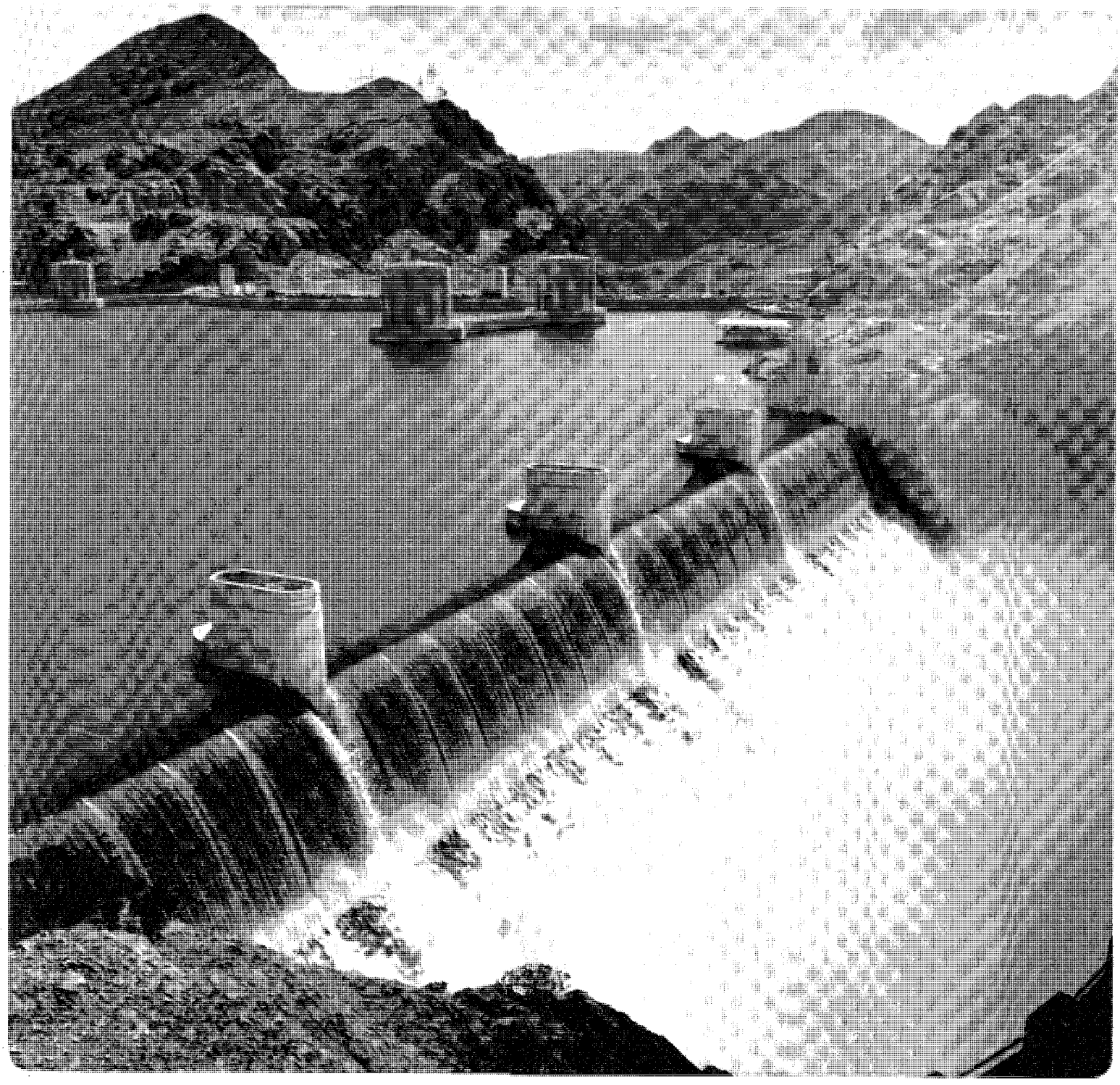
13th Annual Report

Operation of the Colorado River Basin 1983 Projected Operations 1984



Colorado River Basin

Cover: Hoover Dam Nevada Spillway.

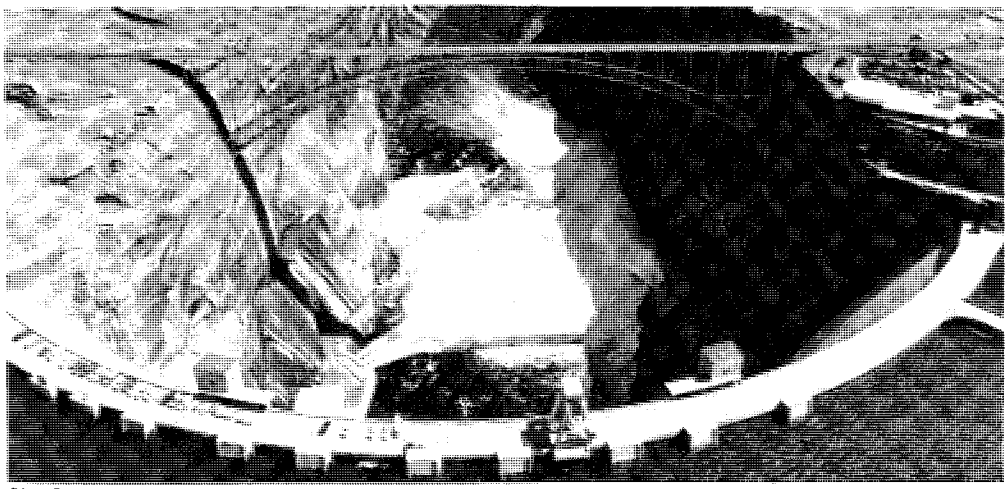
Contents

U.S. Department of the Interior

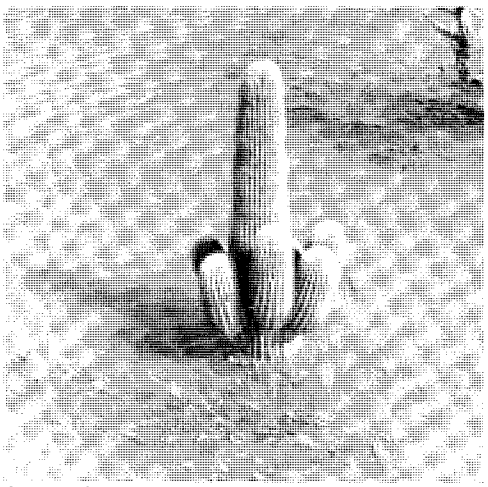
Bureau of Reclamation

January 1984

(Prepared pursuant to the Colorado River Basin Project Act of 1968, Public Law 90-537)



Glen Canyon spilling in July, 1983.



A very wet year.

Introduction

A high mountain watershed, Utah.

The operation of the Colorado River Basin during the past year and the projected operation for the current year reflect flood control, domestic use, irrigation, hydroelectric power generation, water quality control, fish and wildlife propagation, recreation, and Colorado River Compact requirements.

Storage and release of water from the Upper Basin reservoirs are governed by all applicable laws and agreements concerning the Colorado River, including the impoundment and release of water in the Upper Basin required by Section 602(a) of Public Law 90-537. The operation of the Lower Basin reservoirs reflects Mexican Treaty obligations and Lower Basin contractual commitments.

Nothing in this report is intended to interpret the provisions of the Colorado River Compact (45 Stat. 1057), the Upper Colorado River Basin Compact (63 Stat. 31), the Water Treaty of 1944 with the United Mexican States (Treaty Series 994, 59 Stat. 1219), the Decree entered by the Supreme Court of the United States in Arizona v. California, et al. (376 U.S. 340), the Boulder Canyon Project Act (45 Stat. 1057), the Boulder Canyon Project Adjustment Act (54 Stat. 774; 43 U.S.C. 618a), the Colorado River Storage Project Act (70 Stat. 105; 43 U.S.C. 620), or the Colorado River Basin Project Act (82 Stat. 885; 43 U.S.C. 1501).

Authority for Report

White water from the high country.

Pursuant to the Colorado River Basin Project Act (Public Law 90-537) of 1968, I am pleased to present to the Congress, and to the Governors of the Colorado River Basin States, the thirteenth annual report on the operation of the Colorado River Basin.

This report describes the actual operation of the reservoirs in the Colorado River drainage area constructed under the authority of the Colorado River Storage Project Act, the Boulder Canyon Project Act, and the Boulder Canyon Project Adjustment Act during water year 1983 and the projected operation of these reservoirs during water year 1984 under the "Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs," published in the Federal Register June 10, 1970.

William P. Clark, Secretary
United States Department of the Interior

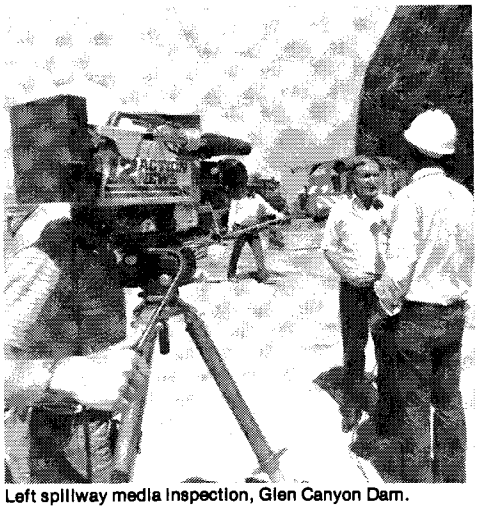
Actual Operations Under Criteria-Water Year 1983

The initial plan of operation for water year 1983, based on average inflow conditions, called for scheduled releases from Lake Powell of 9.6 million acre-feet in order to equalize storage with Lake Mead by the end of September 1983. With this release the contents of Lake Powell would have equalized with that of Lake Mead at approximately 24.2 million acre-feet.

Runoff forecasts beginning in January and updated semimonthly through March steadily declined from 112 percent to 96 percent of average, thus indicating no need for a major modification of the plan. The April runoff forecast, however, rose to 114 percent of average, following a wet March weather regime throughout the basin. Due to the already high reservoir contents throughout the system it was decided to schedule spring and summer releases from Lake Powell in excess of those required to equalize storage with Lake Mead in order to reduce the risk of spilling in water years 1983 and 1984.

By May, the runoff forecast increased only slightly to 117 percent of average, and again to 120 percent of average by mid-May. With an observed precipitation for the month of May of approximately 200 percent of normal, the June forecast of April through July runoff jumped to 9.1 million acre-feet, or 131 percent of average.

Projected Plan of Operation Under Criteria-Water Year 1984



Left spillway media inspection, Glen Canyon Dam.

It became evident, when inflow into Lake Powell did not begin to recede on or about June 7, that the forecast was too low. Subsequent precipitation in June and reevaluation of runoff and snowpack conditions resulted in the forecast being raised to 11.3 million acre-feet on June 14, 13.3 million acre-feet on June 18, and finally to 14.6 million acre-feet on June 22.

Major changes in the projected plan of operations were required to accomodate this unexpected and near record-breaking inflow. Large flood control releases were made from the major storage reservoirs as they filled to capacity and began to spill in late June and early July.

The maximum daily releases during the 1983 flooding were 92,600 cubic feet per second (cfs) from Glen Canyon Dam, 50,800 cfs from Hoover Dam, 45,100 cfs from Davis Dam and 40,300 cfs from Parker Dam. The reservoir system was operated in full accordance with established operating criteria and Corps of Engineers flood control regulations, and was effective in reducing a peak runoff of approximately 128,000 cfs into upstream reservoirs to flows less than levee design capacity along the Lower Colorado River.

Nevada Wing of Hoover Powerplant.

Actual water supply in the Colorado River Basin during water year 1983 turned out to be 180 percent of the long-term average, ranging from 200 percent in the Green River above Flaming Gorge Dam to 114 percent in the Gunnison River above Blue Mesa Dam. Aggregate Colorado River storage at the end of the water year was 58,962,000 acre-feet, representing an increase of 4,932,000 acre-feet from the previous year. By the end of the water year, active storage in the system was approximately 105 percent of the January 1 maximum available storage. This "maximum available storage" represents storage at all Bureau of Reclamation (Reclamation) and Colorado River Storage Project (CRSP) reservoirs, Lake Havasu and above. Flood control regulations require a minimum of 5,350,000 acre-feet of vacant space in the system on January 1.

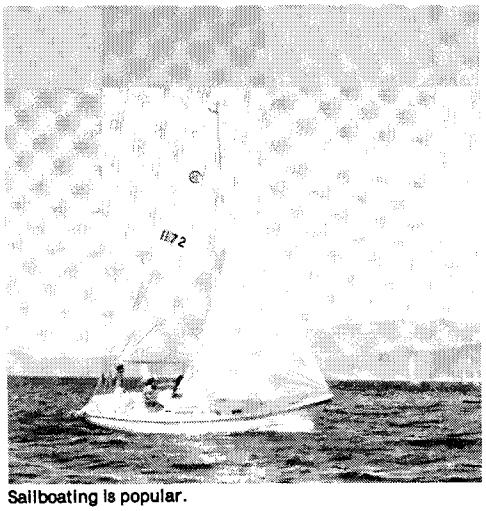
High waters at Gilmore Camp, California.

Determination of "602[a] Storage"

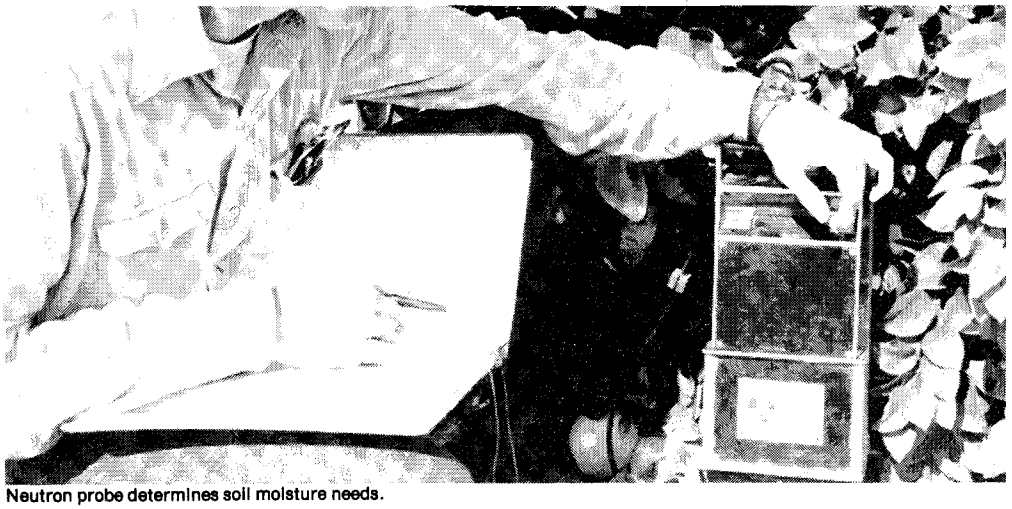
Section 602(a)(3) of the Colorado River Basin Project Act of September 30, 1968 (Public Law 90-537), provides for the storage of Colorado River water, not required to be released under article III(c) and III(d) of the Colorado River Compact in Upper Basin reservoirs, to the extent the Secretary of the Interior (Secretary) finds it necessary to assure compact deliveries without impairment of annual consumptive uses in the Upper Basin.

Article II of the "Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs" (Operating Criteria) provides that the annual plan of operation shall include a determination by the Secretary of the quantity of water considered necessary to be in Upper Basin storage as of September 30 of the current year.

This determination shall consider all applicable laws and relevant factors including, but not limited to the following: (a) historic streamflows; (b) the most critical period of record; (c) probabilities of water supply; (d) estimated future depletions in the Upper Basin, including the effects of recurrence of critical periods of water supply; (e) the "Report of the Committee on Probabilities and Test Studies to the Task Force on Operating Criteria for the Colorado River," dated October 30, 1969, and such additional



Sailboating is popular.



Neutron probe determines soil moisture needs.

studies as the Secretary deems necessary; (f) the necessity to assure that Upper Basin consumptive uses are not impaired because of failure to store sufficient water to assure deliveries under Section 602(a)(1) and (2) of Public Law 90-537.

Taking into consideration these relevant factors, the Secretary has determined that the active storage in Upper Basin reservoirs forecast for September 30,1984, exceeds the "602(a) Storage" requirement under any reasonable range of assumptions which might be applied to those items previously listed. Therefore, the accumulation of "602'(a) Storage"is not the criterion governing the release of water during the current year.

Mexican Treaty Obligations

Annual calendar year schedules of monthly deliveries of water in the limitrophe section of the Colorado River, allotted in accordance with the Mexican Water Treaty signed in 1944, are formulated by the Mexican Section and presented to the United States Section, International Boundary and Water Commission, (Commission), before the beginning of each calendar year.

Upon 30 days advance notice to the United States Section, Mexico has the right to modify, within the total schedule, any monthly quantity prescribed by the schedule by not more than 20 percent. During water year 1983, Mexico received a total delivery of about 9,043,000 acre-feet at the Northerly International Boundary.

Of the 9,043,000 acre-feet of mainstream Colorado River water reaching the Boundary, about 2,989,000 acre-feet was delivered through the Pilot Knob Powerplant wasteway from the All-American Canal. An estimated 5,555,000 acre-feet was released through the Laguna Dam. The remainder of the flow at the Northerly International Boundary was made up of return flows to the Colorado River below the Laguna Dam, and returns to the Gila River below the gaging station near Dome.

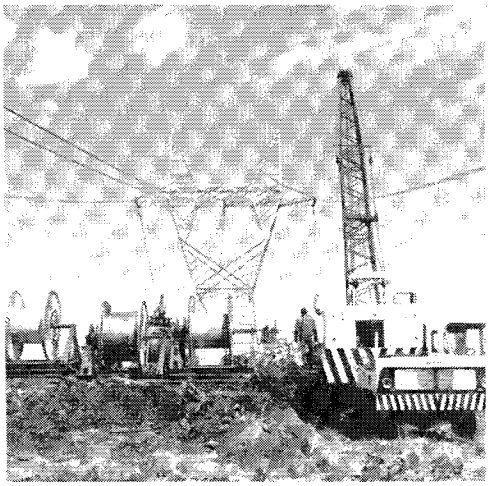
Because of the current water supply conditions, the United States will make scheduled deliveries of 1,700,000 acre-feet of Colorado River water to the Republic of Mexico in calendar year 1984. This release of water is based upon average runoff conditions for the year. Should the runoff in water year 1984 be substantially above average, significant releases for flood control purposes could be required from Hoover Dam. Representatives of the Republic of Mexico will be kept informed of operating schedules through the United States Section of the Commission.

