5% < - ≤ 82.5%	83,655 < - ≤ 100,750	Dry-Normal	B
82.5% < - ≤ 95%	100,750 < - ≤ 116,020	Normal I	C
95% < - ≤ 107%	116,020 < - ≤ 130,670	Normal II	D
107% < - ≤ 136.5%	130,670 < - ≤ 166,700	Wet-Normal	E
136.5% < - ≤ 160%	166,700 < - ≤ 195,400	Wet	F
> 160%	> 195,400	Extreme	G

Notes

[1] Based on 1941-1990 average runoff of 122,124 acre-feet.

Operational Planning Guidelines

The following pages outline the planning guidelines for LADWP operations for each year type. Appendix III contains GLOM runs for each of the representative year types, and also contains a summary sheet for the series of runs which highlights the amount of diversions for each creek, the amount of export, and beginning and ending Grant Lake storage. GLOM runs for the no export and 4,500 acre-feet export scenarios are not provided; however, the same concept of releasing higher baseflows and higher maintenance flows applies to those scenarios. LADWP's operational guidelines meet or exceed all Decision 1631 instream and channel maintenance flow requirements Table U below shows the average annual diversions from the Mono Basin creeks for the 16,000 acre-feet export runs.

Table U

Average Annual Diversions During 16,000 AF GLOM Runs

(all values in acre-feet)

Year-Type	Average Annual Diversions				
	Rush[1]	Lee Vining	Walker	Parker	***Total***
Dry	8,781	5,578	694	947	***16,000***
Dry-Normal	10,783	5,217	0	0	***16,000***
Normal	9,140	6,860	0	0	***16,000***
Wet-Normal	9,167	6,833	0	0	***16,000***
Wet	8,641	7,360	0	0	***16,000***
Extreme	16,000	0	0	0	***16,000***
Weighted Avg.	***9,744***	***5,928***	***139***	***189***	***16,000***
Average Runoff[2]	***59,234***	***48,472***	***5,354***	***9,065***	***122,125***
Avg. % Diverted	***16%***	***12%***	***3%***	***2%***	***13%***

Notes:

1) Includes water taken out of storage from Grant Lake reservoir (if any).

2) Based on the fifty year average (1941-1990).

MONO BASIN OPERATIONS - PLANNING GUIDELINE A

Hydrologic Year Type:	Dry
Forecasted Volume of Runoff (acre-feet):	$\leq$ 83,655

LOWER RUSH CREEK

Instream Flows:

	Apr-Sept	Oct-Mar
Flow (cfs)	31	36

Minimum base flows will be those specified above when Grant Lake reservoir storage is greater than 11,500 acre-feet. If Grant Lake Reservoir storage is less than 11,500 acre-feet, then the base flow will equal the inflow to Grant Lake (Rush Creek at Dam Site).

Channel Maintenance Flows: None

LEE VINING CREEK

Instream Flows:

	Apr-Sept	Oct-Mar
Flow (cfs)	37	25

Minimum base flows will be those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: None

Lee Vining Conduit Diversions: Divert stream flows in excess of the base flows.

WALKER AND PARKER CREEKS

Instream Flows:

	Apr-Sept	Oct-Mar
Parker Creek (cfs)	9	6
Walker Creek (cfs)	6	4.5

Minimum base flows will be those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: None

Lee Vining Conduit Diversions: Divert stream flows in excess of the base flows.

MONO BASIN EXPORTS Constant 22 cfs export to the upper Owens River throughout the year.

MONO BASIN OPERATIONS - PLANNING GUIDELINE B

Hydrologic Year Type: Dry-Normal

Forecasted Volume of Runoff (acre-feet): 83,655 < - ≤ 100,750

LOWER RUSH CREEK

Instream Flows:

	Apr-Sept	Oct-Mar
Flow (cfs)	47	44

Minimum base flows are those specified above or the inflow to Grant Lake reservoir, whichever is less. However, if the inflow is less than the dry year instream flow requirements, then dry year base flow requirements apply (Refer to Schedule A).

Channel Maintenance Flows: 100 cfs for 5 days

- Begin ramping maintenance flows on May 15.
- Ramping rate: 10% change ascending and descending, or 10 cfs incremental change, whichever is greater.

LEE VINING CREEK

Instream Flows:

	Apr-Sept	Oct-Mar
Flow (cfs)	54	40

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: Allow peak flow to pass point of diversion

- Begin ramping for maintenance flows on May 15.
- Ramping rate: 20% change ascending and 15% change descending, or 10 cfs incremental change, whichever is greater.

