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Regional Office No.

UNITED STATES OF AMERICA
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ENVIRONMENTAL ASSESSMENT FOR GLEN CANYON POWERPLANT UPRATING

November 1981

Upper Colorado Regional Office
Salt Lake City, Utah
Durango Projects Office
Durango, Colorado

PRELIMINARY

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I. Need for Action

A. Introduction

The purpose of this environmental assessment is to evaluate the environmental impacts that would occur with the uprating of the generating capacity of Glen Canyon Powerplant. The assessment is prepared in accordance with the National Environmental Policy Act (NEPA) and current Department of the Interior and Bureau of Reclamation guidelines.

B. Need for Uprating the Generators at Glen Canyon Power Plant

To identify those existing hydroelectric facilities with potential for increasing power production of existing generators, a study was initiated in 1975 by the Bureau of Reclamation.

Glen Canyon was very high on the list. The turbines at Glen Canyon have an output of about 150 MW at the design head of 510 feet and 174 MW when the reservoir is full. However, the generators as installed did not match the turbine capability and were only rated up to 143.75 MW.

Things that the uprating of the generators would accomplish include:

1. Correcting deficiency in matching generators' output to turbines' output.
2. Providing increased capacity to meet peak loads.
3. Providing additional capacity for reserves during emergency situations and when power production is reduced while units are out of service for maintenance.

II. Alternatives

A. Preferred Plan

To meet the need for additional generating capacity, several alternatives exist. The preferred action in this case is the uprating of generating capacity at Glen Canyon Dam because it is an opportunity action. Modern developments in technology provide the ability to manufacture generator windings of increased electrical capacity that will fit in the same physical space as the original windings.

The Glen Canyon stator windings have deteriorated and require replacement. New replacement windings will increase the capacity of these generators.

Modification or replacement of equipment that would enable operation beyond present plant capacity is referred to as an uprating, and necessitates review of the capability and limits of all the power equipment: the penstock, turbine, generator, bus, switchgear, transformer, and transmission system.

The power equipment, other than the generators and turbines, have a present capability of about 167 MW. Since the turbines have a maximum capability only slightly greater than 167 MW, it appears the most logical level of uprate is 167 MW per unit.

Uprating the generators to about 167 MW will likely include replacing or reinsulating the field windings, and strengthening the rotor arms and other minor mechanical modifications, such as changing the fan assembly to increase airflow cooling.

Uprating the generators to 167 MW will increase total plant capacity from 1,150 MW to 1,336 MW for an increase of 186 MW; however, since turbine output is dependent on head or reservoir level, utilization of the increased capacity begins when the reservoir level is approximately 3,634 above sea level or higher. The maximum generation of 167 MW is only possible at reservoir levels of 3686 feet and above.

At the new plant capacity of 1,336 MW, the discharge would be 1,700 ft^3/s greater than the present maximum discharge of 32,000 ft^3/s.

B. Other Economic Alternatives

The economic efficiency of uprating the existing generators at Glen Canyon appears to be very favorable. As mentioned in the description of the uprating, the rewinding process is taking place as a normal part of operation and maintenance. Furthermore, with current technology, replacement windings have increased capability and could provide additional capacity if some modifications to other parts of the generator system were made. This modification or uprate is very cost effective when compared with the additional capacity it provides.

As shown in Table 1, 186 MW of additional generation capacity could be developed for $32 per KW by uprating the existing generation system. This compares to a capital cost of $300 per KW for the most likely alternative source of capacity, a combustion turbine plant.

There is some opportunity to expand hydro-power facilities at other generation units of the CRSP but the potential capacity is small and the costs are greater than the uprate at Glen Canyon would be (see Table 1).

TABLE 1
CRSP Generation Expansion Alternatives Comparison

Comparison item	Alternatives Comparison: Glen Canyon uprate	Flaming Gorge: Generator addition	Flaming Gorge: uprate	Blue Mesa uprate	Combustion turbine plant
Increased capacity(KW/year)	186	40	18	24	
Cost per KW of increased installed capacity	$32	$763	$67	$50	$300
Benefit/cost ratio	10.1:1	2.0:1			N/A

C. No Action Alternative

The no action alternative is to simply rewind the generators and ignore the utilization of the turbine capabilities.

III. Environmental Consequences

A. Impacts of Uprating

As a result of the uprating, the flows below the dam could be increased by 1,700 ft^3/s from the present day maximum of 32,000 ft^3/s to a new maximum of 33,700 ft^3/s. The Inland Power Pool requires each power entity to keep a certain amount of its power capabilities in reserve, to be used only in emergency situations. For the CRSP, the amount held in reserve is 144 MW. Since Glen Canyon is the major power producer of this system, it would maintain most of the reserve at this facility; consequently, the normal high release from the dam would not exceed approximately 32,000 ft^3/s compared to recent releases of 30,000 to 31,000 ft^3/s. Recent maximum releases are shown in Table 3. This table also shows the same flows as recorded at the Lee's Ferry gage 15 miles downstream.

As can be seen, the peaks have diminished somewhat by the time they reach Lee's Ferry. This is due to the daily fluctuation in flow and the physical characteristics of the channel.

TABLE 2
Comparison of Maximum Flows Recorded at Lee's Ferry with Maximum Power Plant Discharges Recorded that Same Day At Glen Canyon Dam (1975-1980)

Year	Date	Lee's Ferry in ft^3/sec.	Glen Canyon Dam in ft^3/sec.
1975	May 7	28,400	28,845
1976	May 19	27,100	29,042
1977	Sept. 6	29,000	30,933
	Sept. 7	29,000	30,523
	Sept. 8	29,000	30,387
1978	Jan. 23	28,400	30,879
1979	Jan. 29	28,600	31,571
1980	June 24	44,800	48,998 1/

1/ Spillway test.

Maximum releases travel faster than minimum releases, so they tend to overtake lower flows which result in a dampening of peak releases. The duration of maximum releases also influences the amount of dampening effect. As the duration of steady maximum discharge increases, flow characteristics will approach a steady state. This results in less dampening associated with lengthier peak releases.

Releases associated with uprating the generators (see figure 1) represents a shift away from longer maximum releases to short intervals of peak release.

Figure 2 and Table 3 show the flow releases from the dam as recorded at the dam and recorded flows at Lee's Ferry on September 5, 1978. Figure 1 and the table also show the theoretical releases for a day with the new generating capacity, and the simulated flows that would be recorded as at Lee's Ferry gage.