Regulatory Wastes

Deliveries to Mexico consist of river water delivered to Imperial Dam and waste and drainage return flows from water users below Imperial Dam. In addition to assuring normal water deliveries, the small amount of regulatory storage space in Imperial,Laguna, and Senator Wash Reservoirs was used at times to limit potential downstream flood damages during water year 1983. Regulatory waste for water year 1984 will depend on the actual hydrologic conditions occurring during that time.

Projected Plan of Operation-Water Year 1984

Cleaning a day's catch.



Stringing equipment for transmission line.

A proposed operation plan for water year 1984 for the Colorado River reservoir system was formulated and distributed to representatives of the Colorado River Basin States in October 1983. The plan was prepared in accordance with the Operating Criteria published June 4, 1970, in compliance with Section 602, Public Law 90-537. The plan reflects operation for flood control, domestic and irrigation use of water, hydroelectric power generation, water quality control, fish and wildlife propagation, recreation, and Colorado River Compact requirements.

The plan was based on the need to draw the reservoir system down after the high runoff experienced in water year 1983 to facilitate repairs to the Glen Canyon Dam spillways and to other flood damaged facilities. Large releases are expected to continue from the reservoirs through at least March 1984. These releases are necessary in order to reach a level of system storage space by April 1, 1984, that would enable the system to handle a heavy runoff volume without requiring spillway flows at Glen Canyon Dam and without requiring damaging flood releases from Hoover, Davis and Parker Dams. Releases in the period from April through July will be based on forecasted runoff conditions but will result in greater available space on August 1, 1984, than the minimum flood control requirement of 1.5 million acre-feet.

The plan calls for a minimum objective release from Lake Powell of 11.6 million acre-feet under lower quartile inflow conditions. Under average to upper decile inflow conditions, the scheduled releases from Lake Powell are projected to range from 14.6 to 18.4 million acre-feet.

The projected operation for average runoff conditions for each reservoir in the Colorado River Basin for water year 1984 is described in the following pages. Charts 1-8 show the projected monthly outflows from each reservoir for five assumed hydrologic conditions. Each condition reflected the most current hydrologic information available by including actual forecasted October and November 1983 inflows. Inflows for the remainder of the year were based on the following assumptions of 1984 modified runoff from the basin: (1) average based on the 1906-1981 record of runoff; (2) upper quartile based on the annual level of streamflow which has been exceeded 25 percent of the time during 1906-1981; (3) upper decile based on the annual level of streamflow which has been exceeded 10 percent of the time during 1906-1981; (4) lower quartile based on flows exceeded 75 percent of the time during 1906-1981; and (5) most adverse based on the lowest year of record, which was 1977.

Upper Basin Reservoirs
Fontenelle Reservoir
[Green River]

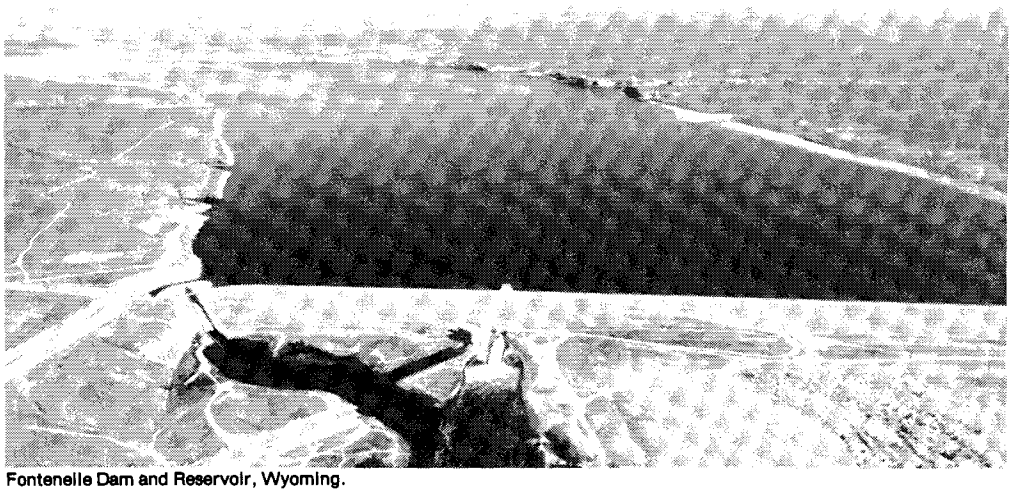
Water Year 1983
The water year 1983 plan of operation for Fontenelle Reservoir was formulated in response to evidence of increased seepage observed along the left abutment of the dam in the fall of 1982. Starting in mid-September and continuing through October 1982, the water surface elevation was drawn down 11 feet to elevation 6495 feet in order to initiate an intensive drilling and test program to investigate the cause and to determine what remedial actions were required. During this period of rapid drawdown, maximum average daily releases reached 10,000 cfs.

To ensure safe operation of the dam, a decision was made to restrict the maximum water surface elevation in water year 1983 to 6496 feet, 10 feet below the spillway crest. Through the remainder of winter and spring, the water surface was gradually lowered to elevation 6476 feet by April 20, 1983. Although the April through July runoff above Fontenelle Reservoir was 1,239,000 acre-feet, approximately 142 percent of average, the reservoir was maintained below water surface elevation 6496 feet, except for 3 days during the peak inflow.

Maximum water surface elevation of the reservoir reached 6497 feet with a content of 274,500 acre-feet on June 14, 1983. Peak inflow of 11,770 cfs occurred on June 13, 1983. During this period the maximum average daily outflow from the reservoir was 9,130 cfs.

In early July 1983, a decision was made, based upon preliminary geologic information, to lower the water surface elevation to 6482 feet in order to accelerate the testing program. Within 2 weeks, the water surface was lowered from elevation 6495 feet to 6482 feet. During this period, maximum average daily discharge reached 12,150 cfs, still 1,000 cfs less than the safe channel capacity below the dam. The water surface elevation remained at or near elevation 6482 feet throughout the remainder of the water year.

A total of 2,029,000 acre-feet was released through the reservoir during water year 1983, with 1,011,000 acre-feet bypassing the powerplant.


Fontenelle Dam and Reservoir, Wyoming.

Water Year 1984
At the beginning of water year 1984, Fontenelle Reservoir was at water surface elevation of 6482 feet, with a water storage content of 177,000 acre-feet. The testing and monitoring program will continue through water year 1984. Preliminary results of these investigations are expected by January 1984. Final results with recommendations for necessary remedial action are due by August 1984.

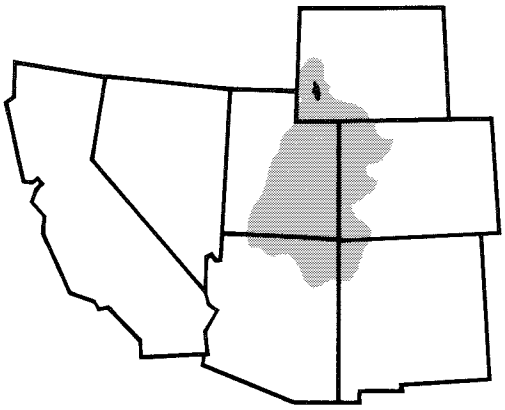
Due to the extensive monitoring network, the dam can be operated safely to supply downstream water needs. However, the reservoir will be operated at reduced levels, between water surface elevations 6475 feet and 6482 feet. The reseryoir will be gradually drawn down to elevation 6475 feet prior to the spring runoff, and will then be allowed to rise to elevation 6482 feet during the peak of the runoff. The reservoir will be maintained at or near this elevation through the remainder of the water year.

The maximum release from the reservoir will be primarily dependent on the magnitude of the runoff. If the runoff is in the upper decile, the peak outflow is expected to be approximately 9,000 cfs. An upper quartile runoff would result in a peak outflow of approximately 7,500 cfs. With an average runoff, the anticipated peak outflow is 6,000 cfs. Assuming a lower quartile runoff, or less, the outflow will probably be no greater than 4,500 cfs.

Fontenelle Active Storage* **Chart 1**

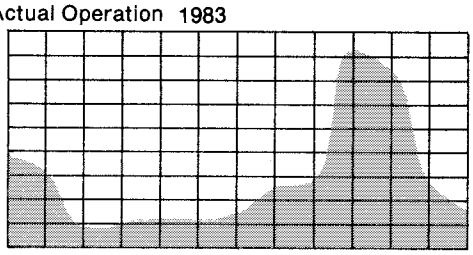
Reservoir	(Acre-Feet)	El.(Ft.)
Maximum Storage	344,834	6506
Rated Head	233,789	6491
Minimum Power	194,962	6485
Surface Area (Full)	8058 Acres	
Reservoir Length (Full)	18 Miles	
Power Plant		
Number of Units	1	
Total Capacity	10,000 Kilowatts	

*does not include 563 acre-feet of dead storage below 6408 feet



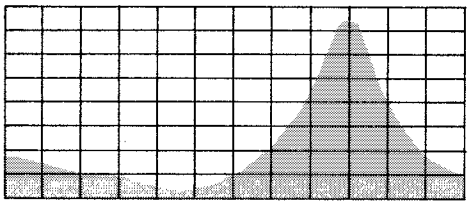
Outflow Monthly Release in 1000 Cubic Feet/Second

Actual Operation 1983

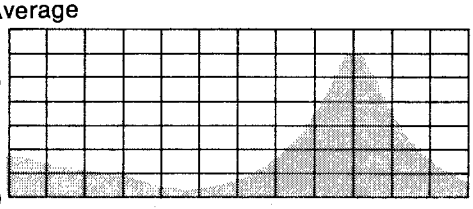


Projected Operation 1984

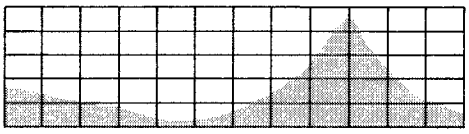
Upper Quartile



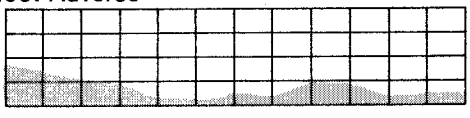
Average



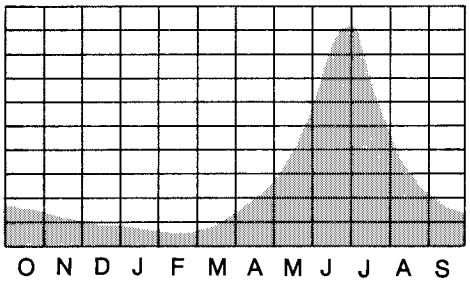
Lower Quartile

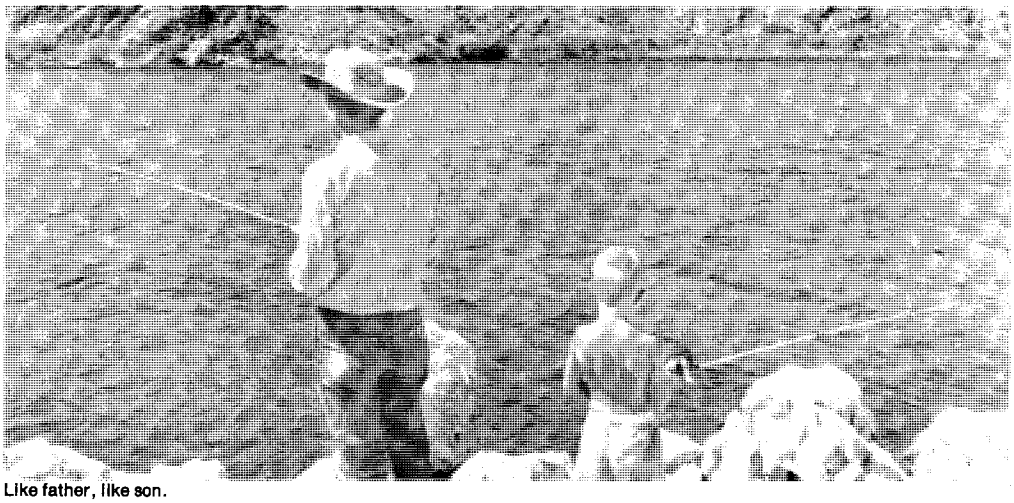


Most Adverse



Upper Decile





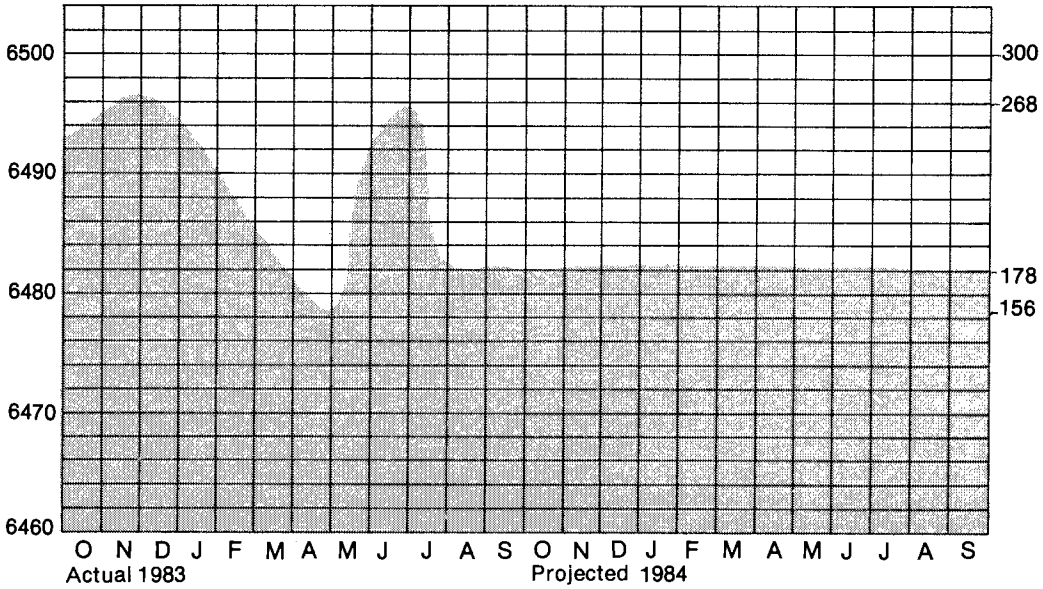
Like father, like son.

Storage

End of Month Elevation in Feet

Usable Content in 1000 Acre-Feet

Non-Linear Scale



Legend

Most Probable

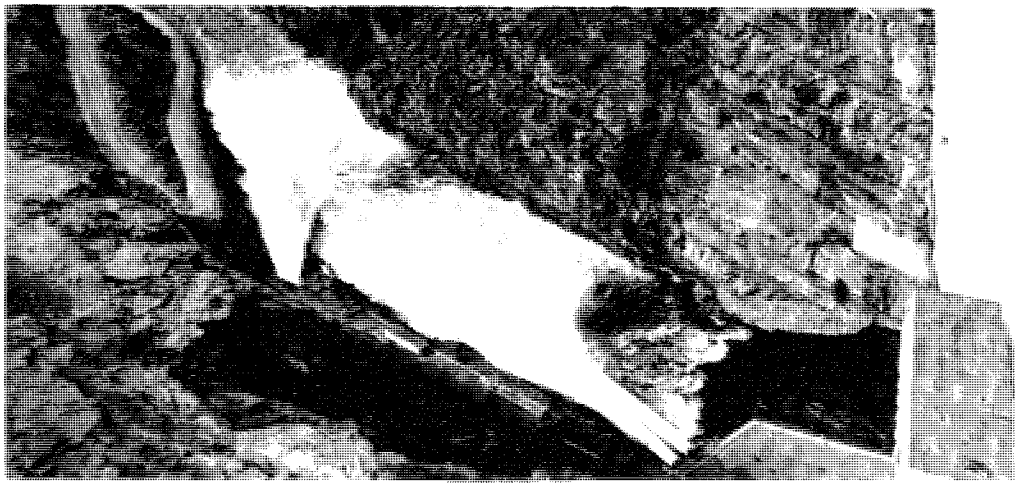
Flaming Gorge Reservoir [Green River]

Water Year 1983

At the beginning of water year 1983, Flaming Gorge Reservoir stored 3,572,000 acre-feet at water surface elevation 6036 feet. Due to high carryover storage and scheduled spillway repair work, higher than normal releases through the reservoir were scheduled for water year 1983.

The water surface was drawn down to elevation 6025 feet prior to the spring runoff. During the draw down, average daily outflow from the reservoir rarely fell below 2,500 cfs. However, due to record runoff above Flaming Gorge, the reservoir filled to elevation 6040 feet by mid-June, and continued to rise almost an additional 4 feet into surcharge. As the water surface elevation approached 6040 feet, a decision was made to place 5-foot high reinforced wooden extensions on the spillway gates to limit the flow through the spillway, thereby minimizing damage to the yet unfinished spillway repair work. Maximum water surface elevation reached 6044 feet with a storage of 3,911,100 acre-feet. By the end of the water year, the reservoir was lowered to elevation 6038 feet and stored 3,676,000 acre-feet of water.

Runoff above Flaming Gorge Reservoir for the water year was 3,175,000 acre-feet, or 200 percent of the average. Maximum inflow into Flaming Gorge of 18,350 cfs occurred on June 11, 1983. During the period of peak inflow, maximum average daily releases from the reservoir ranged from 8,000 to 10,000 cfs. However, another peak inflow of 15,120 cfs occurred on July 5, 1983, which coincided with the directed rapid drawdown of Fontenelle Reservoir upstream. During this period a maximum release of 12,000 was sustained for 2 days, and was then gradually reduced to 4,000 cfs over the next few weeks. The reservoir outflow then remained at or near 4,000 cfs, powerplant capacity, throughout the remainder of the water year.



Tunnel spillway in operation at Flaming Gorge Dam.