Lee Vining Conduit Diversions:

- Divert flows in excess of base flows until May 15.
- Diversions may resume 7 days after peak flow occurs.

WALKER AND PARKER CREEKS

Instream Flows:

	Apr-Sept	Oct-Mar
Parker Creek (cfs)	9	6
Walker Creek (cfs)	6	4.5

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: Allow peak flow to pass point of diversion

Lee Vining Conduit Diversions: None

MONO BASIN EXPORTS Constant 22 cfs export to the upper Owens River throughout the year.

MONO BASIN OPERATIONS - PLANNING GUIDELINE C

Hydrologic Year Type: Normal I
Forecasted Volume of Runoff (acre-feet): 100,750 < - ≤ 116,020

LOWER RUSH CREEK

Instream Flows:

	Apr	May-Jul	Aug-Sept	Oct-Mar
Flow (cfs)	50	75	50	45

Minimum base flows are 47 cfs for the April through September period and 44 cfs for the October through March period, or the inflow to Grant Lake reservoir, whichever is less. If the inflow is less than the dry year instream flow requirements, then dry year base flow requirements apply (See Schedule A).

Channel Maintenance Flows: 250 cfs for 5 days

- Begin ramping maintenance flows on June 1.
- Ramping rate: 10% change ascending and descending, or 10 cfs incremental change, whichever is greater.

LEE VINING CREEK

Instream Flows:

	Apr-Sept	Oct-Mar
Flow (cfs)	54	40

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: Allow peak flow to pass point of diversion

- Begin ramping for maintenance flows on May 15.
- Ramping rate: 20% change ascending and 15% change descending, or 10 cfs incremental change, whichever is greater.

Lee Vining Conduit Diversions:

- Divert flows in excess of base flows until May 15.
- Diversions may resume 15 days after peak flow occurs.

WALKER AND PARKER CREEKS

Instream Flows:

	Apr-Sept	Oct-Mar
Parker Creek (cfs)	9	6
Walker Creek (cfs)	6	4.5

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: Allow peak flow to pass point of diversion

Lee Vining Conduit Diversions: None

MONO BASIN EXPORTS Constant 22 cfs export to the upper Owens River throughout the year.

MONO BASIN OPERATIONS - PLANNING GUIDELINE D

Hydrologic Year Type: Normal II

Forecasted Volume of Runoff (acre-feet): 116,020 < - ≤ 130,670

LOWER RUSH CREEK

Instream Flows:

	Apr	May-Jul	Aug-Sept	Oct-Mar
Flow (cfs)	50	75	50	45

Minimum base flows are 47 cfs for the April through September period and 44 cfs for the October through March period, or the inflow to Grant Lake reservoir, whichever is less. If the inflow is less than the dry year instream flow requirements, then dry year base flow requirements apply (See Schedule A).

Channel Maintenance Flows: 380 cfs for 5 days & 300 cfs for 7 days

- Begin ramping maintenance flows on June 1.
- Ramping rate: 10% change ascending and descending, or 10 cfs incremental change, whichever is greater.

LEE VINING CREEK

Instream Flows:

	Apr-Sept	Oct-Mar
Flow (cfs)	54	40

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: Allow peak flow to pass point of diversion

- Begin ramping for maintenance flows on May 15.
- Ramping rate: 20% change ascending and 15% change descending, or 10 cfs incremental change, whichever is greater.

Lee Vining Conduit Diversions:

- Divert flows in excess of base flows until May 15.
- Diversions may resume 15 days after peak flow occurs.

WALKER AND PARKER CREEKS

Instream Flows:

	Apr-Sept	Oct-Mar
Parker Creek (cfs)	9	6
Walker Creek (cfs)	6	4.5

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: Allow peak flow to pass point of diversion

Lee Vining Conduit Diversions: None

MONO BASIN EXPORTS Constant 23 cfs export to the upper Owens River throughout the year, except during peak flows for lower Rush Creek when exports will be reduced to zero. Ramping for the upper Owens River will occur at 10 cfs increments and during a one week interval.

MONO BASIN OPERATIONS - PLANNING GUIDELINE E

Hydrologic Year Type: Wet-Normal

Forecasted Volume of Runoff (acre-feet): 130,670 < - ≤ 166,700

LOWER RUSH CREEK

Instream Flows:

	Apr	May-Jul	Aug-Sept	Oct-Mar
Flow (cfs)	50	100	50	45

Minimum base flows are 47 cfs for the April through September period and 44 cfs for the October through March period, or the inflow to Grant Lake reservoir, whichever is less. If the inflow is less than the dry year instream flow requirements, then dry year base flow requirements apply (See Schedule A).