TABLE 3

Glen Canyon Dam Releases and Flow Measurements at the Lee's Ferry Gage

September 5, 1978

Time	Glen Canyon Hourly Releases in cubic feet per second	Lee's Ferry Gage in cubic feet per second
2400	19,700	19,860
0100	12,100	16,920
0200	10,400	14,190
0300	9,880	12,220
0400	9,750	11,040
0500	9,880	10,330
0600	11,200	10,210
0700	12,400	10,700
0800	16,600	12,220
0900	25,500	17,160
1000	28,300	22,000
1100	29,800	24,880
1200	30,000	26,070
1300	27,900	26,970
1400	31,100	27,370
1500	27,100	27,230
1600	27,400	27,300
1700	30,100	27,100
1800	27,500	27,030
1900	27,900	26,830
2000	28,200	26,970
2100	29,000	26,830
2200	26,800	26,770
2300	23,700	24,880
2400	17,200	22,650

Future with Uprated Generators

Time		
2400	13,600	20,500
0100	12,100	16,900
0200	10,400	14,300
0300	9,880	12,400
0400	9,750	11,200
0500	9,880	10,600
0600	11,200	10,600
0700	12,400	11,100
0800	16,600	12,600
0900	25,500	16,400
1000	26,300	20,800
1100	27,800	23,800
1200	28,000	25,800
1300	27,900	26,800
1400	31,100	28,100
1500	29,100	29,100
1600	29,400	29,200
1700	33,700	30,300
1800	29,900	31,100
1900	29,900	30,500
2000	28,200	29,800
2100	27,000	28,700
2200	24,800	27,400
2300	21,700	25,400
2400	17,200	22,500

As can be seen from the figure and the table, the differences between the dam releases and the flow being recorded at Lee's Ferry is the reduction in the peak flow. The new releases from the dam would cause an increase in flow at Lee's Ferry. This corresponds to a vertical rise in the river of .2 of a foot or approximately two inches. Downstream from Lee's Ferry, the differences would diminish to zero.

Figure 1 also shows that there would be no change in low flows.

B. Terrestrial

The proposed increase in maximum release capabilities would result in only minor increase in wetted area downstream (see figures 3-6). These figures represent the relationship between flow and wetted perimeter (channel width) at selected locations between Lee's Ferry and Glen Canyon Dam. Figure 7 describes the location of each cross-section. Since absolute maximum releases are projected to occur for short durations, the effects of this higher flow would rapidly diminish downstream. On the average, approximately two feet of additional terrestrial environment would be inundated, therefore no significant impact would occur to terrestrial species or their habitat. Similarly, no impact would occur to historical or archaeological resources which are known to occur well away from the area of impact.

C. Aquatic

Based on a physical habitat simulation model, essentially no change in available usable area for aquatic life would occur at the higher release. Both water temperature and water quality would not be changed from present conditions. Extreme low flows (1,000 - 3,000 ft^3/s) have been identified as the limiting flows to aquatic life. Since the duration and periodicity of these flows would not be altered, no additional impact to aquatic resources would occur.

D. Recreation

The data also indicates an average increase in velocity of .16 feet per second at the higher releases. This, coupled with the fact that there would be little change in wetted perimeter and no change in low flows, means recreation on the river would not be negatively affected.

E. Endangered Species

After reviewing the data, most of the effects of the increase have been shown to occur above Lee's Ferry and are not significant; therefore, no change in the environment is expected to occur below Lee's Ferry. Since no impacts are expected to occur through the Canyon, no impacts would occur to the humpback chub.

F. Floodplain and Wetlands

No floodplain or wetlands encroachment would result from the uprating of the generating capacity at the Glen Canyon Powerplant; therefore, no action under Executive Order 11988 (Floodplain Management) or Executive Order 11990 (Protection of Wetlands) is necessary.