Water Year 1984

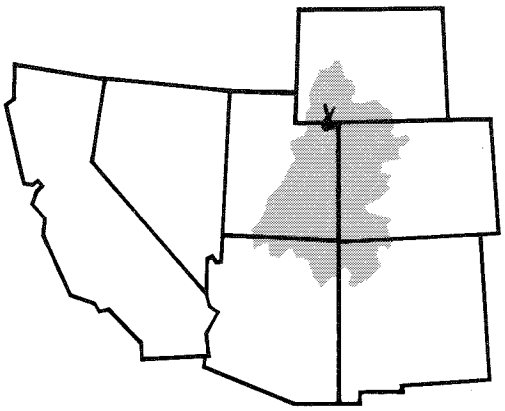
During water year 1984, the reservoir water surface level at Flaming Gorge Reservoir is projected to be drawn down from elevation 6038 feet to about elevation 6023 feet before the spring of 1984. The water surface level will remain high enough under any inflow conditions to launch boats from the reservoir's nine ramps. Maximum water surface elevation of 6035 feet, with a storage of 3,546,000 acre-feet is expected in July.

Due to high carryover storage and scheduled spillway repair work in 1984, releases from Flaming Gorge Reservoir will be higher than average in water year 1984. Under any inflow condition, flow in the river below the dam is not expected to exceed 4,000 cfs or fall below 1,000 cfs.

Flaming Gorge Active Storage* **Chart 2**

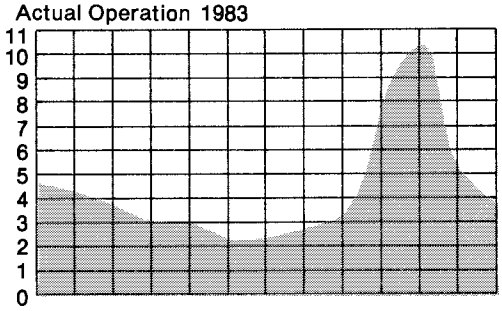
Reservoir	(Acre-Feet)	El. (Ft.)
Maximum Storage	3,749,000	6040
Rated Head	1,062,000	5946
Minimum Power	233,000	5871
Surface Area (Full)	42,020 Acres	
Reservoir Length (Full)	91 Miles	
Power Plant		
Number of Units	3	
Total Capacity	108,000 Kilowatts	

*does not include 40,000 acre-feet of dead storage below 5740 feet



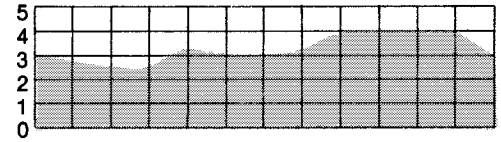
Outflow Monthly Release in 1000 Cubic Feet/Second

Actual Operation 1983

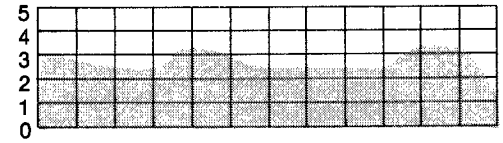


Projected operation 1984

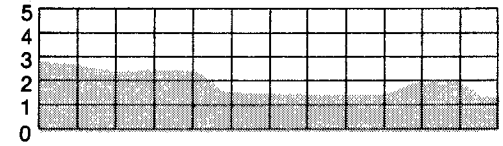
Upper Quartile



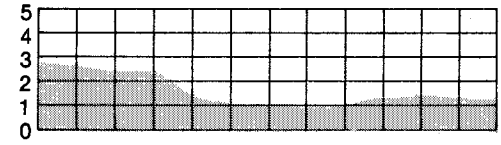
Average



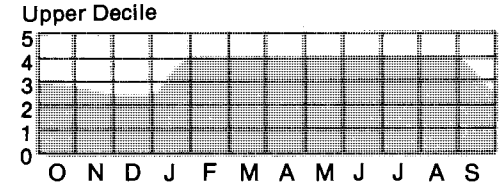
Lower Quartile

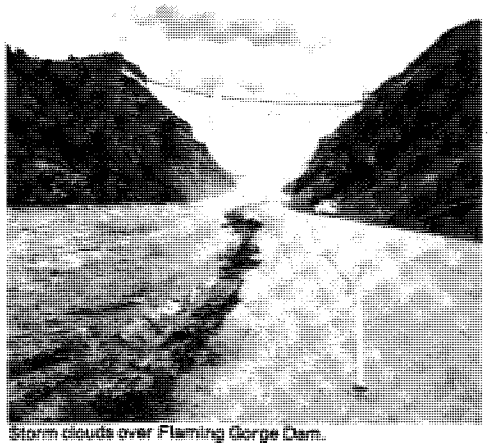


Most Adverse



Upper Decile





Storm clouds over Flaming Gorge Dam.

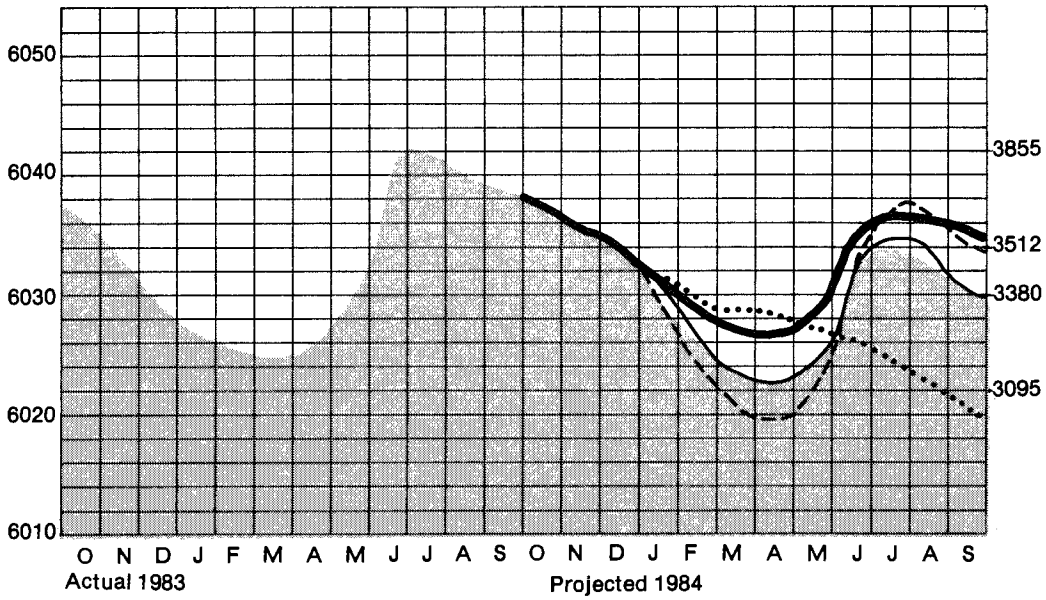
Clean water is essential.

Storage

Usable Content in 1000 Acre-Feet

End of Month Elevation in Feet

Non-Linear Scale



Legend

Most Probable

Upper Quartile

Lower Quartile

Most Adverse

Upper Decile

Wayne N. Aspinall Unit [Gunnison River]
Blue Mesa Reservoir
Morrow Point Reservoir
Crystal Reservoir

Water Year 1983

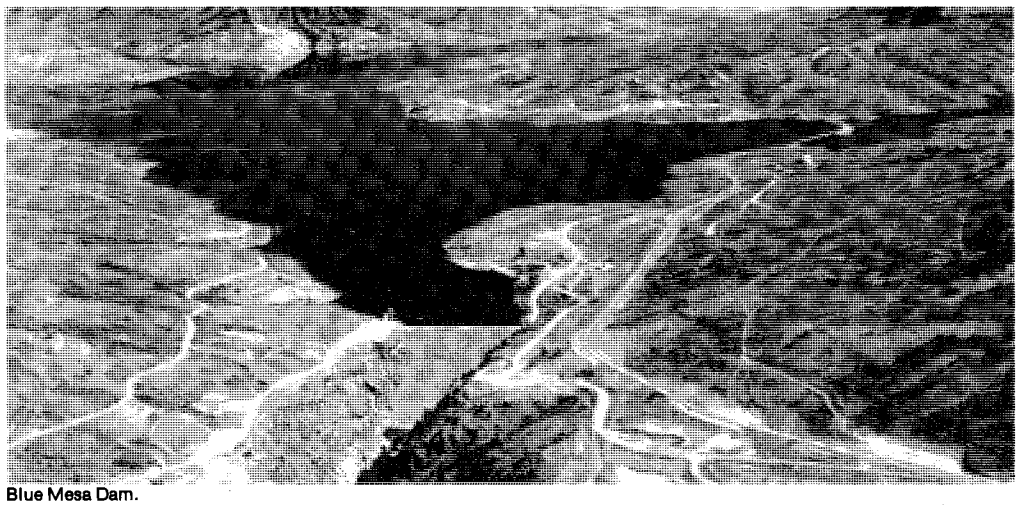
The Wayne N. Aspinall Unit, formerly the Curecanti Unit, includes Blue Mesa, Morrow Point, and Crystal Reservoir. Blue Mesa provides nearly all of the long-term regulation for all three powerplants. Morrow Point provides peaking power, and thus has highly variable releases. The primary function of the Crystal Reservoir is to reregulate the variable Morrow Point releases.

At the beginning of water year 1983, Blue Mesa Reservoir was at water surface elevation 7509 feet, and stored 739,100 acre-feet. The water surface was gradually lowered to elevation 7469 feet, with a content of 429,300 acre-feet, prior to the spring runoff.

The April through July runoff above Blue Mesa was 840,000 acre-feet, or 135 percent of normal. With this runoff, the reservoir filled by the end of June, reaching elevation 7519 feet and storing 822,600 acre-feet. This water surface elevation was sustained through mid-July. During this period, 135,000 acre-feet bypassed the powerplant. By the end of the water year, the water surface was gradually reduced to elevation 7509 feet and the reservoir stored 739,900 acre-feet. A peak inflow of 8,320 cfs occurred on June 20, 1983; maximum outflow of 5,720 cfs occurred on July 1, 1983.

Morrow Point Reservoir was operated at or near capacity between elevations 7153 feet and 7157 feet. During April through July, tributary inflow into the Morrow Point Reservoir was 110,000 acre-feet, 186 percent of normal. A total of 1,367,000 acre-feet was released, with 81,000 acre-feet of water bypassing the powerplant.

Crystal Reservoir was also operated at or near reservoir capacity. The April through July tributary inflow into this reservoir was 182,000 acre-feet or 207 percent of average. A total of 1,624,000 acre-feet was released, with 460,000 acre-feet bypassing the powerplant. During water year 1983, minimum daily outflow from the reservoir was approximately 1,260 cfs. Maximum outflow of 10,000 cfs occurred on June 26, 1983. The maximum outflow would have been greater than 13,000 cfs had not Blue Mesa and Taylor Park Reservoirs moderated the peak inflow. Thus the operation of these reservoirs reduced flood damage along the Gunnison River near Delta, Colorado.



Blue Mesa Dam.

Water Year 1984

Assuming average inflow conditions for water year 1984, the Blue Mesa Reservoir is expected to reach a low of 7464 feet with a content of 398,000 acre-feet by March 1984. The reservoir is projected to fill to near maximum capacity at elevation 7518 feet and to store 819,000 acre-feet by the end of July.

The Morrow Point Reservoir will operate at or near its capacity during the current year. Crystal Reservoir will also operate nearly full except for daily fluctuations needed in regulating the releases from Morrow Point and to meet downstream requirements for fish habitat and diversions through the Gunnison Tunnel.

Assuming average runoff conditions, releases from Crystal Reservoir will be maintained at powerplant capacity--about 1,600 cfs. Under lower quartile runoff conditions, releases will range from a minimum of 700 cfs to a maximum of 1,700 cfs. If the inflow is above average, it will be necessary to bypass the powerplant, possibly with releases as high as 4,000 cfs.

Blue Mesa Active Storage* **Chart 3**

Reservoir	(Acre-Feet)	El.(Ft.)
Maximum Storage	829,523	7519
Rated Head	249,395	7438
Minimum Power	81,070	7393
Surface Area (Full)	9,180 Acres	
Reservoir Length (Full)	24 Miles	
Power Plant		
Number of Units	2	
Total Capacity	60,000 Kilowatts	

*does not include 111,232 acre-feet of dead storage below 7358 feet

Morrow Point Active Storage*

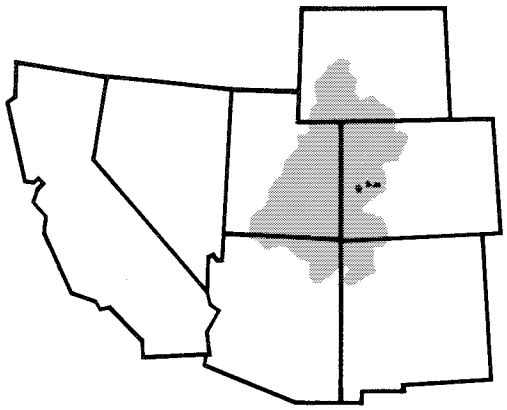
Maximum Storage	117,025	7160
Rated Head	79,805	7108
Minimum Power	74,905	7100
Surface Area (Full)	817 Acres	
Reservoir Length (Full)	11 Miles	
Power Plant		
Number of Units	2	
Total Capacity	120,000 Kilowatts	

*does not include 165 acre-feet of dead storage below 6808 feet

Crystal Active Storage*

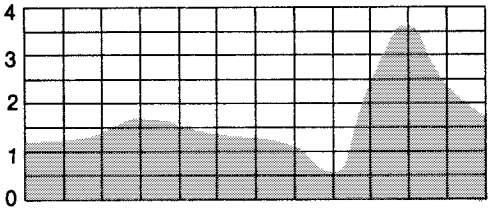
Maximum Storage	17,573	6755
Rated Head	13,886	6742
Minimum Power	10,619	6729
Surface Area (Full)	301 Acres	
Reservoir Length (Full)	7 Miles	
Power Plant		
Number of Units	1	
Total Capacity	28,000 Kilowatts	

* does not include 7,700 acre-feet of dead storage below 6670 feet.



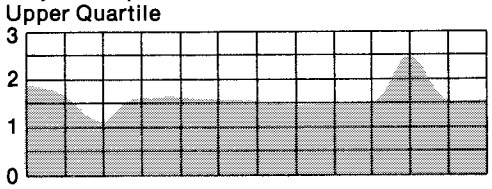
Outflow Blue Mesa Reservoir

Actual 1983 Monthly Release in 1000 Cubic Feet/Second

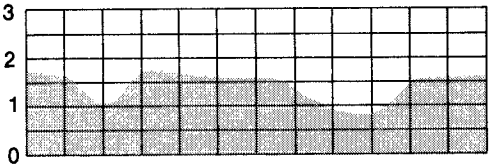


Projected Operation 1984

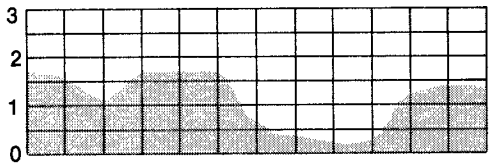
Upper Quartile



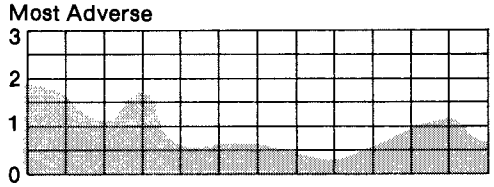
Average



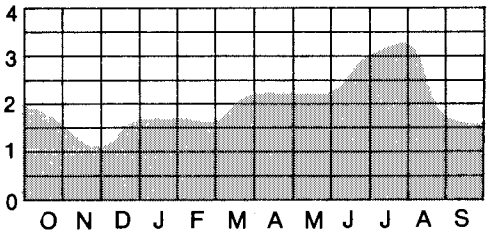
Lower Quartile

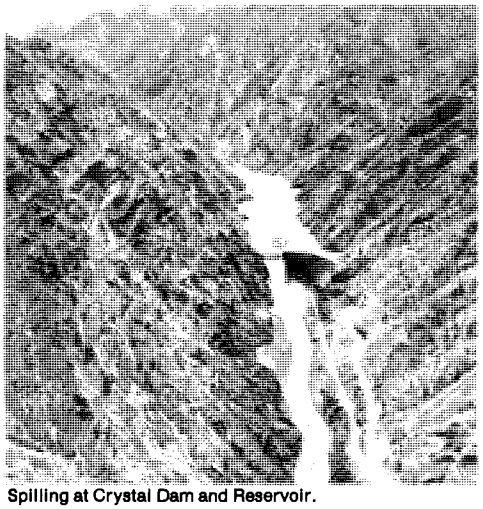


Most Adverse

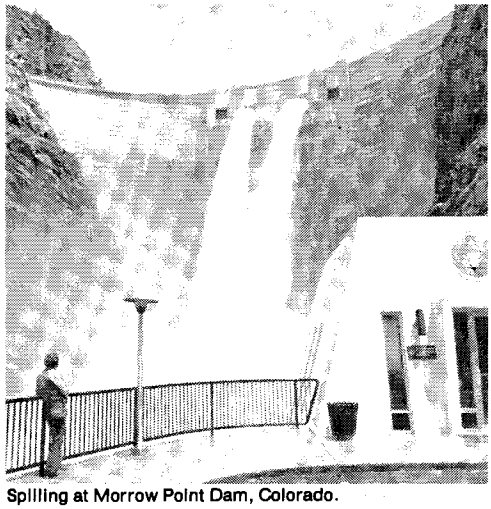


Upper Decile





Spilling at Crystal Dam and Reservoir.