Channel Maintenance Flows: 400 cfs for 5 days & 350 cfs for 10 days

- Begin ramping maintenance flows when Lee Vining Creek peaks.
- Maintenance flow augmented with 50 cfs from Lee Vining Creek for 5 days.
- Ramping rate: 10% change ascending and descending, or 10 cfs incremental change, whichever is greater.

LEE VINING CREEK

Instream Flows:

	Apr-Sept	Oct-Mar
Flow (cfs)	54	40

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: Allow peak flow to pass point of diversion

- Ramping rate: 20% change ascending and 15% change descending, or 10 cfs incremental change, whichever is greater.

Lee Vining Conduit Diversions:

- Divert flows in excess of the base flow until May 15.
- Begin Rush Creek augmentation 7 days after peak flow occurs (50 cfs).
- Resume flow through conditions for 10 days following Rush Creek augmentation.
- Diversions may resume following the 10 day flow through period.

WALKER AND PARKER CREEKS

Instream Flows:

	Apr-Sept	Oct-Mar
Parker Creek (cfs)	9	6
Walker Creek (cfs)	6	4.5

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: Allow peak flow to pass point of diversion

Lee Vining Conduit Diversions: None

MONO BASIN EXPORTS Constant 22 cfs export to the upper Owens River throughout the year.

MONO BASIN OPERATIONS - PLANNING GUIDELINE F

Hydrologic Year Type: Wet
Forecasted Volume of Runoff (acre-feet): 166,700 < - ≤ 195,400

LOWER RUSH CREEK

Instream Flows:

	Apr	May-Jul	Aug-Sept	Oct-Mar
Flow (cfs)	80	150	80	50

Minimum base flows are 68 cfs for the April through September period and 52 cfs for the October through March period, or the inflow to Grant Lake reservoir, whichever is less. If the inflow is less than the dry year instream flow requirements, then dry year base flow requirements apply (See Schedule A).

Channel Maintenance Flows: 450 cfs for 5 days & 400 cfs for 10 days

- Begin ramping maintenance flows when Lee Vining Creek peaks.
- Maintenance flow augmented with 100 cfs and 50 cfs from Lee Vining Creek for 5 and 10 days, respectively.
- Ramping rate: 10% change ascending and descending, or 10 cfs incremental change, whichever is greater.

LEE VINING CREEK

Instream Flows:

	Apr-Sept	Oct-Mar
Flow (cfs)	54	40

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: Allow peak flow to pass point of diversion

- Ramping rate: 20% change ascending and 15% change descending, or 10 cfs incremental change, whichever is greater.

Lee Vining Conduit Diversions:

- Divert flows in excess of the base flow until May 15.
- Begin Rush Creek augmentation 7 days after peak flow occurs (100 cfs & 50 cfs).
- Resume flow through conditions for 10 days following Rush Creek augmentation.
- Diversions may resume following the 10 day flow through period.

WALKER AND PARKER CREEKS

Instream Flows:

	Apr-Sept	Oct-Mar
Parker Creek (cfs)	9	6
Walker Creek (cfs)	6	4.5

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

Channel Maintenance Flows: Allow peak flow to pass point of diversion

Lee Vining Conduit Diversions: None

MONO BASIN EXPORTS Constant 22 cfs export to the upper Owens River throughout the year.

MONO BASIN OPERATIONS - PLANNING GUIDELINE G

Hydrologic Year Type:	Extreme
Forecasted Volume of Runoff (acre-feet):	> 195,400

LOWER RUSH CREEK

<u>Instream Flows:</u>

	Apr	May-Aug	Sept-Mar
Flow (cfs)	80	150	100

Minimum base flows are 68 cfs for the April through September period and 52 cfs for the October through March period, or the inflow to Grant Lake reservoir, whichever is less. If the inflow is less than the dry year instream flow requirements, then dry year base flow requirements apply (See Schedule A).

<u>Channel Maintenance Flows:</u> 500 cfs for 5 days & 400 cfs for 10 days

- Begin ramping maintenance flows when Lee Vining Creek peaks.
- Maintenance flow augmented with 150 cfs and 50 cfs from Lee Vining Creek for 5 and 10 days, respectively.
- Maintenance flows may be augmented with Grant Lake spill.
- Ramping rate: 10% change ascending and descending, or 10 cfs incremental change, whichever is greater.