IV. Agencies and Persons Consulted

FIGURE 1

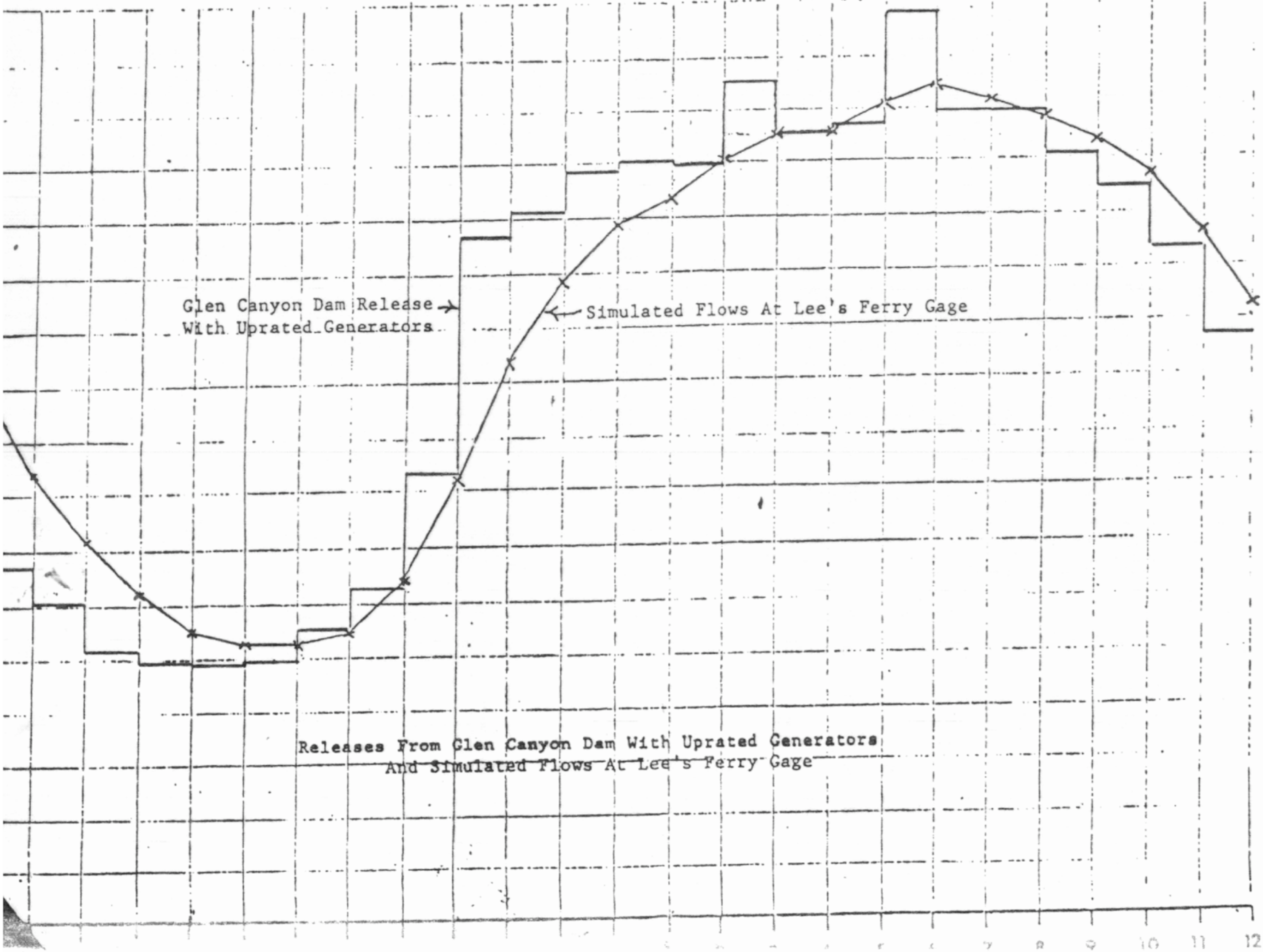

Glen Canyon Dam Release
With Uprated Generators
Simulated Flows At Lee's Ferry Gage
Releases From Glen Canyon Dam With Uprated Generators
And Simulated Flows At Lee's Ferry Gage
7
8
9
10
11
12