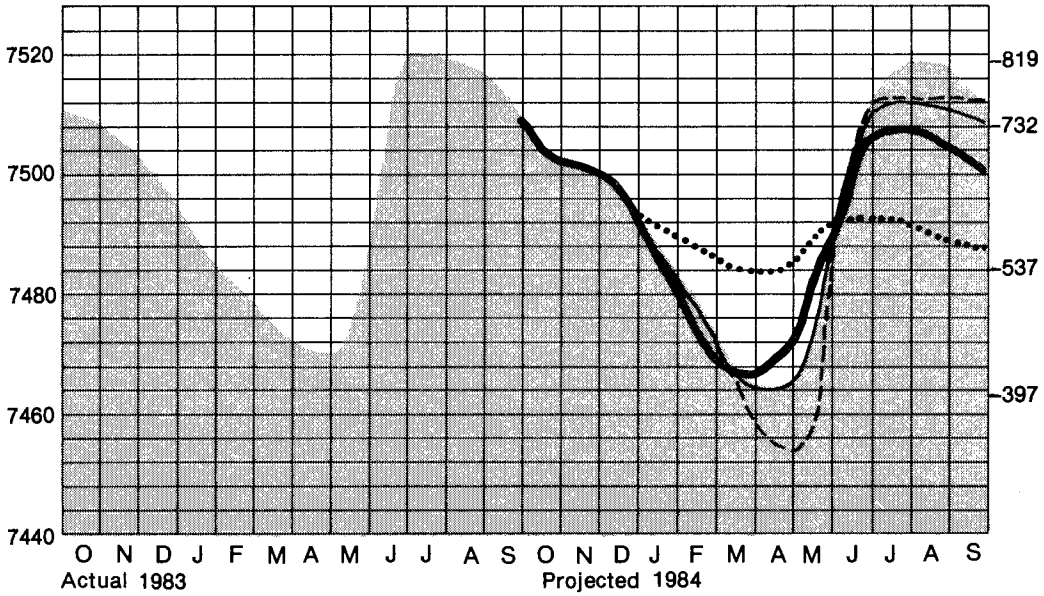
Spilling at Morrow Point Dam, Colorado.

Storage Blue Mesa Reservoir

End of Month Elevation in Feet

Usable Content in 1000 Acre-Feet

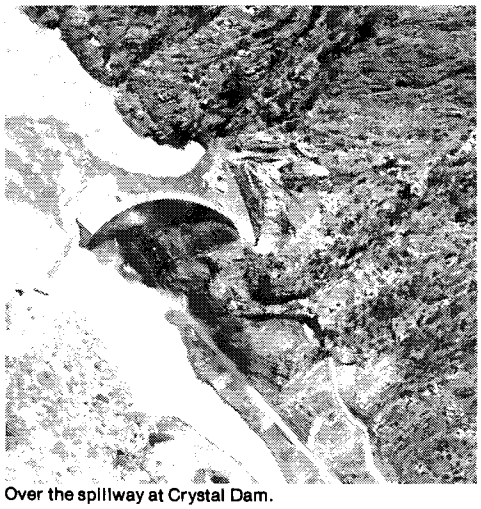
Non-Linear Scale



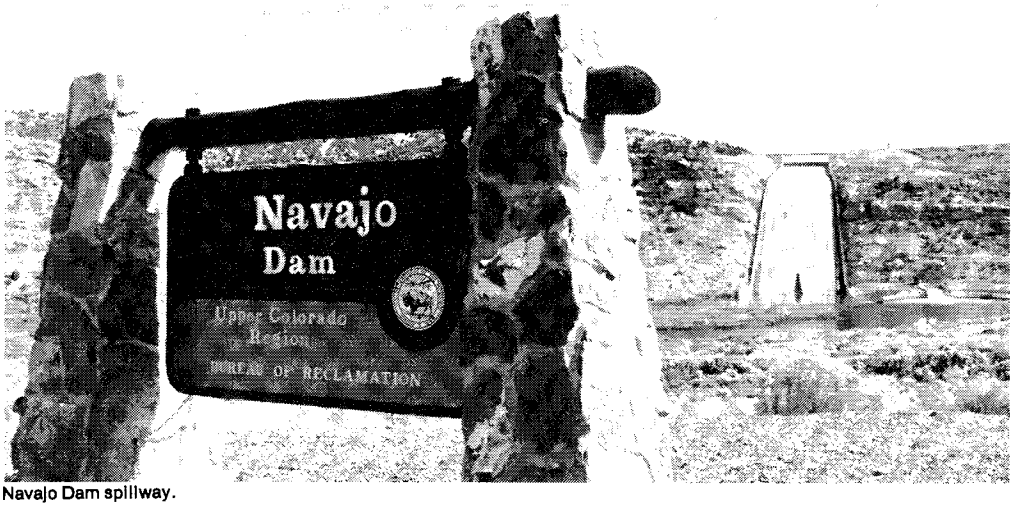
Legend

- Most Probable
- Upper Quartile
- Lower Quartile
- Most Adverse
- Upper Decile

Navajo Reservoir
[San Juan River]



Over the spillway at Crystal Dam.



Navajo Dam spillway.

Water Year 1983
At the beginning of water year 1983, Navajo Reservoir was at elevation 6072 feet with a content of 1,506,000 acre-feet. The reservoir was gradually lowered to elevation 6057 feet prior to the spring runoff, with 1,309,000 acre-feet in storage. Minimum average daily releases during this period were 810 cfs.

With an April through July runoff of 899,000 acre-feet, 128 percent of normal, the reservoir water surface reached a maximum elevation of 6084 feet in early July. At this elevation, approximately 1 foot from full capacity, the reservoir stored 1,679,000 acre-feet. The water surface elevation was then gradually reduced to elevation 6080 feet by the end of the water year.

The maximum average daily inflow to Navajo Reservoir of 8,390 cfs occurred on June 1, 1983. Maximum daily outflow from the reservoir was 2,810 cfs. This reduction in flow reduced flood damage not only on the San Juan River but also on the lower reaches of the Colorado River. A total of 1,141,000 acre-feet was released to the San Juan River, and 130,000 acre-feet were furnished to the Navajo Indian Irrigation Project.

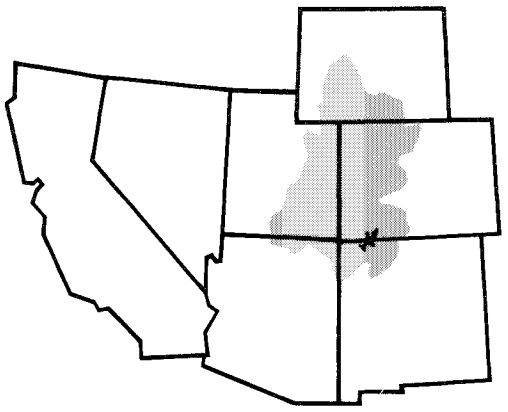
Water Year 1984
On September 30, 1983, Navajo Reservoir stored 1,617,900 acre-feet of water at an elevation of 6080 feet. Assuming average inflow for water year 1984, the projected elevation before snowmelt runoff begins is 6059 feet with a content of 1,329,000 acre-feet. By the end of June 1984, the reservoir is expected to reach an elevation of 6081 feet with a content of 1,641,000 acre-feet. This approximate elevation will be maintained throughout the summer to enhance recreational use.

Releases from Navajo Reservoir for an upper quartile inflow are projected to average 1,200 cfs through the fall and winter and increase to a maximum of 2,000 cfs during the summer. With an upper decile inflow, outflow from the reservoir is expected to peak at 3,200 cfs. For an average inflow, releases are expected to average about 1,250 cfs throughout the year. The projected lower quartile and most adverse releases are projected to average about 900 cfs and 700 cfs, respectively, throughout the water year.

Navajo Active Storage* **Chart 4**

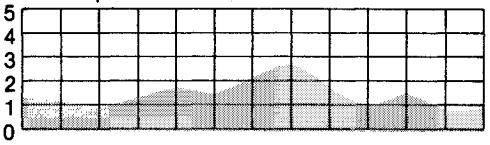
Reservoir	(Acre-Feet)	El. (Ft.)
Maximum Storage	1,696,400	6085
Inactive Storage	660,500	5990
Surface Area (Full)	15,610 Acres	
Reservoir Length (Full)	33 Miles	

*does not include 12,600 acre-feet of dead storage below 5775 feet



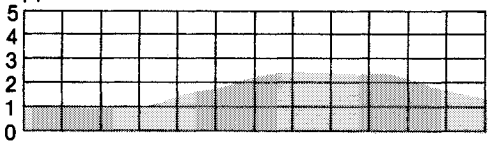
Outflow Monthly Release In 1000 Cubic Feet / Second

Actual Operation 1983

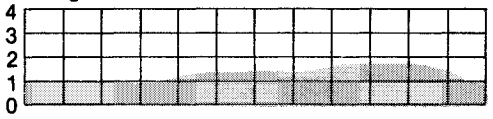


Projected Operation 1984

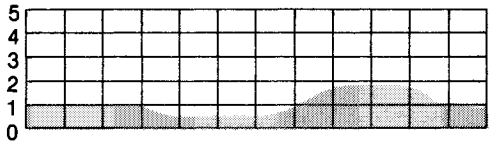
Upper Quartile



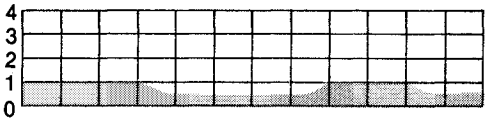
Average



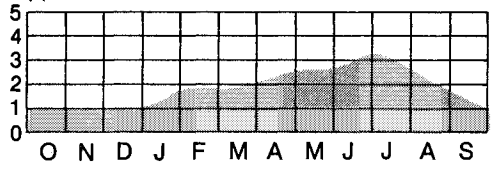
Lower Quartile

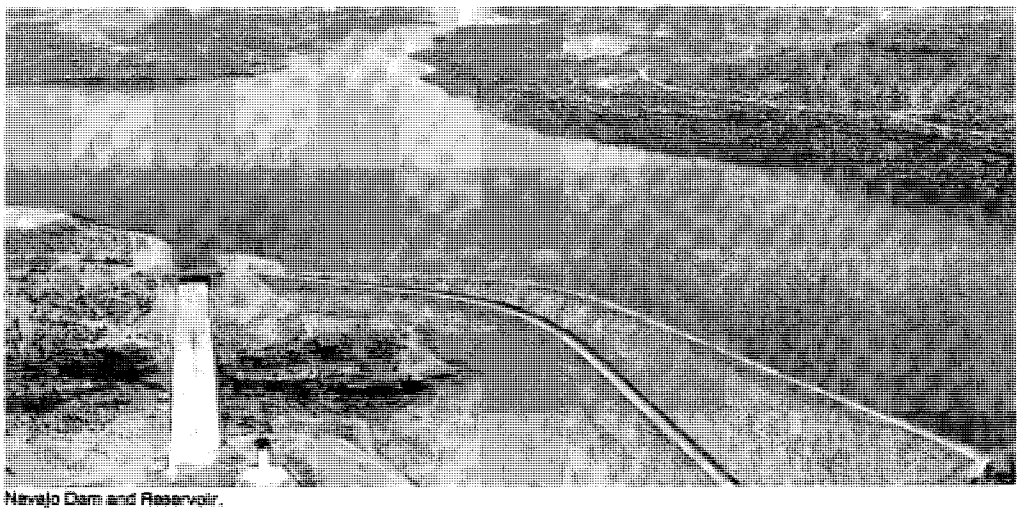


Most Adverse



Upper Decile





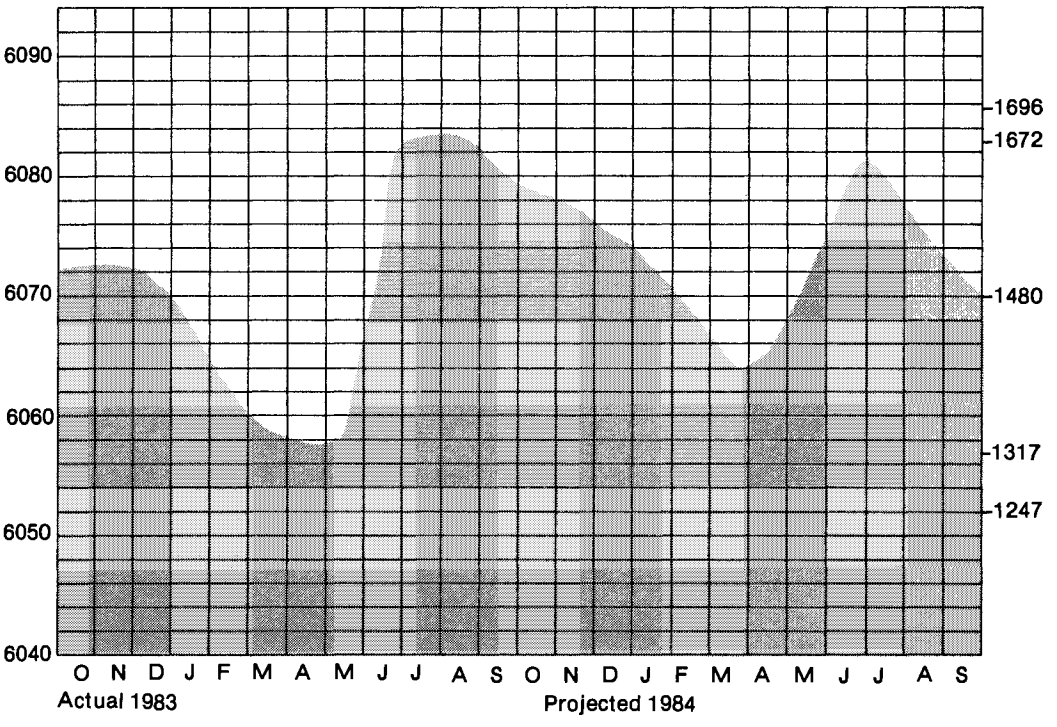
Navajo Dam and Reservoir.

Storage

End of Month Elevation In Feet

Usable Content in 1000 Acre-Feet

Non-Linear Scale



Legend

Most Probable

Upper Quartile

Lower Quartile

Most Adverse

Upper Decile

Lake Powell [Colorado River]

Water Year 1983

During water year 1983, Lake Powell, which is impounded by Glen Canyon Dam, was operated as part of the CRSP in accordance with governing contracts and laws to provide river regulation, optimum power production, recreation, and fish and wildlife enhancement.

On September 30, 1982, the Lake Powell water surface elevation was 3,687 feet with an active content of 23,005,000 acre-feet. The water surface elevation was gradually drawn down to a low of 3,682 feet prior to the spring runoff.

An unusual and unpredictable combination of below normal May temperatures and heavy late spring storms followed rapidly by much above normal temperatures from late May through mid-June and heavy basin-wide rains resulted in a near record-breaking April through July runoff in the Colorado River above Lake Powell. The April through July inflow to Lake Powell was 14.5 million acre-feet, about 190 percent of the long-term average, and the highest inflow for that period since the 1920 record of 14.7 million acre-feet. Runoff above Lake Powell for all of water year 1983 totaled 20.5 million acre-feet, approximately 180 percent of average.

With this near record inflow, the Lake Powell water surface elevation rose past its normal maximum of 3,700 feet to a high of 3708.34 feet on July 14, 1983.

As the water surface rose above 3,700 feet, the flow of water through Glen Canyon Dam's spillway began to cause damage to the concrete lining of the spillways. To reduce the flow of water through the spillways, 8-foot high reinforced steel extensions were placed on the spillway gates. The placement of the spillway gate extensions also reduced the release of water to Lake Mead by permitting the safe storage of almost 1.4 million acre-feet in the reservoir's surcharge pool. The operation of the reservoir was effective in reducing the peak inflow of approximately 116,000 cfs to a maximum daily release of 92,600 cfs near the end of June 1983. The total release of water from Lake Powell during water year 1983 was approximately 17.4 million acre-feet, with 3.6 million acre-feet bypassing the powerplant. Powerplant bypass began on June 2, 1983, and continued through August 11, 1983. By the end of the water year, the active storage in Lake Powell was 24,817,000 acre-feet at elevation 3,699 feet.

Lake Powell and Glen Canyon Dam from visitor's center.

Water Year 1984

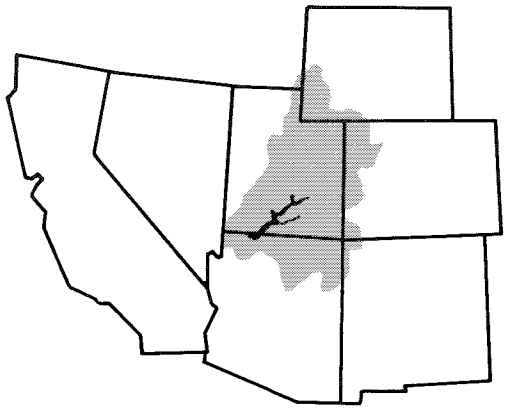
The water year 1984 plan of operation for Lake Powell has been developed in response to scheduled spillway repair work necessitated by the damage caused by the high flows in 1983. The plan is to draw the water surface elevation down sufficiently to enable the reservoir to handle a heavy runoff volume as experienced in 1983, without requiring spillway flows. To draw the reservoir down to approximately elevation 3673 feet, prior to the spring runoff, powerplant capacity releases of approximately 25,000 cfs are scheduled through March 1984. Beginning April 1, 1984, releases will be based on the April through July volume runoff forecast reflecting the current hydrologic conditions.

Assuming average runoff conditions, scheduled releases from Lake Powell will be 14.5 million acre-feet. If the runoff is in the lower quartile, the releases are expected to be at least 11.6 million acre-feet. With an upper quartile or greater inflow, the releases from Lake Powell will likely exceed 15.6 million acre-feet. With an upper decile inflow, it will be necessary to bypass the powerplant.