LEE VINING CREEK

<u>Instream Flows:</u>

	Apr-Sept	Oct-Mar
Flow (cfs)	54	40

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

<u>Channel Maintenance Flows:</u> Allow peak flow to pass point of diversion

- Ramping rate: 20% change ascending and 15% change descending, or 10 cfs incremental change, whichever is greater.

<u>Lee Vining Conduit Diversions:</u>

- Begin Rush Creek augmentation 7 days after peak flow occurs (150 cfs & 50 cfs).
- Resume flow through conditions after completing of Rush Creek augmentation.

WALKER AND PARKER CREEKS

<u>Instream Flows:</u>

	Apr-Sept	Oct-Mar
Parker Creek (cfs)	9	6
Walker Creek (cfs)	6	4.5

Minimum base flows are those specified above or the stream flow at the point of diversion, whichever is less.

<u>Channel Maintenance Flows:</u> Allow peak flow to pass point of diversion

<u>Lee Vining Conduit Diversions:</u> None

MONO BASIN EXPORTS Constant 22 cfs export to the upper Owens River throughout the year.

Dry and Wet Cycle Contingency Measures

The preceding operational planning guidelines were developed using the GLOM, which is a one year model, based on daily changes. A disadvantage with the GLOM is that it is not effective at modeling dry cycles and wet cycles which are typical in the Mono Basin. In consideration of these cycles, LADWP developed a dry cycle and wet cycle contingency plan.

Dry Cycle

When two or more dry years occur consecutively, LADWP will release channel maintenance flows every other year. These releases will commence in the second consecutive year and will continue every other dry year thereafter (i.e. on the second, fourth, etc.). The occurrence of a year type other than a dry year will terminate the dry year cycle and the corresponding channel maintenance flows for that year type will be released. Dry cycle maintenance flows will be 100 cfs for 5 days on Rush Creek and 75 cfs for 5 days on Lee Vining Creek. Due to facility constraints, ramping rates, both ascending and descending, for these maintenance flows will be at 10 cfs increments. Sample GLOM runs for the two driest - 1976 and 1977 - consecutive years on record are included in Appendix V. The runs showed that 16,000 acre-feet could be exported during the first year but exports during the second year would be limited to 12, 325 acre-feet the second year. The reduction during the second year occurs since exports are curtailed when Grant Lake reservoir storage approaches 12,000 acre-feet.

Wet Cycle

When two or more wet years occur consecutively, LADWP will release higher base flows in Rush Creek throughout the year. The higher base flows will commence on the second year and will continue every year thereafter until desired storage levels are achieved. The occurrence of a year other than a wet year will terminate this release pattern; however, it may be necessary to continue the increased base flows for one additional year to reduce Grant Lake reservoir storage to its target between 30,000 and 35,000 acre-feet. During such a wet cycle, LADWP will not export water above the 16,000 acre-feet export permitted by Decision 1631 in the transition period. All excess water will remain in Grant Lake for future export or released to Mono Lake. Sample GLOM runs for the two wettest - 1982 and 1983 - consecutive years on record are also included in Appendix V. For the two wettest years, the runs indicate that Grant Lake spills in the second year providing a peak flow in excess of 675 cfs.

X. Potential Deviations from the Grant Lake Operations and Management Plan

The Grant Lake Operations and Management Plan is intended to guide and plan the future operations of LADWP's facilities in the Mono Basin. LADWP developed operational planning guidelines for releasing water into Rush, Lee Vining, Walker, and Parker Creeks. Stated as such, the guidelines support the goals and targets for Grant Lake reservoir management, Lee Vining conduit diversions, upper Owens River releases, and Mono Basin stream flows. LADWP's plan will attempt to provide the proposed flows, however, operational changes or adjustments to these flow will be necessary throughout the year. It is unrealistic for LADWP to be confined to rigid operational schedules. Flexibility must be maintained to account for changes in meteorologic conditions, operational and physical constraints, errors in forecasting, and for emergency situations. The operational schedules provided herein are not minimum requirements but rather, are recommended flow patterns. All minimum flow requirements are established by Decision 1631.

The most frequent type of change would be to increase or decreased the instream baseflows on Rush Creek following the peak. LADWP will make these changes to reach the target for Grant Lake storage (between 30,000 and 35,000 acre-feet). Such a change may occur at any time during the runoff year[15]. In addition to adjusting the base flows, it may be necessary to depart from the proposed channel maintenance flows for lower Rush Creek in the wetter year types. This action will be less frequent than the changes in base flow, but still must be acknowledged. Changes in peak flows may be either unintentional or intentional.