FIGURE 2

Releases From Glen Canyon Dam
And Recorded Flows At Lee's Ferry Gage

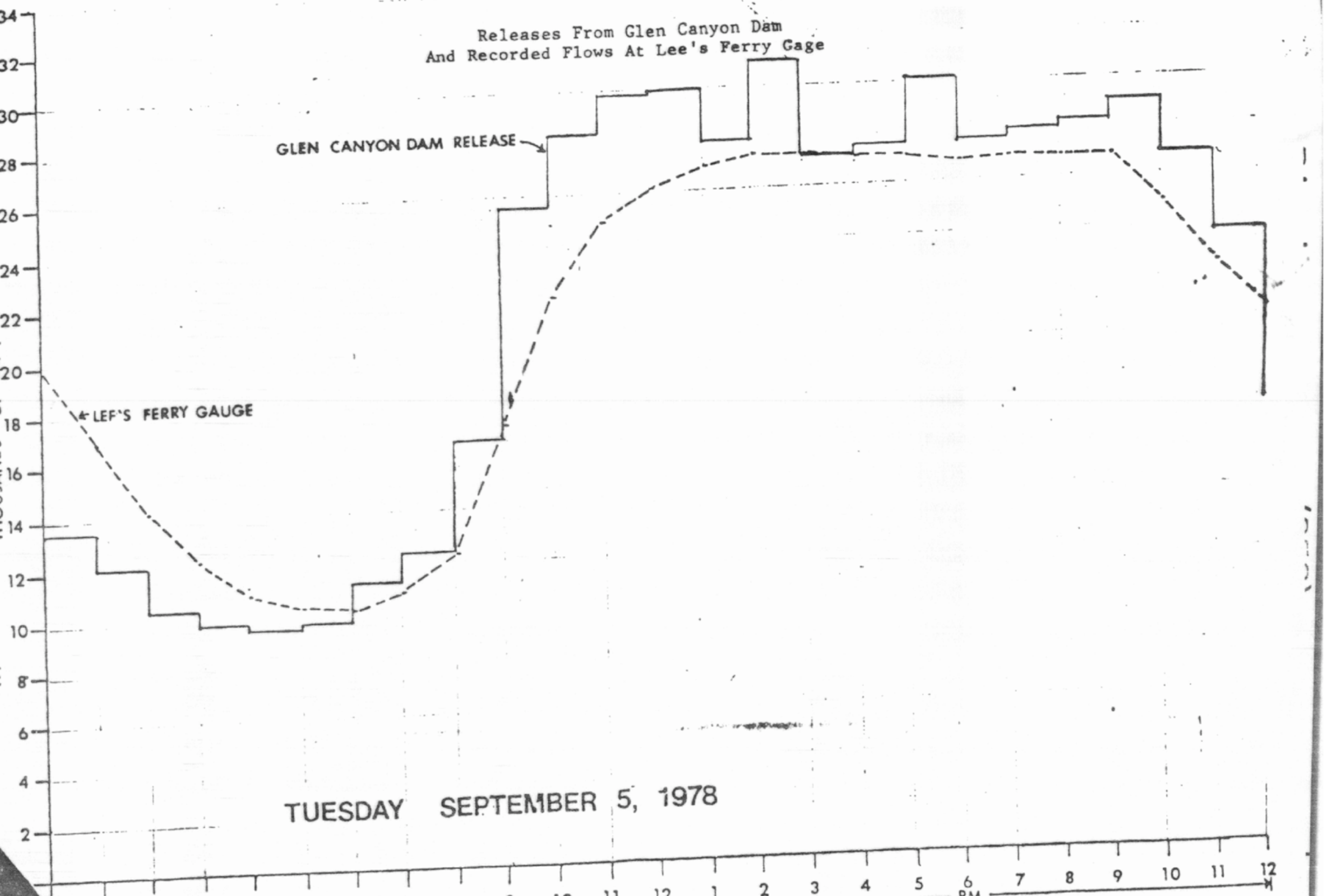


FIGURE 3

CROSS SECTION 5 R.M. 3.9

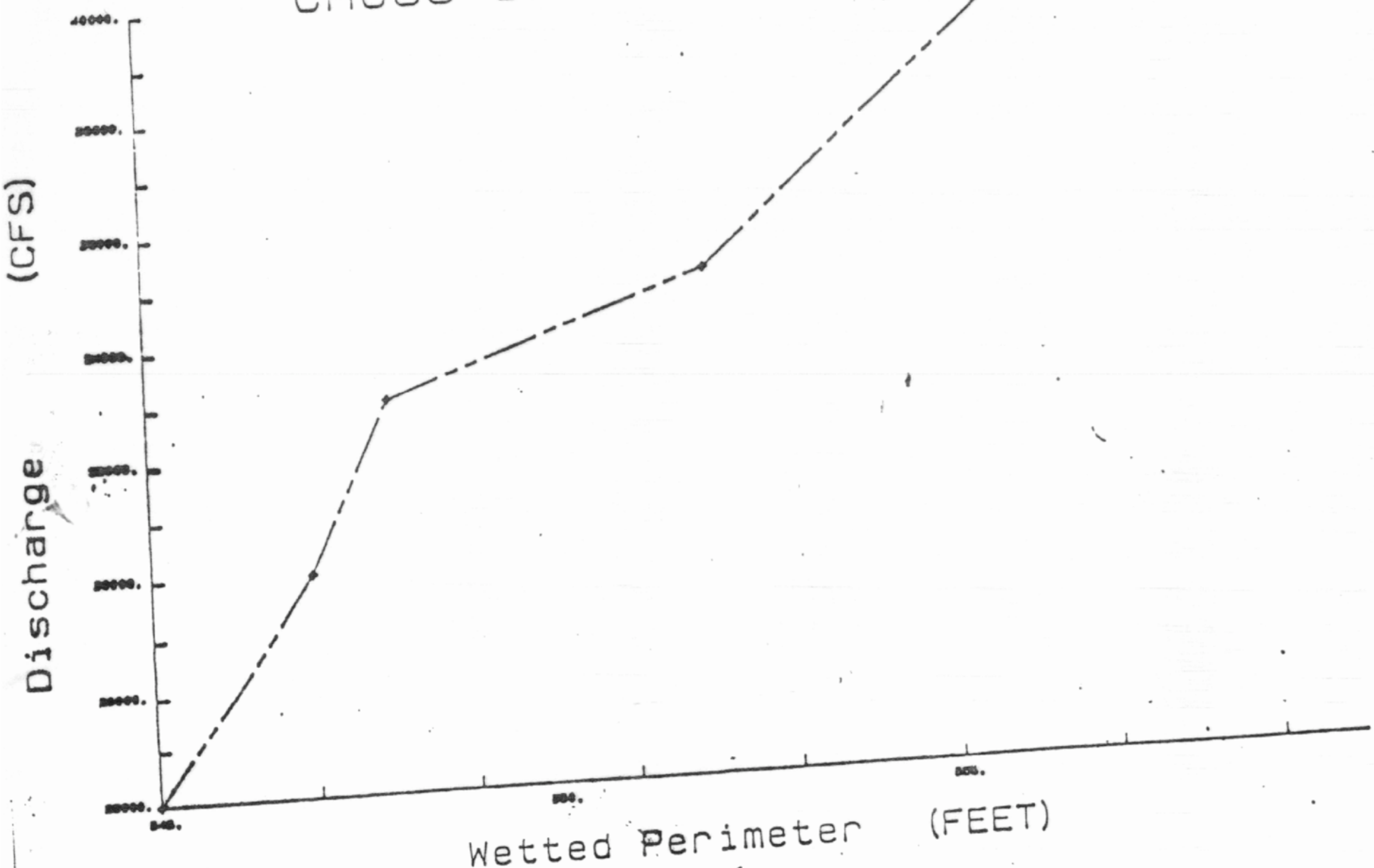