Lake Powell Active Storage* **Chart 5**

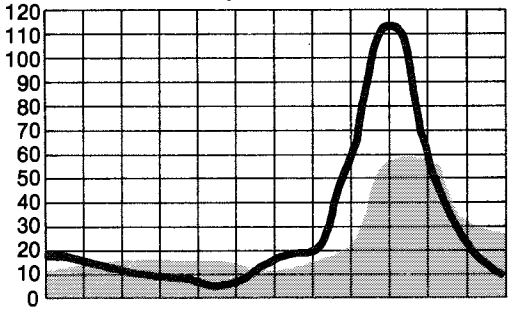
Reservoir	(Acre-Feet)	El. (Ft.)
Maximum Storage	25,002,000	3700
Rated Head	9,428,000	3570
Minimum Power	4,126,000	3490
Surface Area (Full)	161,390 Acres	
Reservoir Length (Full)	186 Miles	
Power Plant		
Number of Units	8	
Total Capacity	1,021,000 Kilowatts	

*does not include 1,998,000 acre-feet of dead storage below 3370 feet



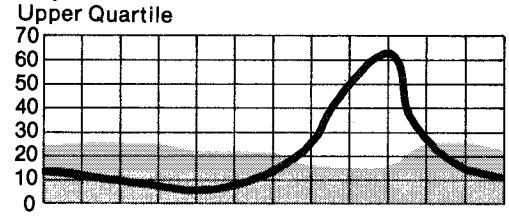
Inflow **Outflow**

Actual 1983 Monthly Values In 1000 Cubic Feet/Second

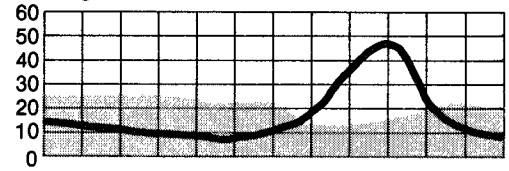


Projected 1984

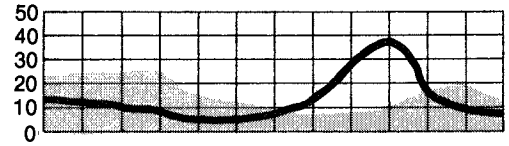
Upper Quartile



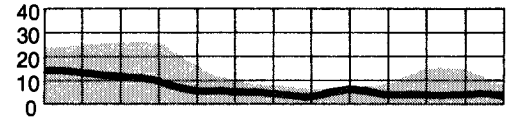
Average



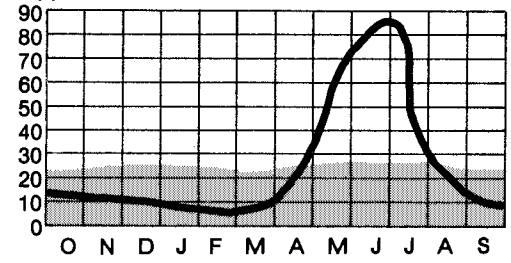
Lower Quartile

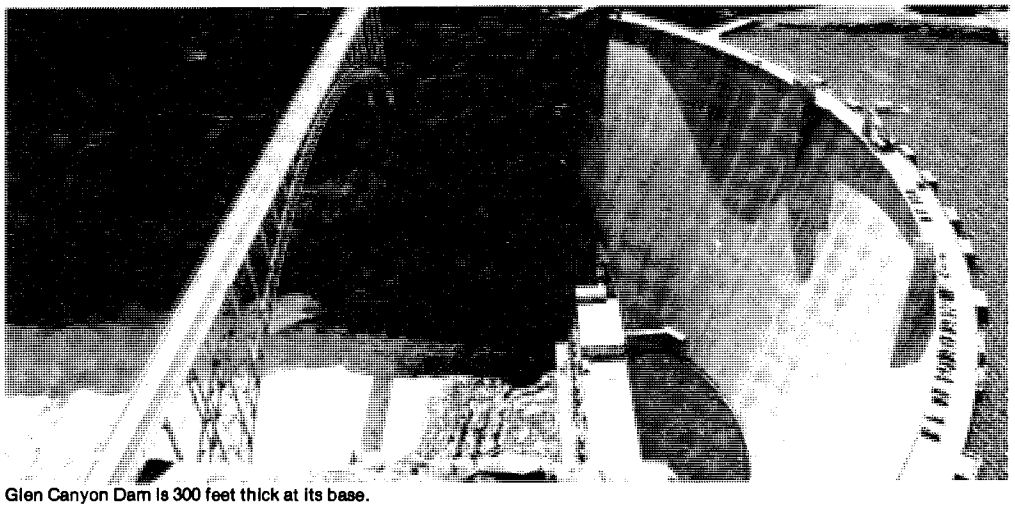


Most Adverse



Upper Decile





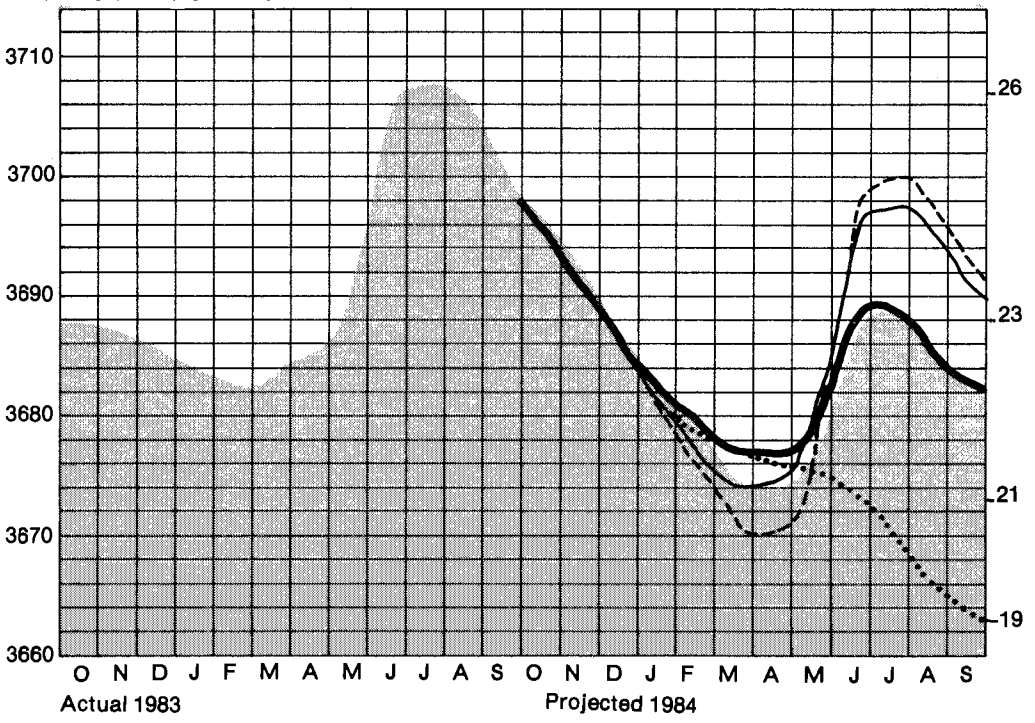
Glen Canyon Dam is 300 feet thick at its base.

Storage

Usable content in Million Acre-Feet

End of Month Elevation In Feet

Non-Linear Scale



Legend

Most Probable

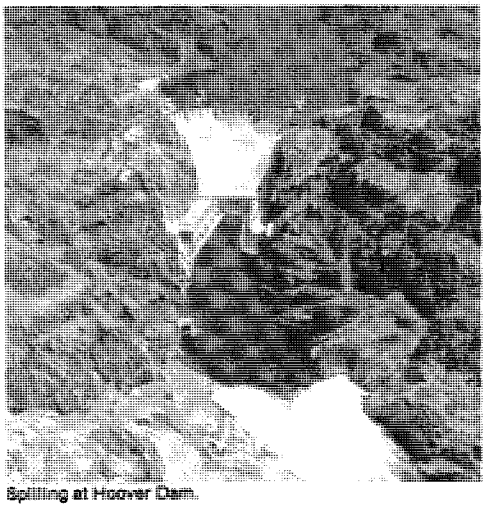
Upper Quartile

Lower Quartile

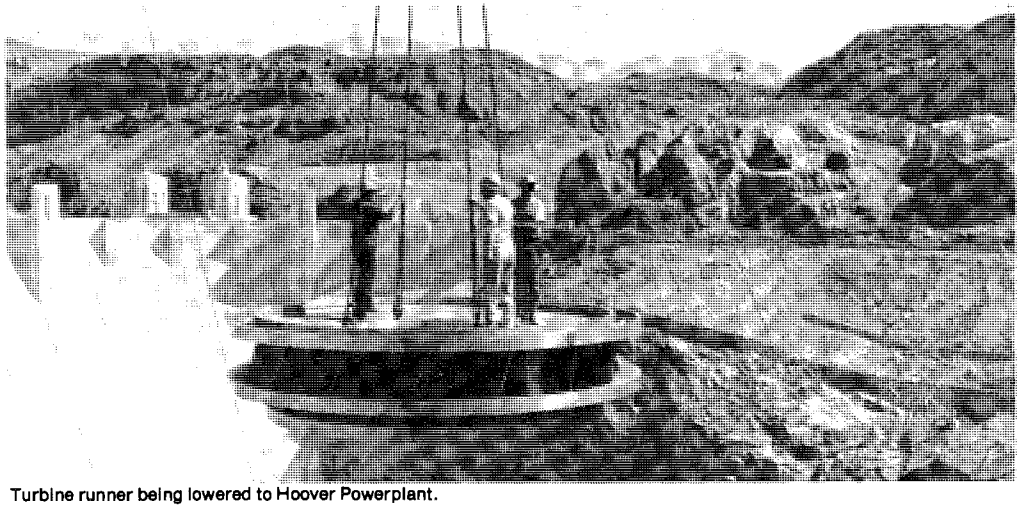
Most Adverse

Upper Decile

Lower Basin Reservoirs
Lake Mead [Colorado River]



Spilling at Hoover Dam.



Turbine runner being lowered to Hoover Powerplant.

Water Year 1983

At the beginning of water year 1983, Lake Mead, impounded by Hoover Dam, had a water surface elevation of 1199 feet and an active storage of 22,773,000 acre-feet. During the winter and spring months the water level gradually rose to 1212 feet by the end of May 1983. During the high inflow conditions of June and July, Lake Mead reached a high elevation of 1225.8 feet near the end of July, with a peak active storage of 26,864,000 acre-feet.

During the water year, releases were made to meet downstream water use requirements in the United States and Mexico, flood control requirements, programed levels of Lakes Mohave and Havasu, and transit losses which include river and reservoir evaporation, uses by phreatophytes, changes in bank storage, unmeasured inflows, and diversions. The total release from Lake Mead through Hoover Dam during water year 1983 was approximately 14,755,000 acre-feet. Of that amount, approximately 12,653,000 acre-feet passed through the turbines for power production. At the end of the water year, Lake Mead had a water surface elevation of 1218 feet and an active storage of 25,658,000 acre-feet which reflects an increase in storage during the water year of 2,885,000 acre-feet. On September 30, 1983, the active storage of Lake Mead was 841,000 acre-feet greater than the active storage in Lake Powell.

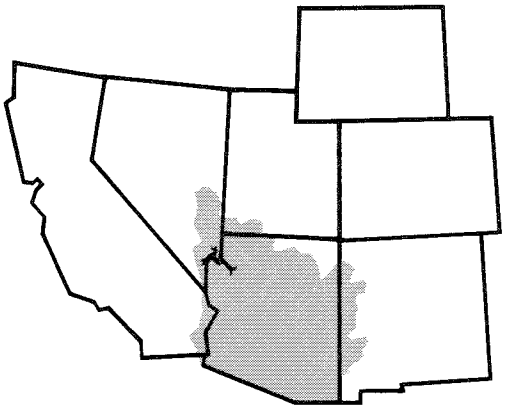
Water Year 1984

Under average inflow conditions during the 1984 water year, the Lake Mead water level is scheduled to be drawn down to elevation 1212 feet at the end of February 1984, then be drawn down to a low elevation of 1207 feet at the end of June 1984. At that level, the lake will have in active storage about 23.9 million acre-feet. During water year 1984, a total of about 15.8 million acre-feet is scheduled to be released from Lake Mead, all passing through the powerplant.

Lake Mead Active Storage* **Chart 6**

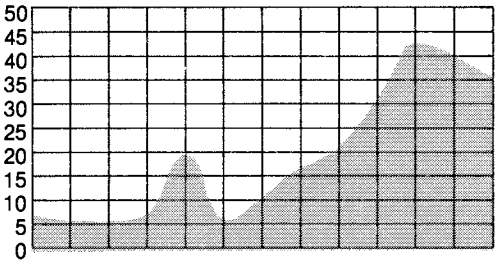
Reservoir	(Acre-Feet)	El. (Ft.)
Maximum Storage	27,377,000	1229
Rated Head	13,653,000	1123
Minimum Power	10,024,000	1083
Surface Area (Full)	162,700 Acres	
Reservoir Length (Full)	115 Miles	
Power Plant		
Number of Units	17	
Total Capacity	1,344,800 Kilowatts	

*does not include 2,378,000 acre-feet of dead storage below 895 feet



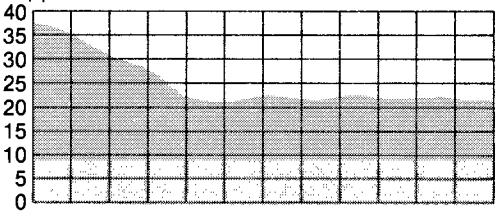
Outflow Monthly Release in 1000 Cubic Feet / Second

Actual Operation 1983

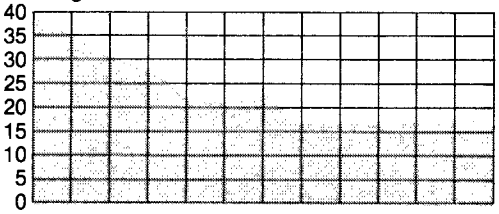


Projected Operation 1984

Upper Quartile

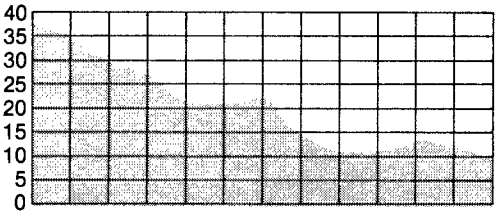


Average

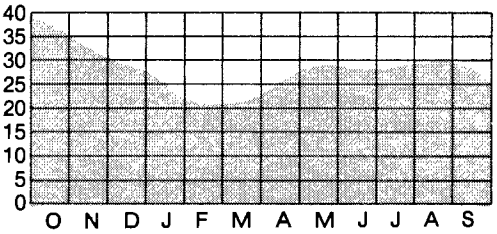


Lower Quartile

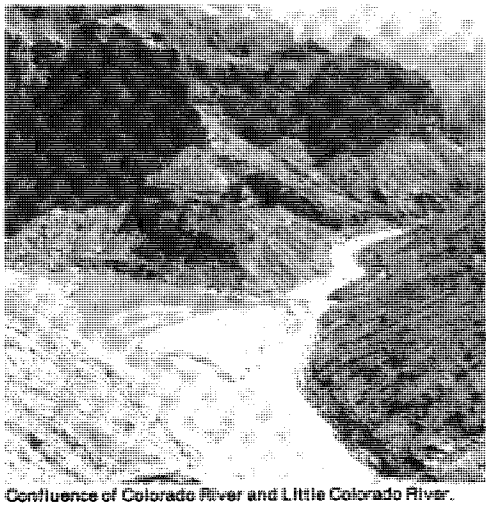
Most Adverse



Upper Decile



Twenty-two millionth visitor at Hoover Dam.



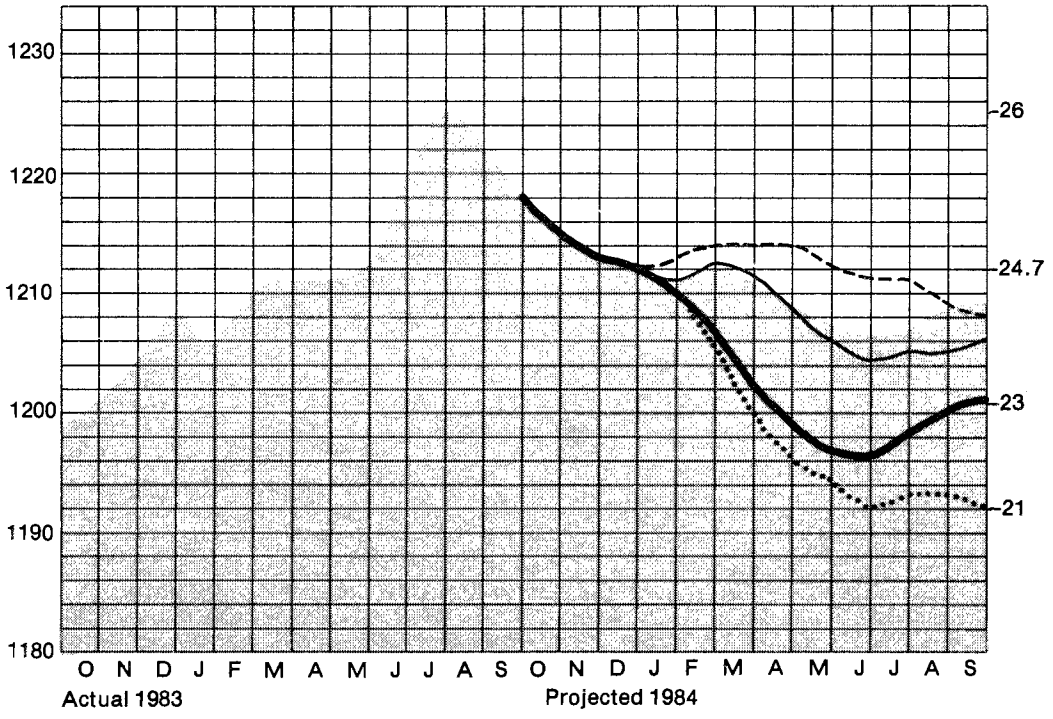
Confluence of Colorado River and Little Colorado River.