For example, an involuntary reduction will occur when there is insufficient water available from Lee Vining Creek to perform the Rush Creek augmentation or if the window for diverting the peak passes. However, historic records indicate that there is sufficient water and opportunity to support the augmentation, but the possibility of not meeting the recommended flows still exists.

If a readily apparent discrepancy exists between the forecasted and the actual runoff, LADWP may consider it necessary to reduce the channel maintenance flows. As an example, in 1993 LADWP's runoff forecast for the Mono Basin was 135% of normal while the actual runoff was closer to 115% of normal. This represents an error of approximately 15%; an approximately 24,000 acre-feet difference between the forecasted and actual runoff. Although this example did not result in a change in year type, a forecast which is on the border of two different year types will have a greater effect on reducing the base flow during the remainder of the runoff year.

Unfortunately, it is impossible to anticipate all the situations, events and circumstances that may require changes to the plan. Adjustments must be made as the runoff season progresses. Further, when emergency situations arise, the operator needs to make

[15] The runoff year is typically defined as the April 1 to March 31 period.

immediate adjustments to the plan. Such emergencies include structural failures or sudden heavy rainfall events. The operator must have sufficient flexibility to respond to those emergencies. Other emergencies may not be as immediate, but may be just as critical. For example, if an earthquake occurred blocking a major aqueduct into Southern California, exports from the Mono Basin might be temporarily increased instead of remaining constant. Therefore, LADWP must maintain reasonable flexibility in operating its facilities to adjust or react to unpredictable circumstances.

XI. Impacts and Evaluations of Grant Lake Operations and Management Plan

Post Transition Effects

The final Grant Lake Operations and Management Plan does not include post transition operations. There are three reasons for not including post transition operations in the final plan:

- The draft plan neglected significant considerations regarding Mono Lake maintenance flows;
- This plan is a working document and is subject to periodic reviews and revisions
- There are too many uncertainties regarding the restoration efforts, ecosystem responses, and the length of time required to raise Mono Lake to 6,391 feet.

The draft Grant Lake Operations and Management Plan excluded Mono Lake maintenance flows for the post transition GLOM runs. Instead, the post transition GLOM examples, presented in the draft, were developed using minimum Decision 1631 flow requirements which underestimates actual flow releases. As discussed in Appendix II, there is a general misunderstanding that once the transition period is complete, LADWP will release only the minimum flows required by Decision 1631. This is not the case. Modeling results, performed by the SWRCB, indicate that the Mono Lake elevation would fluctuate between 6,388 feet and 6,390 feet if the minimum instream flows were released (SWRCB 158). Therefore, to maintain a target Mono Lake elevation of 6,392 feet, LADWP must release additional lake level maintenance water above the instream flow requirements. In a typical normal year during the transition period, LADWP must release 76,000 acre-feet for instream purposes and an additional 30,000 acre-feet to raise Mono Lake. However, maintenance water for Mono Lake is reduced to approximately 16,000 acre-feet after the transition period which represents less than a 15% reduction in releases to Mono Lake.

The Grant Lake Operations and Management Plan is a working document subject to review and revision every five years. The revisions will occur as new information is gathered and the results of the proposed flows can be observed.

The Grant Lake Operations and Management Plan affects not only the streamflows as described previously, but also the level of Mono Lake and the supply of water to Los Angeles. Figure 34 shows the expected future levels of Mono Lake based on the operational assumptions of the Grant Lake Operations and Management Plan. As the figure shows, the median length of time for Mono Lake to rise to 6,391 feet is 27 years. That figure was derived assuming an April 1, 1995, Mono Lake level of 6,379.3 feet. With average runoff, the length of time that the export will be limited to 16,000 acre-feet per year would be 26 years. In actuality, however, runoff tends to be anything but average and the range of time to reach 6,391 feet varies considerably. As figure 35 indicates, if the future were consistently wet, it would take about 12 years, while if we experienced a prolonged dry cycle, it would take about 33 years. (These figures were obtained using the LAASM model and the 1941-1990 historic Mono Basin runoff.)

There are several uncertainties which preclude LADWP from establishing a post transition flow regime at this time. For example, the shortest length of time to raise Mono Lake to 6,391 feet is 9 years and the longest length of time is 38 years (see Figure 35). Based on average runoff, it would take approximately 27 years for Mono Lake to reach the target elevation. This uncertainty results from the inability to predict future hydrologic conditions. Without knowledge of the future hydrology, quantitative assessments regarding riparian ecosystem recovery cannot be made. Further, it is unrealistic to prescribe water requirements to maintain an environment that has yet to be established. Therefore, due to uncertain ecosystem responses, unknown water requirements, and unpredictable future hydrologic conditions, it is unrealistic to include a post transition flow proposals at this time. However; post transition effects of the various streamflow alternatives were evaluated and addressed earlier in the "Comparison of Mono Basin Streamflow Management Alternatives" section.