FIGURE 4

CROSS SECTION 10 R.M. 7.6

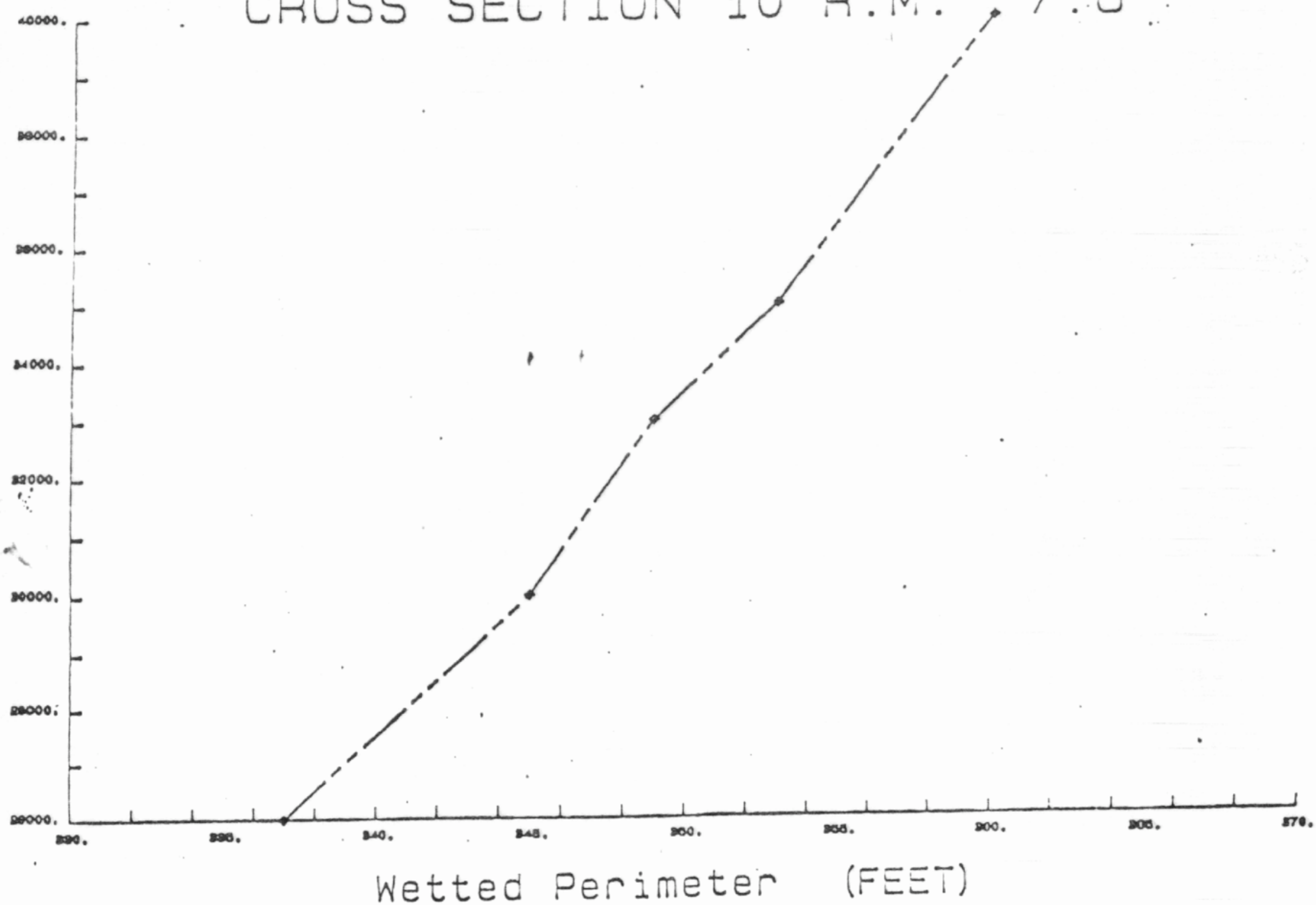


FIGURE 5

CROSS SECTION 15 R.M. 11.6

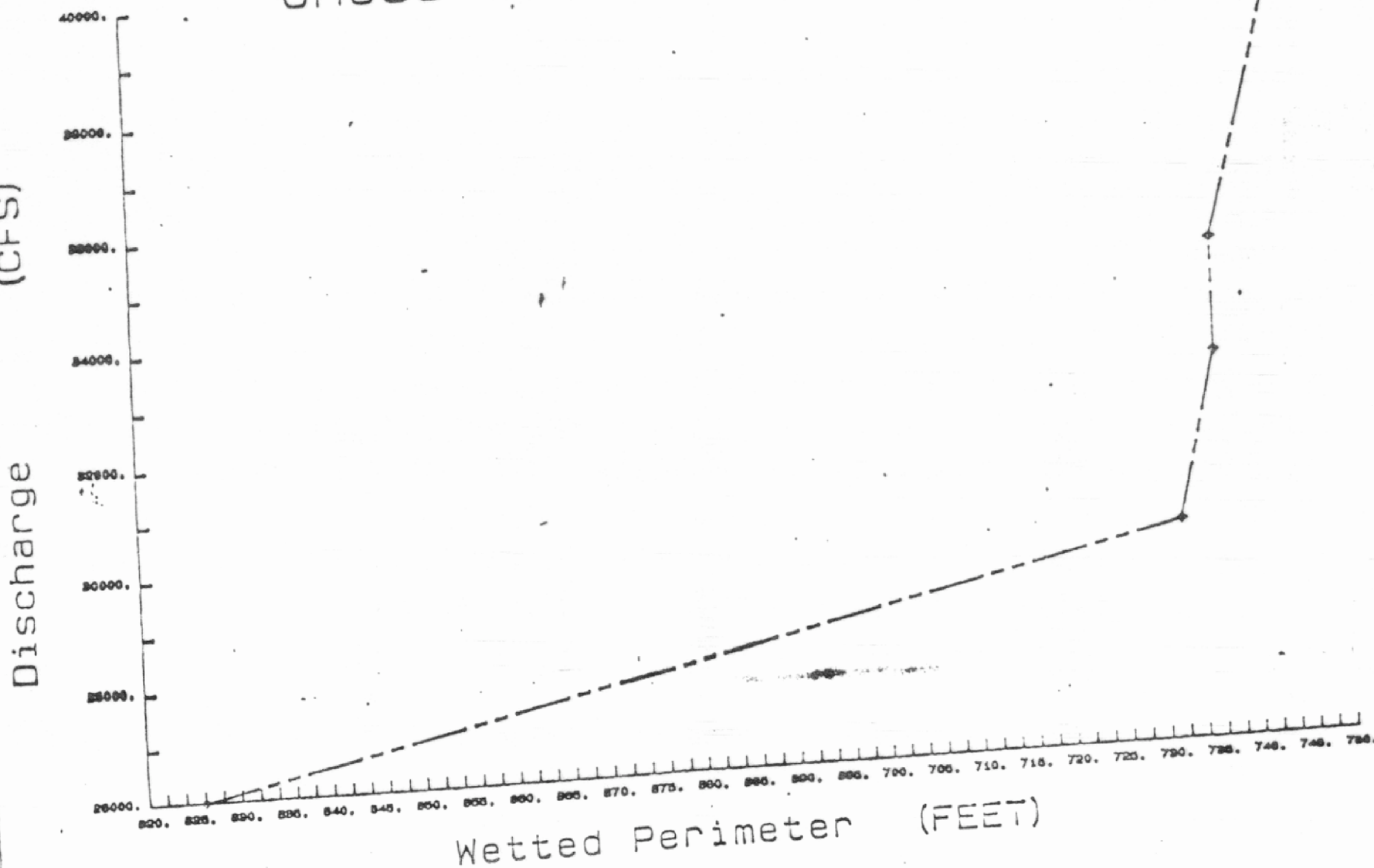
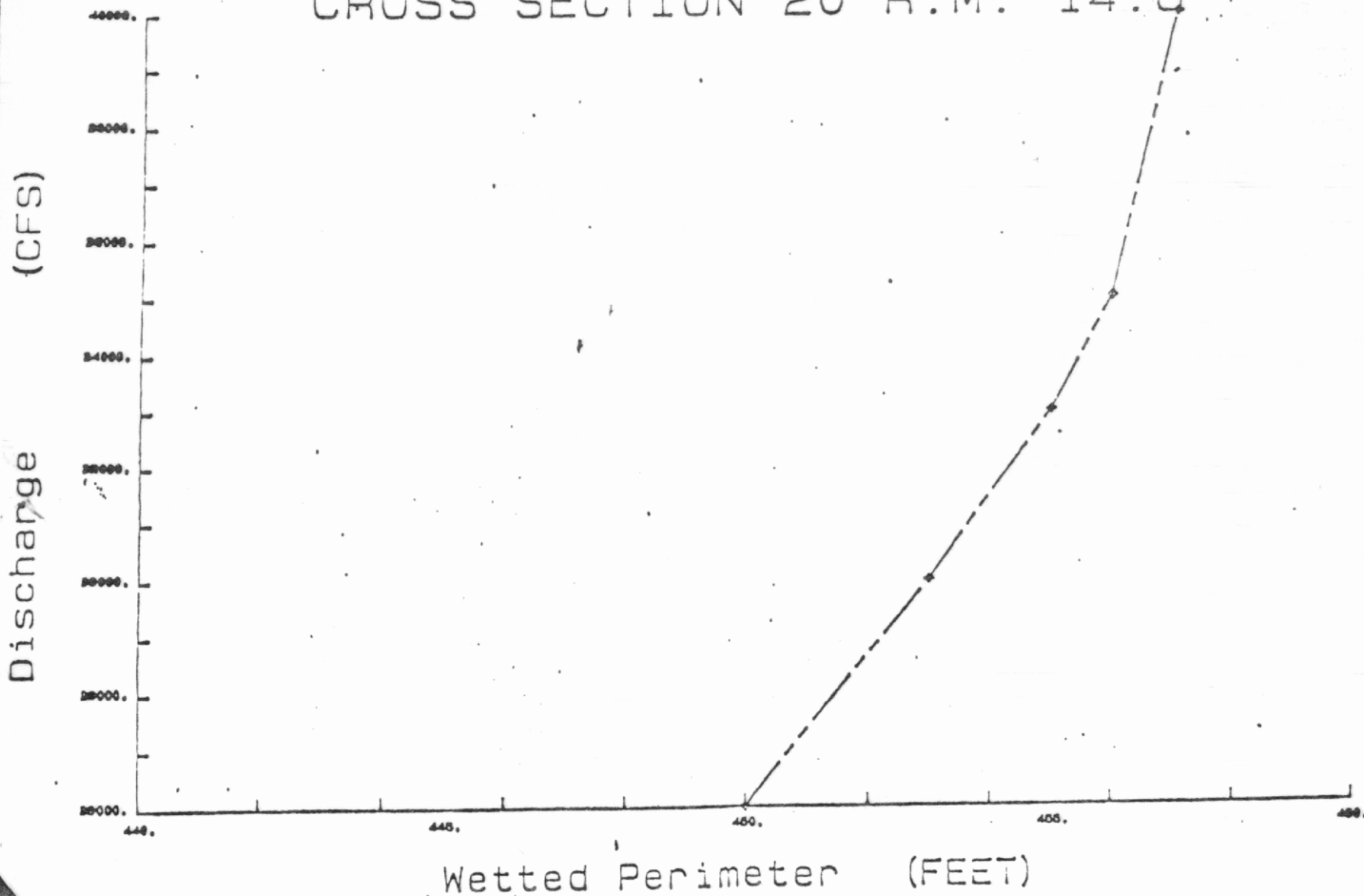