Storage

End of Month Elevation in Feet

Active Content in Million Acre-Feet

Non-Linear Scale



Actual 1983 Projected 1984

Legend

Most Probable

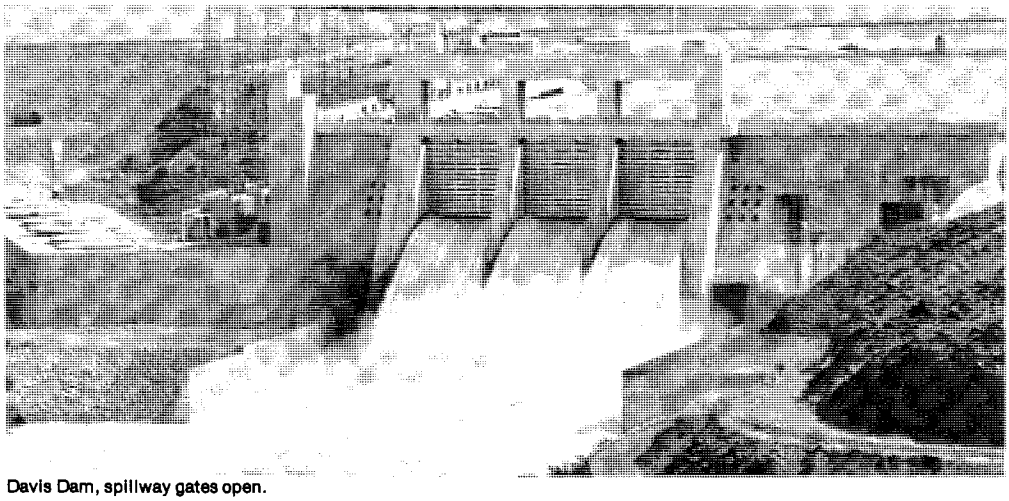
Upper Quartile

Lower Quartile

Most Adverse

Upper Decile

Lake Mohave [Colorado River]



Davis Dam, spillway gates open.

Examining milo yield.

Water Year 1983

At the beginning of water year 1983, the water surface elevation of Lake Mohave, which is impounded by Davis Dam, was 632 feet, with an active storage of 1,419,000 acre-feet.

During the winter months, the water level was gradually raised to approximately 644 feet, with an active storage of 1,714,000 acre-feet at the end of March 1983. The water level was drawn down during April and May to elevation 641. During the month of June, Lake Mohave reached a high elevation of 646.6, with an active storage of 1,800,000 acre-feet. The reservoir ended the water year at elevation 639 feet with 1,600,000 acre-feet in active storage.

Lake Mohave releases were made to satisfy flood control requirements and downstream water use requirements, with a small amount of reregulation at Lake Havasu. During the water year, approximately 14,778,000 acre-feet were released at Davis Dam. Of that amount, approximately 11,827,000 acre-feet passed through the turbines for power production.

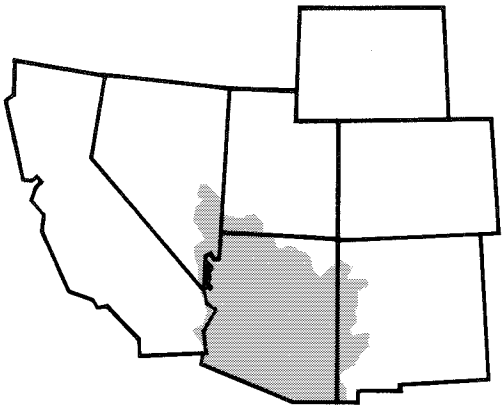
Water Year 1984

Under average inflow conditions the water level of Lake Mohave is scheduled to reach an elevation of 641 feet by the end of January 1984 and remain at that elevation for the remainder of the water year. During the water year a total of 16 million acre-feet is scheduled to be released from Lake Mohave to meet all downstream and flood control requirements. Of that total, approximately 14.5 million acre-feet is scheduled to pass through the powerplant and 1.5 million acre-feet to bypass it.

Lake Mohave Active Storage* **Chart 7**

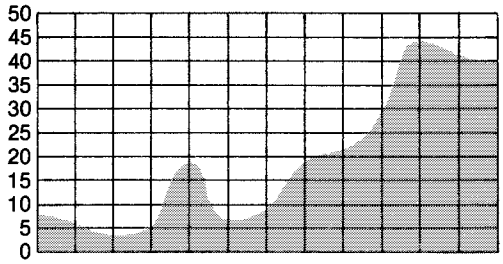
Reservoir	(Acre-Feet)	El. (Ft.)
Maximum Storage	1,810,000	647.0
Rated Head	1,188,000	623.0
Minimum Power	217,500	570.0
Surface Area (Full)	28,200 Acres	
Reservoir Length (Full)	67 Miles	
Power Plant		
Number of Units	5	
Total Capacity	240,000 Kilowatts	

*does not include 8,530 acre-feet of dead storage below 533.39 feet



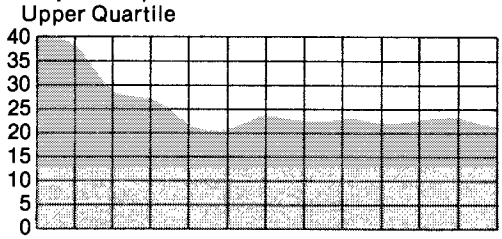
Outflow Monthly Release in 1000 Cubic Feet/Second

Actual Operation 1983

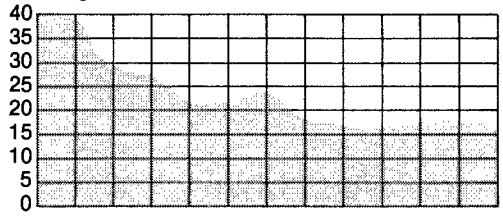


Projected Operation 1984

Upper Quartile

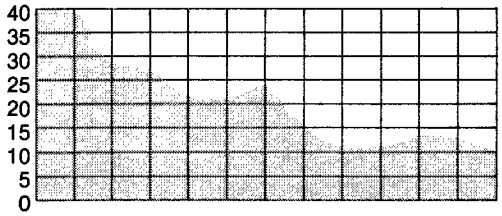


Average

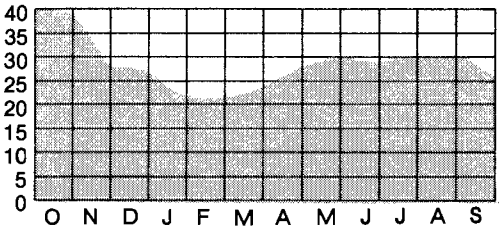


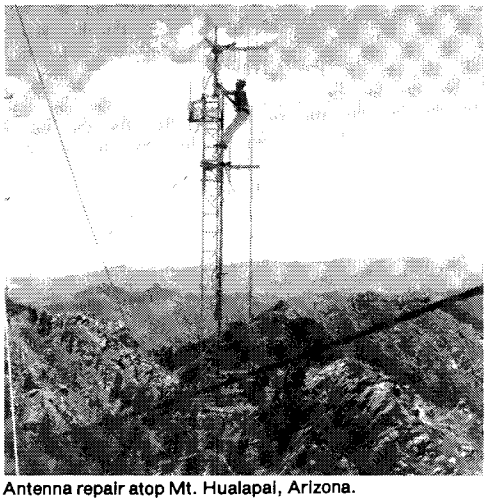
Lower Quartile

Most Adverse

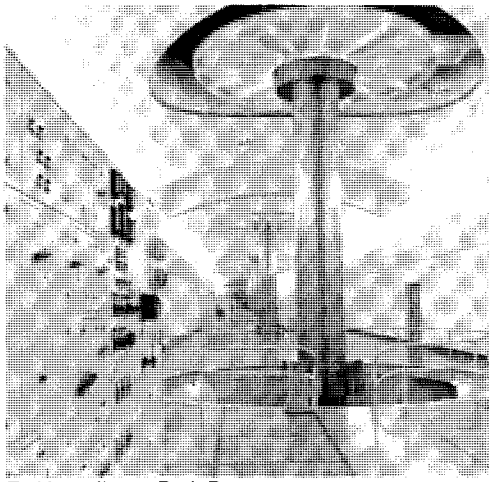


Upper Decile





Antenna repair atop Mt. Hualapai, Arizona.



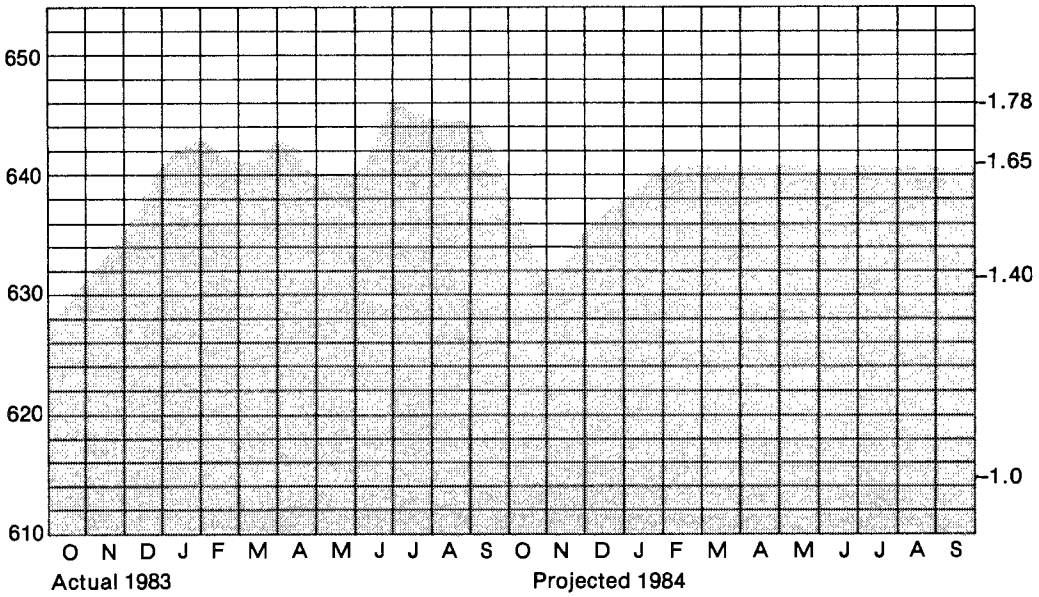
Turbine gallery at Davis Dam.

Storage

Usable Content in Million Acre-Feet

End of Month Elevation in Feet

Non-Linear Scale

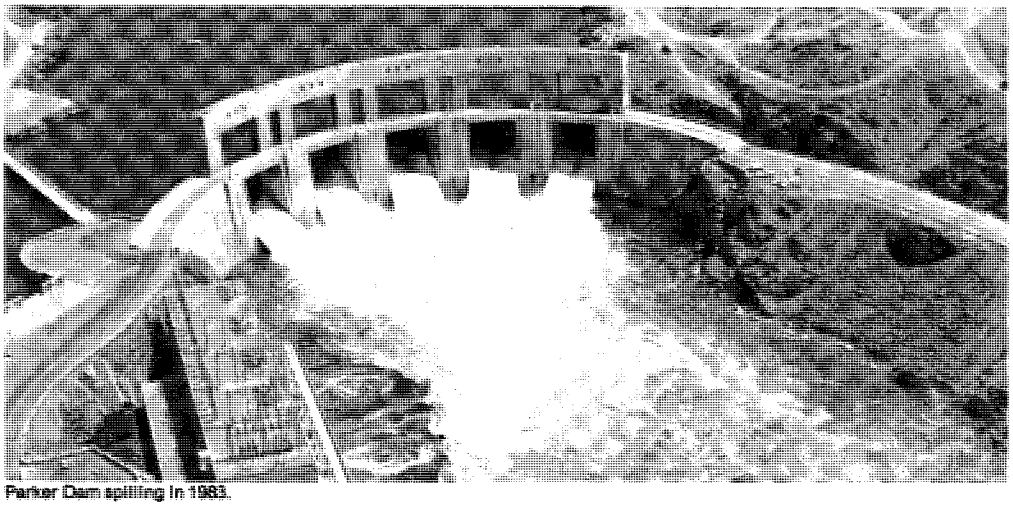


Actual 1983 Projected 1984

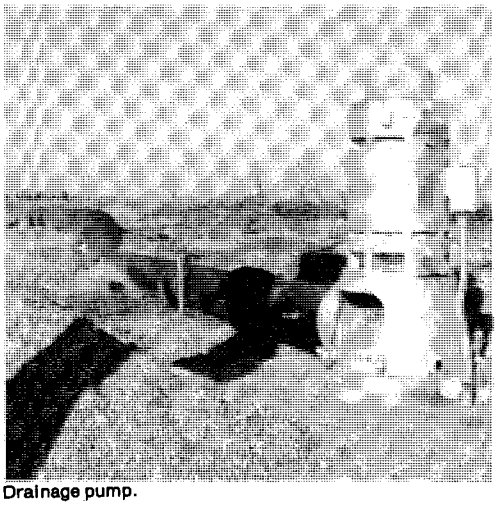
Legend

Most Probable

Lake Havasu [Colorado River]



Parker Dam spilling in 1983.



Drainage pump.

Water Year 1983

At the beginning of water year 1983, the water level of Lake Havasu, impounded by Parker Dam, was at elevation 447 feet with an active storage of approximately 560,000 acre-feet. The reservoir was drawn down to approximately elevation 445 feet, with an active storage of about 525,000 acre-feet in January to provide vacant space for runoff from the drainage area between Davis and Parker Dams. The water level was then raised to an approximate elevation of 450 feet by the end of May, with an active storage of about 609,000 acre-feet. By the end of the water year, Lake Havasu was drawn down to about 446 feet with an active storage of 541,000 acre-feet.

During the water year, approximately 13,782,000 acre-feet were released at Parker Dam, of which approximately 10,269,000 acre-feet passed through the turbines for power production. The total release amount included flood control releases from Alamo Dam on the Bill Williams River.

Space in the top 10 feet of Lake Havasu (about 180,000 acre-feet) is reserved by the United States for control of floods and other uses, including river regulation. Normally, only about the top 4 feet, or 77,000 acre-feet of space, have been used for this purpose since the Alamo Reservoir on the Bill Williams River has been in operation.

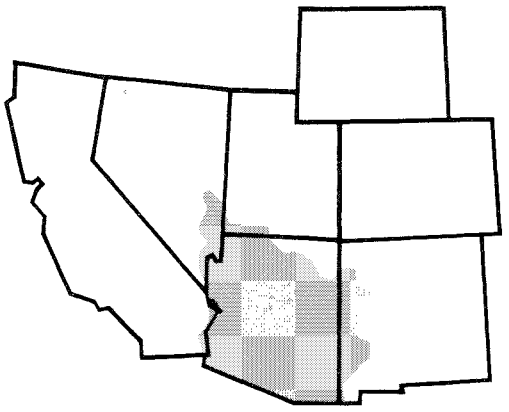
Water Year 1984

Lake Havasu is scheduled at the highest levels consistent with the requirements for maintaining reservoir regulation space. The yearly low elevation of approximately 446 feet is scheduled for the November through February high flood hazard period. The yearly high of about 450 feet is scheduled for the low flood hazard months of May and June. During water year 1984, a total of approximately 14.9 million acre-feet is scheduled to be released from Lake Havasu to meet all downstream and flood control requirements. Of that total, approximately 12.3 million acre-feet are scheduled to pass through the Parker powerplant.

Lake Havasu Active Storage* **Chart 8**

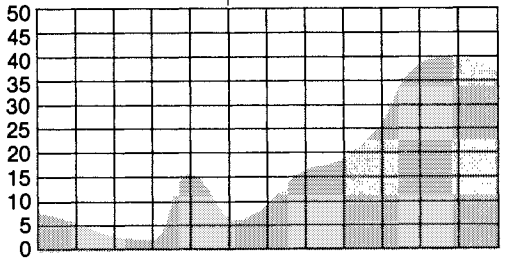
Reservoir	(Acre-Feet)	El. (Ft.)
Maximum Storage	619,400	450.0
Rated Head	619,400	450.0
Minimum Power	439,400	440.0
Surface Area (Full)	20,400 Acres	
Reservoir Length (Full)	35 Miles	
Power Plant		
Number of Units	4	
Total Capacity	120,000 Kilowatts	

*does not include 28,600 acre-feet of dead storage below 400.0 feet

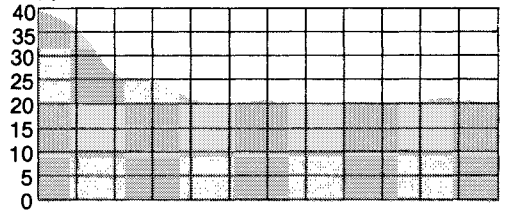


Outflow Monthly Release In 1000 Cubic Feet / Second

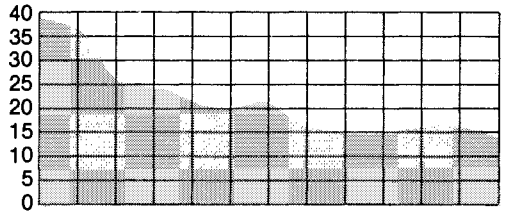
Actual Operation 1983



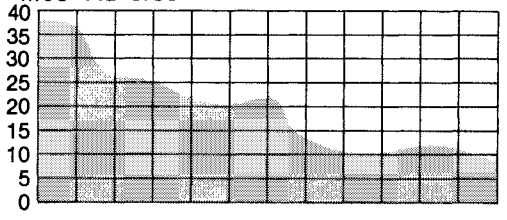
Projected Operation 1984
Upper Quartile



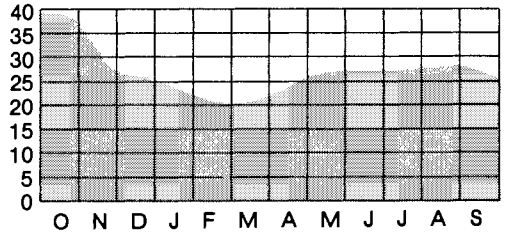
Average



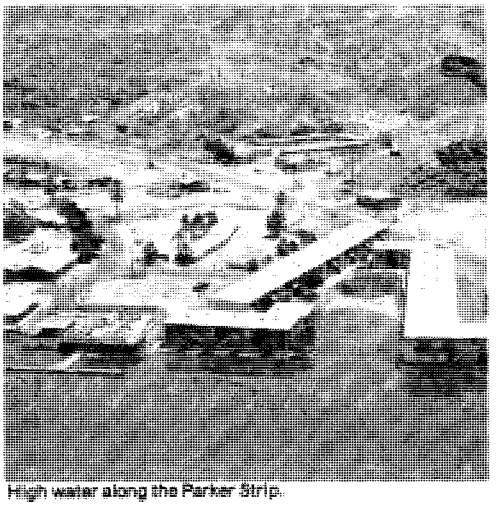
Lower Quartile
Most Adverse



Upper Decile



Reception area at Davis Dam



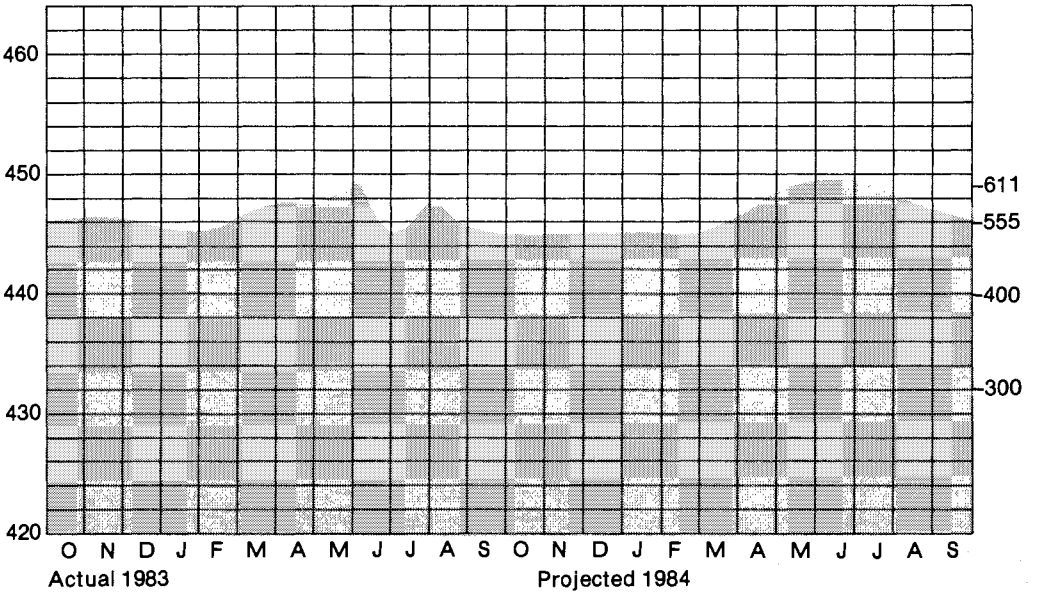
High water along the Parker Strip.