The export of water from the Mono Basin will be 16,000 acre-feet per year once Mono Lake reaches 6,380 feet and will continue at this rate until Mono Lake reaches 6,391 feet. Once this transition period ends, the average export is expected to be about 30,000 acre-feet per year, depending on runoff conditions. This average includes periods when exports are limited to 10,000 acre-feet (about 25% of the time) and periods when exports are only limited by fish flow requirements and capacity constraints.

As Mono Lake elevation rises, a closer investigation of the flows and their inter-relationship with the riparian ecosystem will be required. LADWP will prepare a post transition operating plan during the runoff year in which the April 1 Mono Lake elevation exceeds 6,389.5 feet. The development of the post transition plan will take into consideration the restoration monitoring results, recovery of the existing ecosystem, the effectiveness of the past flow proposals, and historic operations. Interested parties will have an opportunity to provide input during the development of the post transition Grant Lake Operations and Management Plan. The final plan will then be submitted to the SWRCB for approval.

Figure 34: PROJECTED APRIL 1 MONO LAKE ELEVATION
Using Flow Management Requirements of Decision 1631

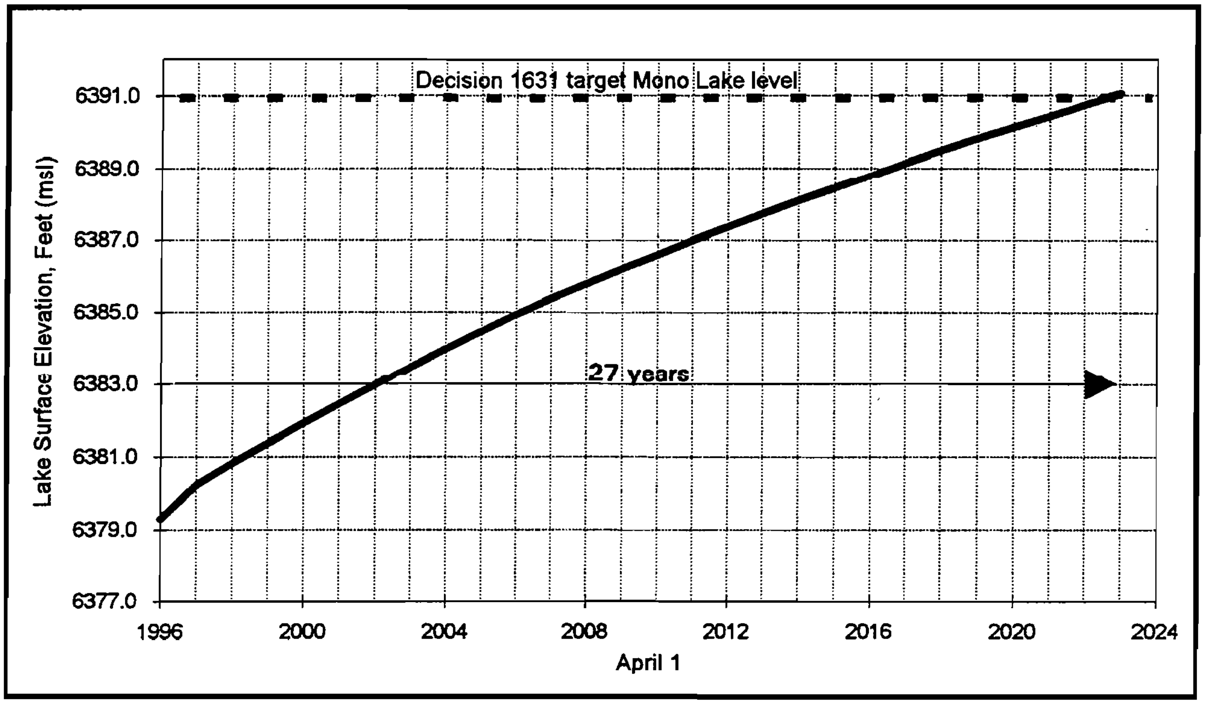
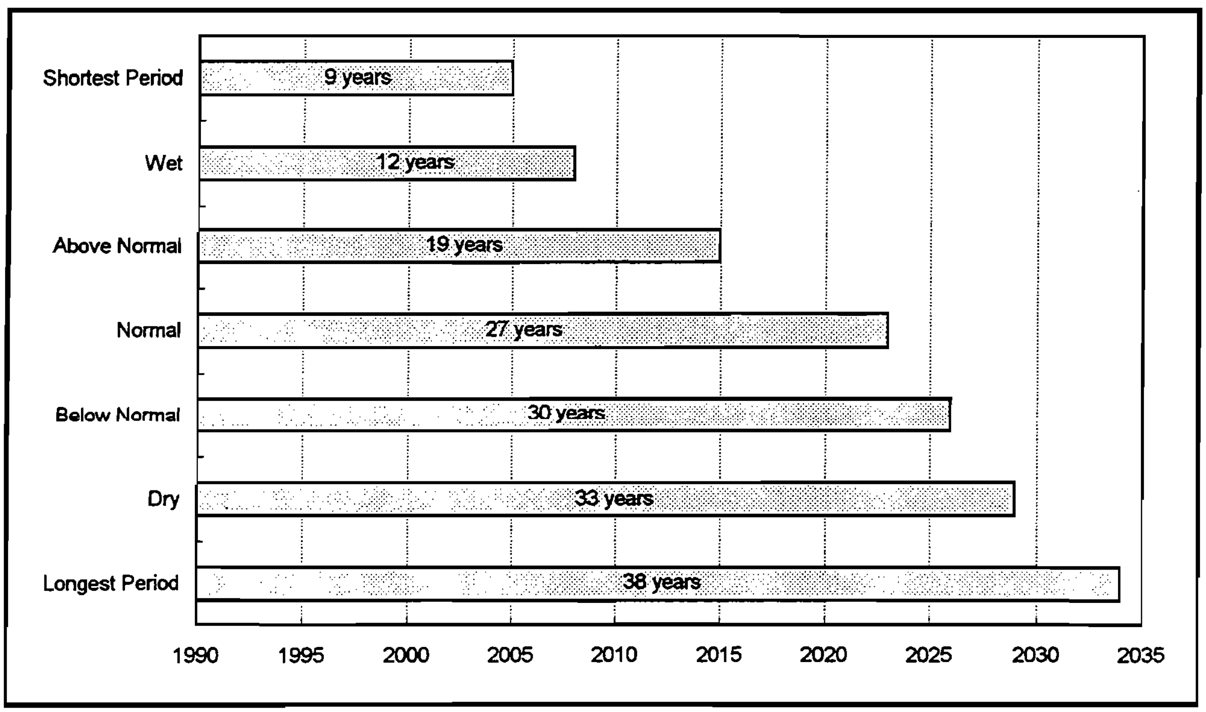