FIGURE 6

CROSS SECTION 20 R.M. 14.6



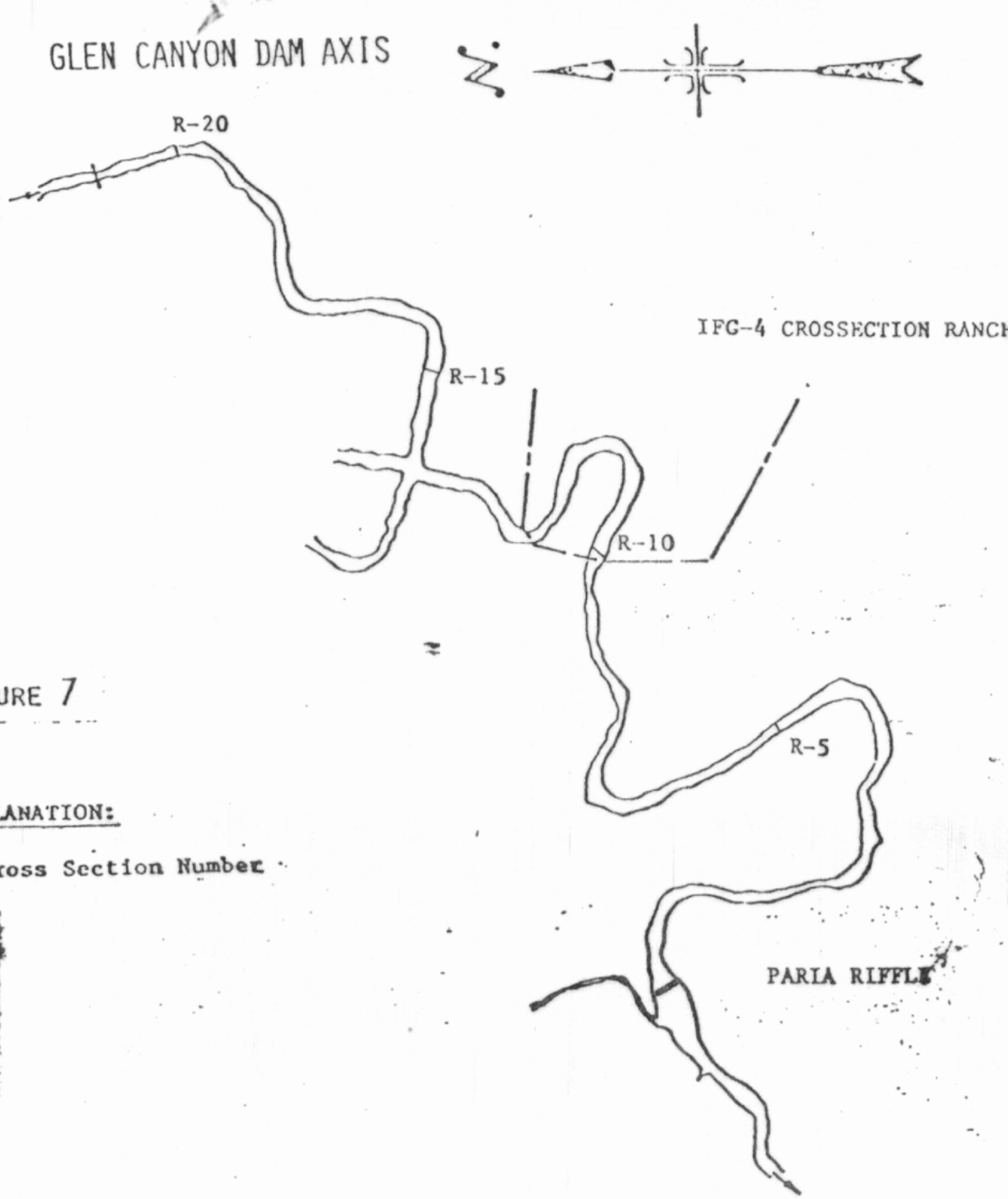


FIGURE 7

EXPLANATION:

R=Cross Section Number

COLORADO RIVER - ARIZONA
LEE'S FERRY TO GLEN CANYON DAM AXIS
WETTED PERIMETER CROSS SECTION LOCATIONS

Prepared 11/9/81

MAXIMUM RELEASE OF WATER FROM GLEN CANYON DAM
FOR EACH MONTH FROM SEPT 1964 TO SEPT 1981
AND EACH DAY RELEASE EXCEEDED 28,000 c.f.s.

Date		c.f.s.	Lake Elevation
1964	Sept 2	7,150	
	Oct 16	5,900	
	Nov 16	6,200	
	*Dec 30	13,500	3491.94
1965	Jan 27	9,300	
	Feb 12	15,100	
	Mar 17	27,175	
	April 10	30,375	
	11	28,400	
	22	30,980	
	23	37,775	
	24	35,875	
	25	35,350	
	26	45,330	
	27	42,660	
	28	36,175	
	29	35,825	
	30	32,450	
	May 3	45,605	
	4	50,905	
	5	40,200	
	6	40,225	
	7	47,400	
	8	47,650	
	9	39,375	
	10	36,550	
	11	36,325	
	12	32,000	
	16	51,925	
	17	32,180	
	18	29,105	
	20	37,325	
	21	41,325	
	22	42,615	
	23	53,275	
	24	54,975	
	25	54,675	
	26	54,850	
	27	54,650	
	28	54,350	
	29	52,205	
	30	51,880	
	31	42,643	