Storage

Usable Content in 1000 Acre-Feet

End of Month Elevation In Feet

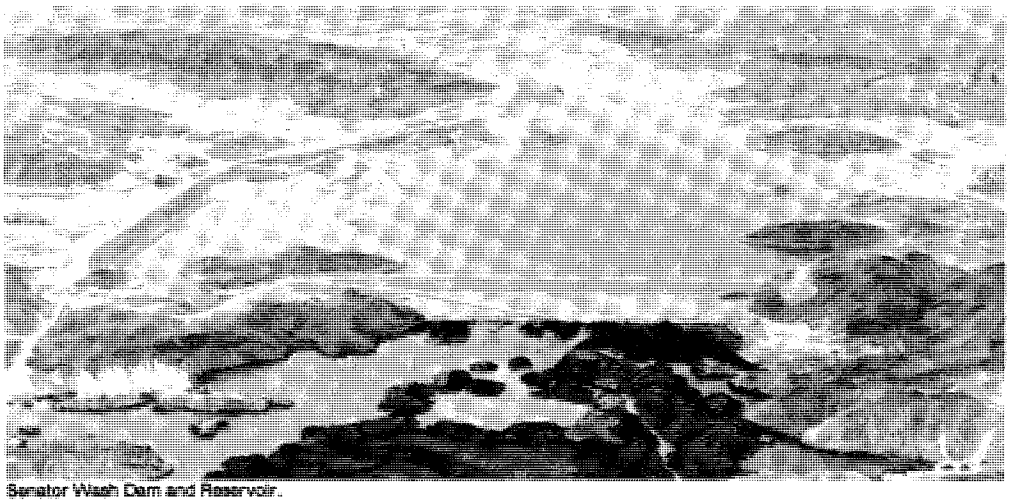
Non-Linear Scale



Legend

Most Probable

River Regulation



Senator Wash Dam and Reservoir.

Water levels in nearly all of the major reservoirs in the Colorado River basin reached their highest elevations since these dams were constructed. The natural virgin runoff reaching the streams of the Colorado River drainage system above Glen Canyon Dam during water year 1983 was estimated at about 23.9 million acre-feet. Of this amount, approximately 3.7 million acre-feet were consumptively used within the Upper Colorado River Basin States.

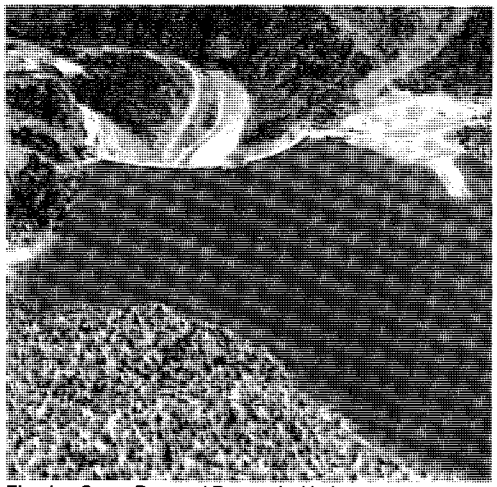
Adjustments in storage in mainstem reservoirs resulted in an inflow to Lake Powell of 20.3 million acre-feet. The release from Glen Canyon Dam, based on measurements at the gaging station at Lees Ferry, Arizona, was 17.4 million acre-feet. For the 1-year and 10-year periods ending September 30, 1983, 17,437,000 acre-feet and 95,975,000 acre-feet, respectively, passed the compact point at Lee Ferry.

The projected water year 1984 release from Lake Powell, based on most adverse runoff conditions is 10,300,000 acre-feet. The projected release for an upper quartile runoff condition is 15,850,000 acre-feet. When added to the flow of the Paria River, this would result in an Upper Basin delivery ranging from 98.0 to 103.5 million acre-feet for the 10-year period ending September 30, 1984.

Daily releases are made from the storage reservoirs in the Lower Basin to meet the incoming orders of the water user agencies. When possible, all water passes through the powerplant units. The daily releases are regulated on an hourly basis to meet as nearly as possible the power loads of the electric power customers. Minimum daily flow objectives are provided in the river to maintain fishery habitat.

A combination of high runoff conditions and river regulation below Hoover Dam resulted in a total delivery to Mexico of approximately 8,080,000 acre-feet in excess of the scheduled treaty quantity (1,700,000 acre-feet) during water year 1983. Of that amount, 169,800 acre-feet of drainage waters were bypassed for salinity control pursuant to provisions of Minute No. 242 of the Commission.

Flood Control

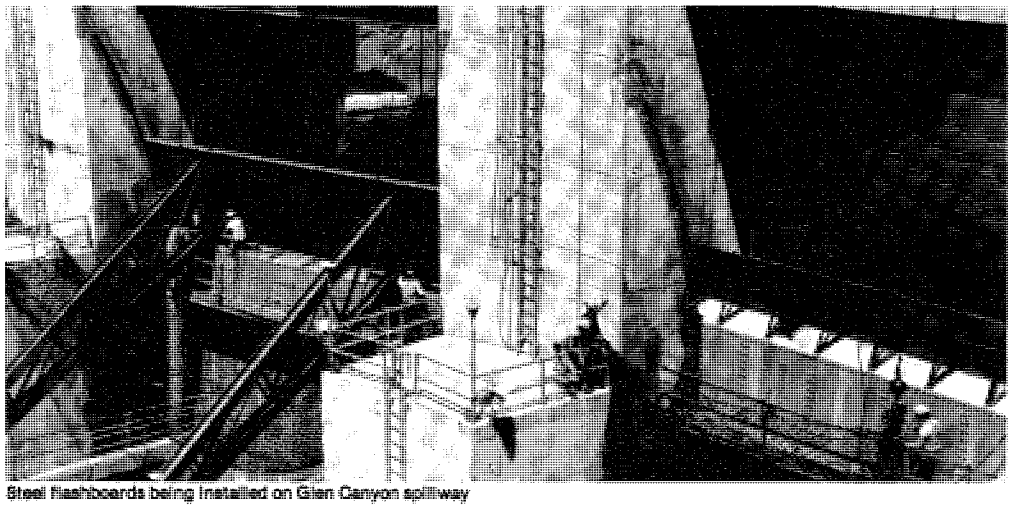


Flaming Gorge Dam and Reservoir, Utah.

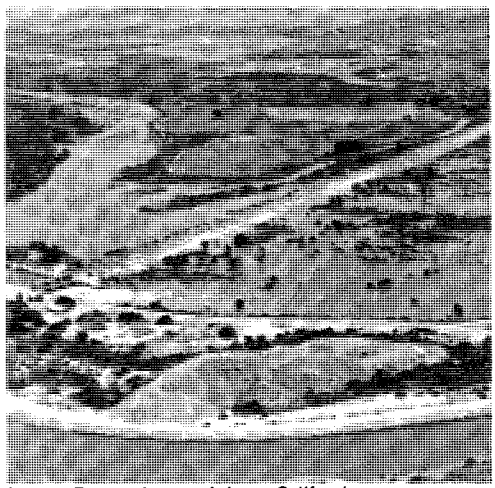
The reservoirs within the basin received far greater total inflow than during normal years. In the Upper Basin, Navajo and Blue Mesa Reservoirs are operated for flood control by providing space to store snowmelt floods. Although Flaming Gorge and Glen Canyon Reservoirs have no specifically assigned requirement for flood control, they do reduce flood flows since they are operated to reduce spills. The space they provide is counted as part of the flood control space that is required by the Army Corps of Engineers (Corps) flood control regulations at Lake Mead.

In 1983, Navajo Reservoir reduced the maximum flow of the San Juan River at the dam from 8,380 cfs to 2,810 cfs. This reduced damage along the San Juan River, especially near Farmington, New Mexico. The maximum flow of the Gunnison River at Crystal Dam was decreased from more than 13,000 cfs to 10,000 cfs due to storage in Blue Mesa and Taylor Park Reservoirs. This reduced damage along the Gunnison River, especially near Delta and Grand Junction, Colorado.

Lake Mead is the only reservoir on the Colorado River in which a specific space is exclusively allocated for mainstem flood control. Flood control regulations for Hoover Dam have been updated and revised based on findings of a joint study by Reclamation and the Corps, with consultation and advice of State and local interests.



Steel flashboards being installed on Glen Canyon spillway



Laguna Dam and gates, Arizona-California.

A final report which summarized the study findings and recommended a new flood control operation plan for Hoover Dam was released July 1983. Flood control storage space will be maintained in Lake Mead as stipulated in the Report's Field Working Agreement between Reclamation and the Corps for flood control operation of Hoover Dam and Lake Mead. These regulations establish releases in a manner that maximizes public benefits in the United States with reasonable consideration for conditions in Mexico.

As was stated earlier, large flood control releases were made from the major storage reservoirs as they filled to capacity from the runoff and began to spill in late June and early July. Flow over the spillways of Hoover Dam occurred for the first time in its history, except for a test of the structure in 1941. The maximum daily releases during the 1983 flooding were 92,600 cfs from Glen Canyon Dam, 50,800 cfs from Hoover Dam, 45,100 cfs from Davis Dam, and 40,300 cfs from Parker Dam.

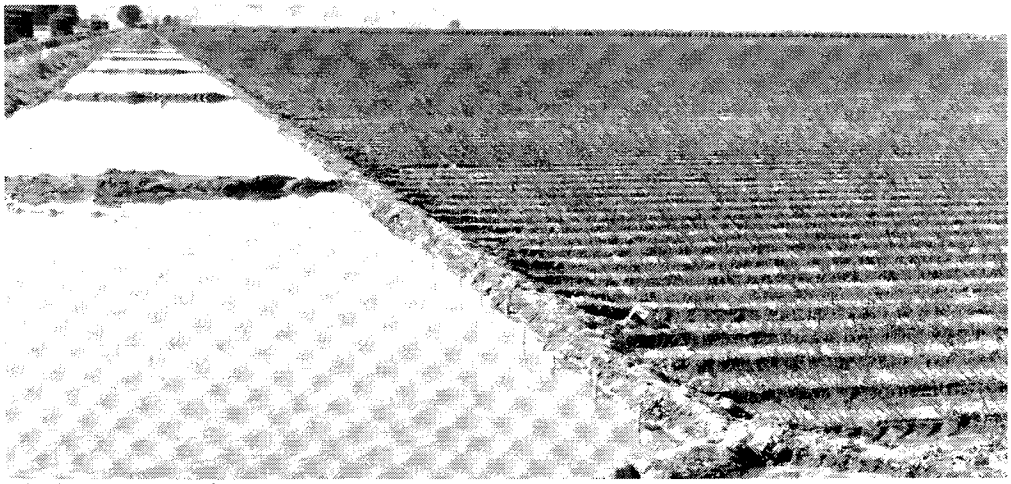
There has been flood damage to structures , dikes, and other facilities along the Colorado River. Private businesses and residences, and Federal Government facilities were affected. While the design channel capacity downstream from Davis and Parker Dams is 40,000 cfs, flood-plain development and encroachment results in significant flood damages at lesser flows. Maximum flows from Davis and Parker Dams were less than the levee design of 50,000 cfs. Flood damage was generally limited to properties located on the flood plain inside the levee system. Releases have remained near the maximum levels experienced during the flooding in order to evacuate adequate storage space in the reservoirs prior to the water year 1984 runoff.

The reservoir system has been operated in full accordance with established operating criteria and the Corps flood control regulations. The combined effect of the Upper Basin reservoirs, including Flaming Gorge and Lake Powell, and Lower Basin reservoirs, Lake Mead, Lake Mohave, and Lake Havasu, was to reduce the flow of the Lower Colorado River from approximately 128,000 to about 40,000 cfs. Until river flows decrease, detailed assessment of flood damage cannot be made.

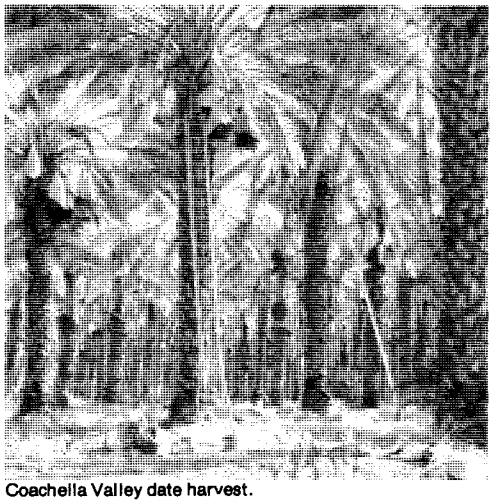
Total Colorado River reservoir system storage at the start of water year 1983 was approximately 54,030,000 acre-feet and about 58,962,000 acre-feet at the end of the water year, representing a 4,932,000 acre-feet decrease in total remaining available reservoir space.

In addition to the mainstem structures, Alamo Dam on the Bill Williams River, and Painted Rock Dam on the Gila River (both in the Lower Basin) received flood inflow during the winter months of water year 1983 and also during October, 1983. Painted Rock and Alamo Reservoirs are scheduled to be operated at low flood control levels during 1984.

Beneficial Consumptive Uses



Irrigating young green onions.



Coachella Valley date harvest.

An extensive discussion of consumptive uses is not attempted in this report as that subject has been treated in detail in Reclamation's "Colorado River System Consumptive Uses and Losses Report, 1976-1980." That report was prepared jointly by the Upper and Lower Colorado Regional Offices and was released in 1983. It presents estimates of the consumptive uses and losses from the Colorado River System for each year from 1976 through 1980. The following table summarizes annual water use from the system by States, including water use supplied by ground-water overdraft.

Water Use by States * 1976 - 1980

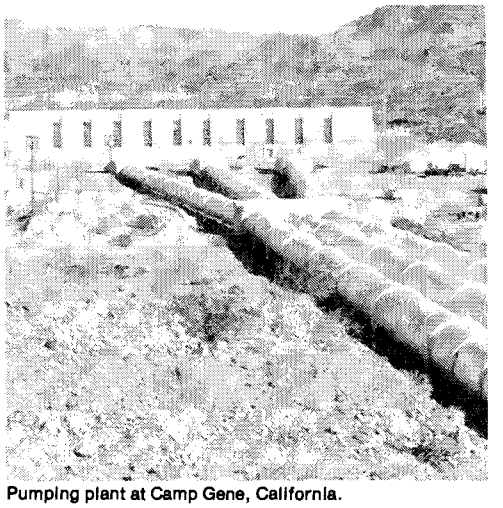
(1,000 acre-feet)

State	1976	1977	1978	1979	1980	Average 1976-80
Arizona	5,033	5,369	5,351	5,409	5,641	5,361
California	4,813	4,837	4,624	4,591	4,680	4,709
Colorado	1,679	1,608	1,937	1,824	1,744	1,758
Nevada	226	227	224	228	233	228
New Mexico	310	239	361	432	457	360
Utah	705	462	746	798	738	690
Wyoming	282	219	333	348	337	304
Other **	1,931	1,832	1,887	2,070	2,063	1,956
Total - Colorado River System	14,979	14,793	15,463	15,700	15,893	15,366
Water Passing to Mexico						
Treaty	1,475	1,554	1,513	1,668	1,707	1,583
Minute 242	205	209	194	171	185	193
Excess Releases	69	68	38	927	4,251	1,071
Subtotal-Water Passing to Mexico	1,749	1,831	1,745	2,766	6,143	2,847
Total - Colorado River System and Water Passing to Mexico	16,728	16,624	17,208	18,466	22,036	18,213

* Onsite consumptive uses and losses; includes water uses satisfied by ground-water overdrafts.

** Represents mainstream reservoir evaporation in the Upper Basin and mainstream reservoir evaporation and channel losses below Lee Ferry in the Lower Basin.

Harvesting green onions.



Pumping plant at Camp Gene, California.

Upper Basin Uses and Losses During 1983

The three largest sources of consumptive use in the Upper Colorado Basin are agricultural use within the drainage basin, diversion to adjacent drainage systems, and evaporation losses. During water year 1983, the estimated use for agricultural and municipal and industrial supply in the Upper Basin was 2,469,000 acre-feet. Estimated evaporation losses were 751,000 acre-feet from mainstem reservoirs. Approximately 527,000 acre-feet were diverted for use in adjacent drainage basins. Thus, total estimated consumptive use amounted to 3,747,000 acre-feet. Storage in the Upper Basin mainstem reservoirs increased by approximately 1.8 million acre-feet during water year 1983.