Figure 35: TRANSITION PERIOD SCENARIOS FOR MONO LAKE
To Reach 6,391 Feet With Decision 1631



Evaluation of Grant Lake Objectives

During the transition period, the majority of the time Grant Lake storage will be maintained between 30,000 and 35,000 acre-feet, with annual fluctuations of approximately 10,000 acre-feet. In the driest years, storage will be reduced to maintain export of 16,000 acre-feet, while in the wettest years storage will increase. The benefits of maintaining Grant Lake at this level include:

- Grant Lake reservoir will be accessible for boating access, including much of the back bay portion of the reservoir
- The reservoir will be high enough to shorten the distance trout must migrate without cover from the reservoir to upper Rush Creek
- Temperatures in lower Rush Creek will have minimal impact from reservoir warming
- The reservoir will be high enough to quickly spill in wet years to provide beneficial high flows down lower Rush Creek
- A constant export of 16,000 acre-feet per year can be relied upon, unless a drought more severe than any recorded occurs

Evaluation of Upper Owens River Objectives

During the transition period when 16,000 acre-feet is exported, it will be exported at a constant rate year round. Between 20 and 25 cfs will flow through the Mono Craters Tunnel. This rate will not be changed unless a severe drought occurs or a record wet year occurs and there is danger of Lake Crowley spilling. Both situations would require a reduction of Mono Basin exports. Otherwise, the gate will be set at a constant flow and remain there for the 27 years or so that Mono Lake is rising to 6,392 feet. The benefits of maintaining a constant export to the upper Owens River include:

- The water exported from the Mono Basin will have the property of a spring source, which is consistent with the hydrology of the upper Owens River;
- With export averaging 22 cfs, the flow in the upper Owens River will almost never drop below 75 cfs;
- Because the flow of water is constant, rapid flow changes will not occur.