Date		c.f.s.	Lake Elevation
1965	June 1	41,243	
	2	38,315	
	3	38,365	
	4	38,215	
	5	40,425	
	6	48,505	
	7	48,405	
	8	43,435	
	9	41,100	
	10	40,875	
	11	48,055	
	12	55,415	
	13	55,365	
	14	55,290	
	*15	55,735	3492.81
	16	35,255	
	17	35,469	
	18	45,165	
	19	45,250	
	20	45,190	
	21	45,540	
	22	46,060	
	23	46,110	
	24	45,960	
	25	45,440	
	26	30,390	
	July 31	16,900	
	Aug 5	16,850	
	Sept 11	16,950	
	Oct 21	19,450	
	Nov 4	17,900	
	Dec 28	18,700	
1966	Jan 26	20,750	
	Feb 16	19,750	
	Mar 17	19,650	
	Apr 27	20,582	
	*May 18	20,900	3543.47
	June 2	20,423	
	July 13	18,836	
	Aug 17	17,725	
	Sept 24	18,836	
	Oct 31	18,420	
	Nov 10	20,215	
	Dec 22	16,920	

*High water release for the year

	Date	c.f.s.	Lake Elevation
1967	Jan 3	19,110	
	Feb 15	15,600	
	Mar 9	18,450	
	*Apr 19	24,400	3509.10
	May 11	21,530	
	June24	21,005	
	July 6	18,835	
	Aug 8	17,400	
	Sept 7	17,575	
	Oct 31	15,200	
	Nov 22	19,400	
	Dec 15	20,690	
1968	Jan 22	21,950	
	Feb 9	19,150	
	Mar 29	24,840	
	*Apr 14	26,960	3516.63
	May 7	26,600	
	June20	25,840	
	July19	26,360	
	Aug 28	24,800	
	Sept11	21,670	
	Oct 17	19,395	
	Nov 20	19,605	
	Dec 19	21,250	
1969	Jan 24	20,970	
	Feb 1	23,000	
	Mar 14	23,320	
	Apr 21	24,720	
	*May 14	26,800	3559.57
	June 6	26,600	
	July 1	25,200	
	Aug 11	25,280	
	Sept 8	23,200	
	Oct 30	21,635	
	Nov 13	22,160	
	Dec 4	24,800	
1970	Jan 8	23,600	
	Feb 11	21,620	
	Mar 10	19,920	
	Apr 24	27,440	
	May 20	27,280	
	Jun 25	26,840	
	*July17	27,760	3601.63
	Aug 26	26,240	
	Sept 2	27,160	
	Oct 22	18,485	
	Nov 24	20,200	
	Dec 22	26,000	

	Date	c.f.s.	Lake Elevation
1971	Jan 7	24,000	
	Feb 26	21,425	
	Mar 2	21,775	
	Apr 5	29,000	
	May 24	28,600	
	May 25	28,240	
	May 26	28,400	
	Jun 18	30,000	
	Jun 25	28,600	
	Jun 28	28,160	
	July12	29,500	
	Aug 3	28,360	
	16	28,360	
	23	29,200	
	25	28,240	
	26	28,120	
	*Aug 30	31,200	3617.42
	Sept 1	29,750	
	11	28,160	
	13	28,760	
	14	29,150	
	15	28,320	
	16	28,920	
	Oct 14	22,825	
	Nov 15	27,080	
	Dec 31	26,600	
1972	Jan 31	26,400	
	Feb 1	26,560	
	Mar 8	16,340	
	Apr 14	28,960	
	May 11	29,163	
	12	29,447	
	15	29,163	
	16	28,879	
	23	30,158	
	24	29,873	
	25	30,726	
	26	29,873	
	31	29,021	
	Jun 1	30,200	
	2	32,100	
	8	29,000	
	13	29,450	
	15	30,450	
	27	38,680	
	28	28,000	
	July27	31,900	
	31	29,250	

*High water release for the year

Date	c.f.s.	Lake Elevation
1972 Continued		
Aug 2	28,760	
7	30,700	
8	29,550	
9	31,650	
*10	32,800	3613.48
11	29,600	
14	31,550	
15	30,350	
16	28,840	
17	29,100	
18	30,850	
21	31,900	
22	30,750	
28	29,800	
29	30,100	
30	28,080	
Sept14	29,850	
15	29,450	
16	28,480	
18	28,800	
Oct 16	27,080	
Nov 30	26,200	
Dec 6	28,640	
7	28,200	
11	29,400	
12	28,480	
13	29,950	
14	29,750	
15	28,760	
18	28,280	
19	28,680	
21	30,100	
22	28,480	
27	29,200	
28	28,680	
29	29,300	
30	30,000	
1973 Jan 2	28,879	
3	28,879	
4	28,737	
5	29,447	
6	29,305	
8	29,645	
9	29,502	
10	29,215	
11	29,933	
12	30,220	
15	29,215	
16	28,353	
17	29,645	
18	29,215	
19	29,215	

Date	c.f.s.	Lake Elevation
1973 Jan 20	28,640	
22	29,645	
23	29,071	
24	29,358	
25	28,640	
26	29,645	
27	29,645	
29	28,927	
31	29,502	
Feb 20	29,358	
21	29,502	
Mar 22	29,358	
23	29,645	
25	28,927	
26	29,645	
27	29,933	
28	30,076	
29	29,645	
30	29,645	
Apr 2	29,645	
3	29,645	
4	29,502	
5	29,645	
6	29,502	
9	29,071	
10	29,693	
11	29,838	
12	29,838	
13	29,548	
14	29,693	
15	29,257	
16	29,403	
17	29,838	
18	29,548	
19	29,693	
20	29,257	
21	29,403	
22	28,822	
23	29,403	
24	29,257	
25	29,112	
26	29,257	
27	28,677	
28	29,403	
29	29,112	
30	29,693	
May 1	28,967	
17	28,353	
18	28,927	
19	28,927	
*June 5	30,817	3619.76
6	30,256	
7	29,414	
8	30,536	
11	28,853	

*High water release for the year

Date	c.f.s.	Lake Elevation
1973 Continued		
June 26	28,539	
27	29,315	
July 5	28,359	
11	28,086	
Aug 21	26,309	
Sept 5	18,734	
Oct 25	21,026	
Nov 27	24,126	
Dec 17	23,048	
1974 Jan 2	28,980	
3	29,250	
4	29,384	
5	28,710	
7	29,654	
8	29,250	
9	28,171	
10	28,306	
*11	29,924	3647.32
12	28,171	
21	29,250	
Feb 25	21,700	
Mar 28	23,452	
Apr 23	21,430	
May 13	28,242	
28	28,375	
June 17	28,036	
24	28,167	
25	28,167	
26	28,561	
27	28,692	
28	28,430	
July 1	28,167	
2	28,198	
8	28,561	
9	28,430	
10	28,298	
11	28,167	
16	28,430	
17	29,439	
18	28,774	
19	29,306	
22	29,173	
24	28,375	
25	28,508	
26	28,242	
Aug 1	28,774	
14	28,109	
20	29,040	
22	28,375	
23	28,774	

Date	c.f.s.	Lake Elevation
1974 Aug 24	29,306	
25	28,109	
26	28,375	
28	28,508	
Sept 25	25,609	
Oct 30	24,531	
Nov 6	28,306	
26	28,576	
27	28,710	
Dec 16	28,036	
1975 Jan 10	28,576	
11	28,980	
12	28,845	
13	29,384	
21	28,441	
Feb 10	26,362	
Mar 27	23,992	
Apr 28	21,295	
May 7	28,845	
8	29,115	
27	28,171	
Jun 4	29,306	
5	28,109	
6	28,375	
13	28,109	
16	29,306	
23	28,167	
30	38,561	
Jul 1	28,823	
3	28,298	
5	28,167	
6	28,692	
7	28,430	
8	28,823	
9	28,954	
10	28,561	
11	28,298	
14	28,518	
17	28,518	
18	28,780	
19	28,256	
21	28,780	
22	28,387	
23	28,911	
27	28,649	
29	29,435	
31	28,515	
Aug 5	28,911	
6	28,911	
7	28,780	
8	28,649	
*9	29,566	3674.27

*High water release for the year

Date	c.f.s.	Lake Elevation
1975 Aug 10	28,387	
11	28,649	
19	28,125	
26	28,911	
29	28,387	
Sept 4	28,387	
9	28,518	
11	28,125	
Oct 6	28,780	
Nov 11	27,994	
Dec 17	28,256	
18	28,125	
20	28,256	
1976 Jan 14	28,256	
19	28,256	
Feb 10	25,767	
Mar 12	28,387	
Apr 26	24,886	
May 14	28,074	
19	29,042	
Jun 3	28,125	
7	28,518	
8	28,911	
9	28,256	
10	28,387	
29	28,125	
*Jul 6	29,304	3672.28
9	28,125	
26	28,387	
28	28,387	
Aug 30	28,387	
Sep 10	27,732	
Oct 28	25,683	
Nov 28	24,886	
Dec 30	28,340	
1977 Jan 3	28,606	
5	29,004	
6	29,221	
7	28,818	
8	28,413	
10	28,278	
11	29,356	
14	28,548	
17	29,760	
18	28,413	
19	28,009	
24	28,144	
25	28,298	
27	28,682	
29	28,682	
30	29,356	
1977 Feb 1	22,662	
Mar 2	29,221	
3	28,144	
Apr 18	17,420	
May 2	17,420	
Jun 27	29,491	
Jul 7	28,009	
8	28,413	
18	28,278	
19	29,221	
22	28,278	
25	28,413	
31	28,144	
Aug 1	29,625	
2	28,682	
3	29,087	
4	28,548	
8	28,952	
12	29,087	
13	29,491	
15	28,817	
16	30,164	
17	29,760	
18	29,760	
19	29,567	
20	28,885	
22	29,704	
23	29,294	
24	29,704	
25	30,250	
26	29,021	
Sep 1	30,114	
2	29,567	
* 6	30,933	3641.52
7	30,523	
8	30,387	
Oct 6	21,985	
Nov 21	26,727	
Dec 20	26,865	
1978*Jan 19	31,155	3626.95
20	28,664	
23	30,879	
24	30,187	
31	29,356	
Feb 1	28,425	
Mar 3	25,654	
Apr 21	22,914	
May 26	27,280	
Jun 5	28,475	
Jun 26	28,144	
Jul 10	27,066	

*High water release for the year

Date	c.f.s.	Lake Elevation
1978 Continued		
Aug 7	28,548	
8	28,009	
15	28,144	
16	28,548	
17	28,144	
21	29,087	
22	29,760	
23	29,625	
24	29,760	
25	29,087	
28	28,009	
31	29,895	
Sep 4	28,202	
5	31,069	
6	29,431	
7	29,841	
8	30,660	
10	29,294	
11	28,065	
Oct 19	26,154	
Nov 20	26,563	
Dec 18	28,387	
20	28,941	
27	28,911	
28	29,495	
29	28,941	
1979 Jan 2	28,526	
3	29,079	
4	29,356	
5	30,048	
6	28,249	
8	30,187	
9	29,910	
10	28,526	
11	28,526	
12	28,526	
15	30,602	
16	29,771	
17	30,187	
18	28,526	
19	29,910	
22	29,356	
23	28,664	
24	28,526	
25	30,048	
26	29,218	
*29	31,571	3629.37
30	29,771	
31	29,633	

Date	c.f.s.	Lake Elevation
1979 Feb 1	30,602	
2	29,079	
3	28,941	
5	29,356	
6	29,356	
7	29,771	
15	29,218	
16	28,526	
Mar 2	26,727	
Apr 9	23,061	
May 23	24,886	
Jun 13	28,515	
Jul 11	28,160	
13	28,031	
23	28,290	
27	28,548	
31	29,194	
Aug 1	29,194	
2	28,548	
4	28,548	
5	28,160	
6	28,935	
7	29,064	
8	28,677	
17	28,419	
20	28,677	
26	28,290	
28	28,677	
Sept 4	28,031	
6	28,419	
Oct 29	25,190	
Nov 1	25,319	
Dec 26	26,946	
1980 Jan 28	28,387	
29	28,640	
30	28,387	
Feb 5	25,898	
Mar 19	24,932	
Apr 13	25,243	
May 31	25,381	
Jun 6	28,945	
8	28,691	
9	28,945	
10	28,313	
11	28,062	
14	35,358	
15	28,062	
16	34,932	
17	39,357	
18	39,381	

*High water release for the year

Date		c.f.s.	Elevation	Date	c.f.s.	Elevation
1980 Continued						
	Jun 23	44,907				
	*24	48,998	3700.21			
	25	31,160				
	26	37,661				
	27	37,786				
	28	37,912				
	29	37,661				
	30	37,661				
	Jul 1	37,786				
	2	37,410				
	3	31,892				
	4	30,418				
	5	30,543				
	6	30,418				
	7	30,167				
	8	29,813				
	10	28,313				
	11	28,187				
	12	28,313				
	16	28,438				
	22	28,187				
	Aug 9	28,691				
	18	28,309				
	22	28,181				
	Sep 5	27,290				
	Oct 6	24,872				
	Nov 15	25,448				
	Dec 10	27,515				
1981	Jan 20	24,932				
	Feb 1	26,869				
	Mar 30	18,925				
	Apr 3	22,482				
	May 5	20,068				
	Jun 29	20,450				
	Jul 20	28,935				
	29	28,290				
	Aug 3	26,773				
	Sept 9	26,160				

*High water release for the year