Evaluation of Releases to Mono Lake Tributary Stream Objectives

The Grant Lake Operations and Management Plan describes the proposal to release water above and beyond the minimum streamflows listed in Decision 1631. The total amount of releases each year will depend upon the quantity of runoff forecast. The benefits of the flows proposed include:

- Flow release patterns are consistent with the natural restoration policy and promote the recovery of the stream and stream channel ecosystem.
- The peak streamflows will be released for each creek during the transition period, except during drought periods.
- In many months, the base flows are increased above the minimums required in Decision 1631.
- During transition, a proportional amount of water is diverted from Rush and Lee Vining creeks.
- During transition, Walker and Parker creeks are only diverted in dry years.
- The flow pattern yields enough flexibility to keep exports to the upper Owens River constant and to maintain Grant Lake reservoir at a high elevation.
- The flow patterns yield enough flexibility to make changes as the runoff year progresses.

XII. Grant Lake Operations and Management Plan Updates

The Grant Lake Operations and Management Plan will require modification as information is gathered and new ideas learned. It is not practical to plan the operations of Mono Basin facilities for the next 50 years, or even 10 years, without allowing for improvements. New information emerges continually and should be incorporated into future plans.

Decision 1631 allows for flexibility in the LADWP operations in the Mono Basin. In July 1995, LADWP developed a proposed operations plan for the Mono Basin based on the April 1 Mono Basin runoff forecast. The proposal was distributed to interested parties, and comments on the plan were solicited. As comments were received, the plan was updated and the Grant Lake TAG group concurred on the operations for the year. As the year progressed, the LADWP kept the TAG informed on the status of streamflows and reservoir levels. As the runoff season continued, it was apparent that the cooperative process was a success.

While the TAG process will end with the adoption of the restoration plans, the cooperative planning process will hopefully continue. Each year, the proposed Mono Basin operations for the year will be distributed for comments to interested parties. A proposal to release the Mono Lake maintenance water will be proposed and changed as parties provide input. There is no need or reason to prescribe flows for future years and be locked into any particular flow regime, as is proposed by the stream restoration scientists. Each year, the water will be released in the most beneficial flow pattern for a given year based on the current knowledge of the stream system. As such the guidelines presented in this plan should be used as a reference point to develop the operational plan. Rather than establishing specific operating criteria, the application of this plan will be primarily for planning purposes. It is impossible to foresee all potential contingencies and predict future hydrologic events..

Another area that may benefit from adjustments to the plan is the upper Owens River. Several flow management proposals were considered, including increasing flows during the irrigation season, before arriving at the final plan. All parties involved, however, agreed that there was not enough information presently available to set the flow pattern for the next decade. If the upper Owens River landowners, the DFG, and the LADWP agree on changing the export pattern to benefit the upper Owens River, those changes should be made. The upper Owens River landowners will be kept on the distribution list for proposed flows each year and will be given the opportunity to suggest modification in the pattern of export to the upper Owens River.

The LADWP reviews its runoff forecast model and re-computes the long-term hydrologic averages every five years. Along with these updates, the Grant Lake Operations and Management Plan will also be review for potential revisions. Included in each revision will be a new expected timetable for Mono Lake to reach its target elevation, new definition of the runoff year-type breakdown as the average changes, and any operational modification resulting in changes to LADWP facilities. Therefore, the Grant Lake Plan will be reviewed in the year 2001 and every five years thereafter at least until the level of Mono Lake reaches 6,389.5 feet. As stated earlier, LADWP will develop a post transition Grant Lake Operations and Management Plan during the runoff year that Mono Lake elevation exceeds 6389.5 feet. Interested parties will be given the opportunity to provide input to proposed revisions to the existing plan and in the development of the post transition Management Plan. LADWP will submit subsequent revisions of the Grant Lake Operations and Management plan to the SWRCB for approval.

XIII. References

SWRCB (California State Water Resources Control Board). 1994. Mono Basin Water Rights Decision 1631 - decision and order amending water right licenses to establish fishery protection flows in streams tributary to Mono Lake and to protect public trust resources at Mono Lake and in the Mono Basin (Water Right Licenses 10191 and 10192, Application 8042 and 8043, City of Los Angeles, Licensee). Sacramento, California.

Ridenhour, R. L., C. Hunter, and W. J. Trush. October 4, 1995. Work Plan: Mono Basin Stream Restoration (Rush Creek, Lee Vining Creek, Walker Creek, and Parker Creek). Prepared for Los Angeles Department of Water and Power.