Lower Basin Uses and Losses

During water year 1983, an estimated 4,739,000 acre-feet of water were released from Lake Havasu to meet the requirements for water deliveries at Imperial Dam, as well as those of the Colorado River Indian Reservation near Parker, Arizona, the Palo Verde Irrigation District near Blythe, California, other miscellaneous users along the river, and transit losses between Parker Dam and Imperial Dam.

The major water diversion above Parker Dam was by The Metropolitan Water District of Southern California (District). The District pumped approximately 738,000 acre-feet from Lake Havasu during water year 1983. None of this water was utilized for delivery to the city of Tijuana, although the contract for temporary emergency delivery of a portion of Mexico's treaty entitlement is still in existence. During water year 1983, releases of approximately 5.6 million acre-feet were made from Lake Mohave to provide for releases at Parker Dam; to supply diversion requirements of the District, miscellaneous contractors, and other users; to offset evaporation and other transit losses between Davis and Parker Dams; and to maintain the scheduled levels of Lake Havasu.

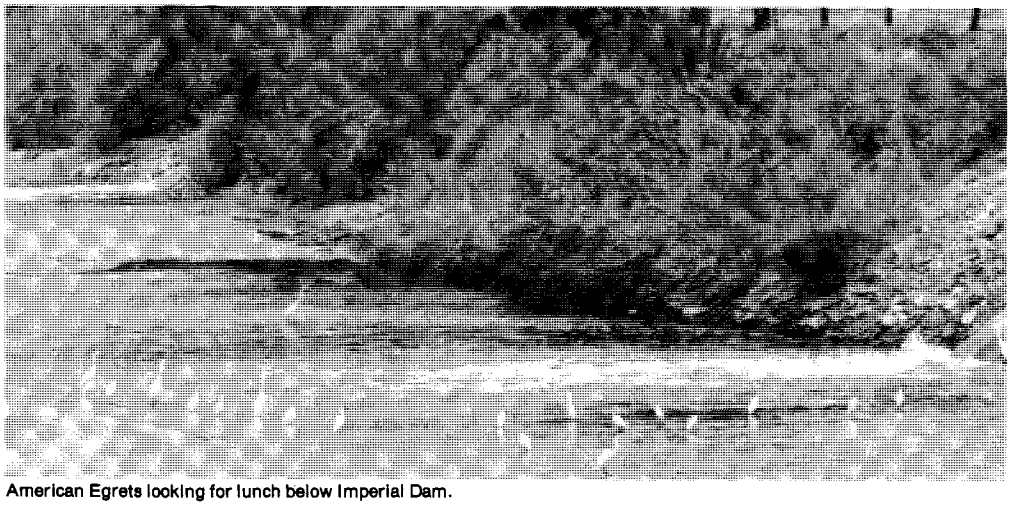
During water year 1983, releases of approximately 5.6 million acre-feet were made from Lake Mead at Hoover Dam to regulate the levels of Lake Mohave and to provide for the small users and the losses from that reservoir. In addition, 138,000 acre-feet were diverted from Lake Mead for use by the Lake Mead National Recreation Area, Boulder City, Basic Management, Inc., and contractors of the Division of Colorado River Resources, in Nevada. During water year 1983, the total releases and diversions from Lake Mead were an estimated 14,880,000 acre-feet.

For water year 1984, a total release of 14.9 million acre-feet from Lake Havasu has been projected, including consumptive use requirements in the United States below Parker Dam, transit losses in the river between Parker Dam and the Mexican Border, flood control requirements, and treaty deliveries to Mexico. Of the total projected, 12.3 million acre-feet would pass through the Parker Powerplant and approximately 2.6 million acre-feet would have to bypass the powerplant.

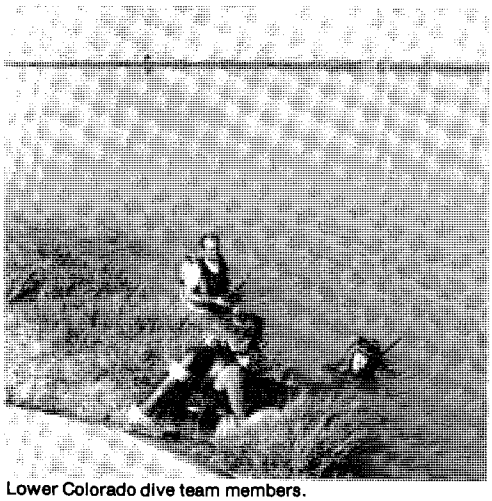
During water year 1984, the District is expected to divert 1,014,000 acre-feet by pumping from Lake Havasu. Consumptive uses by small users, river losses or gains, and reservoir losses between Davis Dam and Parker Dam are projected to be a net loss of 118,000 acre-feet.

There are no major users between Hoover Dam and Davis Dam. During water year 1984 the net diversions from Lake Mead are projected at 149,000 acre-feet. Evaporation from Lake mead is projected to be about 984,000 acre-feet and net gain between Glen Canyon Dam and Lake Mead is expected to be about 1,024,000 acre-feet.

Water Quality Operations



American Egrets looking for lunch below Imperial Dam.



Lower Colorado dive team members.

Since water quality aspects of Colorado River operations are extensively described in the biennial series of reports entitled "Quality of Water, Colorado River Basin", only minimal discussion of this aspect of operation is presented in this report. Report No. 11 of the biennial series was issued in December 1982.

During water year 1983, the United States bypassed a total of 169,800 acre-feet through the Bypass Drain and Mode 3. This water was replaced with a like amount of other water, pursuant to Minute No. 242 of the International Boundary and Water Commission.

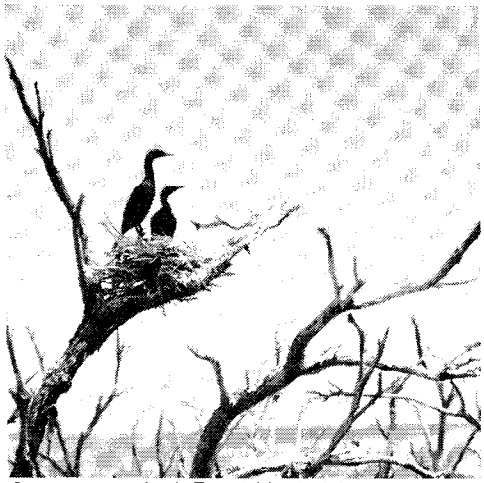
Under the provisions of Minute No. 242, the Republic of Mexico is entitled to receive at Morelos Dam water of a quality no worse than 115 parts per million (p/m)($\pm$ 30 p/m) greater than that arriving at Imperial Dam. During water year 1983, the average salinity of the Colorado River at Imperial Dam was 755 p/m. During that period the average salinity of the waters at Morelos Dam was 768 p/m, resulting in a salinity differential of 13 p/m, well within the provision of Minute No. 242.

The total flows in the Bypass Drain during water year 1984 are estimated to be about 150,000 acre-feet. A small amount of drainage water could be returned to the Colorado River below Morelos Dam during water year 1984.

In recognizing the need to manage water quality of the Colorado River, it has been recommended that long-term salinity increases in the river be controlled through a water quality improvement program generally described in the report, "Colorado River Water Quality Improvement Program", dated February 1972, and a status report of the same title, dated January 1974.

The program calls for a basin-wide approach to salinity control while the Upper Basin continues to develop its compact-apportioned waters. The initial step towards improvement of the quality of the river's water was authorization by the Congress of the Colorado River Basin Salinity Control Project (Public Law 93-320), on June 24, 1974.

Environmental Programs



Cormorants nesting in Topock Marsh, Arizona.

Imperial Dam with Senator Wash Dam in upper background, California.

Upper Basin

Fish and wildlife in and near CRSP reservoirs and areas downstream faced new and in many cases dramatic changes in their normally relatively static environment during the 1983 operational year. High spring flows not only decreased average water temperatures and increased the stage and velocity of most tailwater discharges, but also inundated hundreds of acres of streamside terrestrial habitat.

Impacts to these resources have not yet been fully quantified. In some cases fisherman use and success has continued in spite of the hindrance to access caused by the high flows. Riparian areas and sandy beaches adjacent to tailwater reaches were eliminated in several areas where water velocities removed substrate materials. Deposition of much of the suspended material following the high water, however, caused new beaches to be formed and invading riparian growth is already being reestablished. Although not accustomed to such dynamic changes in their habitats below regulated reservoirs, it appears that the fish and wildlife resources situated there have remained resilient despite the pressures place on their environment.

Management of the tailwater fisheries and investigations funded by Reclamation is focusing on balancing the needs for cold water trout species in the immediate tailwater reaches and on the downstream needs of warmer water endangered species.

Consultation with the Fish and Wildlife Service regarding the impacts of the CRSP reservoirs on the endangered Colorado River fishes is still ongoing. Studies designed to provide biological answers and operational options are being initiated and will help fulfill Reclamation responsibilities and requirements mandated by the Endangered Species Act.

In addition to the native species, a recently initiated investigation of selected sport species and their specific habitat requirements will be completed within 2 years. This information will also assist Reclamation in determining flow requirements and habitat preferences of economically and recreationally important trout species.

Information gained from both aquatic studies will be incorporated into the overall operation of the reservoirs to insure continued protection of important environmental values while maintaining other numerous project purposes.

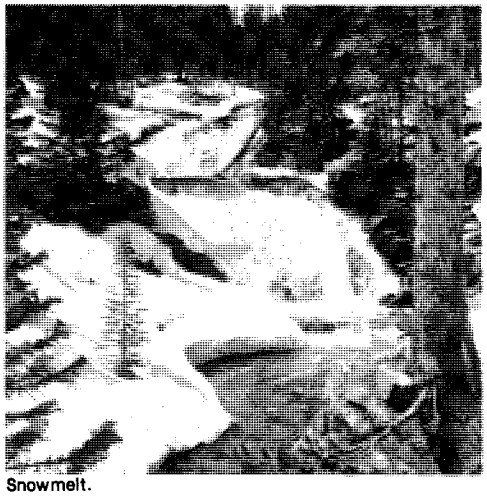
In June 1983, Reclamation initiated the Glen Canyon Environmental Studies in cooperation with the National Park Service and other Federal and non-Federal agencies. These studies were developed to coincide with the generator uprating program at Glen Canyon Dam. The target date for completion of the environmental studies is October 1986.

Initially the studies were developed to address the impacts of the increased flexibility on release potential arising from the powerplant uprate. However, as a result of the high flows of 1983, and subsequent reevaluation of the studies, the potential for studying a wider range of operational and biological relationships now exists. The environmental studies will now additionally focus on evaluating the impact of current operations. Information gathered relating to the operation of Glen Canyon Dam will be useful to several State and Federal cooperating agencies in helping manage natural and recreation resources from the dam downstream to Lake Mead. The study program consists of four main components: Sediment, Biological, Recreation, and Operations. Reclamation is providing the funding and program management while the National Park Service is providing coordination and logistical support.

Lower Basin

Reclamation biologists are presently studying how animal drownings can be avoided along proposed and existing canals and those under construction. Artificial oases and water catchments are being placed in different locations to see if the mammals will drink from them rather than the canals, thereby lessening mammal mortality in the canals.

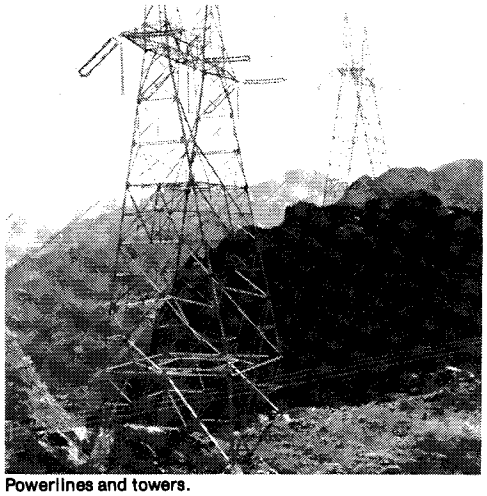
Environmental Programs [cont.]



Snowmelt.

Studies have also investigated the distribution and movement of desert mule deer and desert bighorn sheep along the Tucson and Granite Reef Aqueducts to determine what areas there would be best used for oases, catchments, crossings, fencing, or escape devices. Escape ramps, ladders, and steps are also being studied on an existing canal (Mohawk Canal) to determine their effectiveness. The results of these investigations will have Bureau-wide significance for lined canals with large mammal mortality problems.

A 5-year study of the black bass fishery in Lake Mead was concluded in 1982. The study has revealed that many factors are causing black bass in Lake Mead to decline. Of these factors, two seem to be paramount. One is the entrapment of large quantities of nutrients upstream caused by the construction and operation of Glen Canyon Dam. The second is fluctuating lake levels in Lake Mead which adversely affect food and cover for young bass. With these findings, steps can now be taken to begin restoring and enhancing this valuable fishery.



Powerlines and towers.

A contract was awarded in August 1983, to determine the value of backwaters along the Lower Colorado River. Past Reclamation actions to mitigate for impacts or enhance the environment have allowed for construction of some backwater areas. The study will evaluate existing "natural" and constructed backwaters on the river to see if they provide good fish and wildlife habitat.

In 1982, an environmental commitment program was implemented in the Lower Colorado Region. This program assigns responsibilities and sets procedures to insure that environmental commitments made in the final environmental documents are carried out during construction and operation of projects.

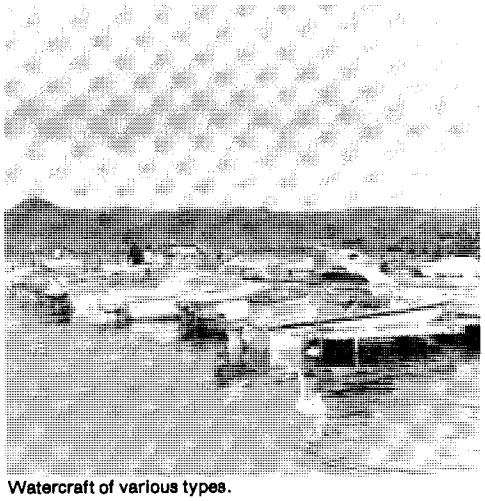
Since its inception, environmental commitment plans have been developed on two features of the Central Arizona Project-Phase A of the Tucson Aqueduct and the Salt-Gila Aqueduct Final Environmental Impact Statements.

Deer using canal escape ramp.

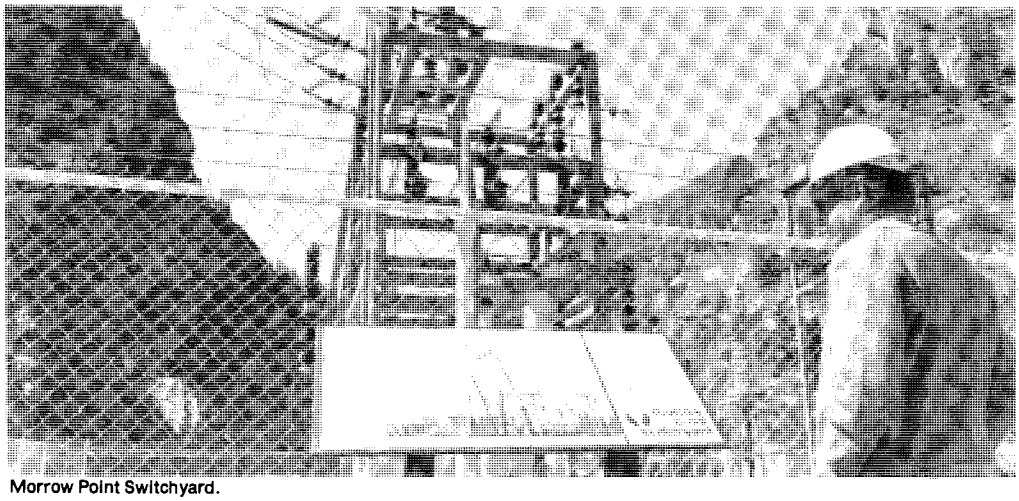
Work is winding down on the vegetation management contract with the Arizona State University. The work being done under this contract has provided a data base for evaluating the environmental impacts of vegetation management along the Lower Colorado River. The final phases of the study include a comprehensive final report, a description of vegetation and wildlife on the Colorado River and its tributaries, a revegetation study, a riparian vegetation and wildlife model, and a report on the utilization of riparian habitat by desert mule deer. The valuable data derived from this study will also be used on other projects.

Reclamation participated in a survey of potential habitat, in an effort to determine the numbers and location of the endangered Yuma Clapper Rail. The survey covered five divisions of the Lower Colorado River and was conducted in May and June 1983. Reclamation environmentalists have taken the lead producing a summary report for this interagency effort for the past 2 years.

Power Operations



Watercraft of various types.



Morrow Point Switchyard.

Upper Basin-Colorado River Storage Project

A contract for slightly over $12,000,000 was awarded to Westinghouse Electric Corporation (Westinghouse) in late December 1982, for uprating all of the Glen Canyon Powerplant generators. Westinghouse began work in early December 1983 and plans to complete the uprating of the last unit in July 1987.

The following table summarizes CRSP generation, purchases, disposition, and revenues from power operations for fiscal year 1983 and presents projections for fiscal year 1984.

The total revenue from power operations in fiscal year 1983 was $109,005,554.79. For fiscal year 1984, estimated revenues are $133,000,000.

Water Year 1983

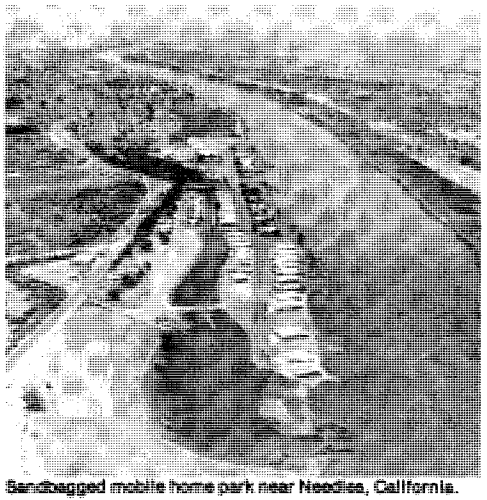
Sources of Energy	**Kilowatt-hours**
Net Generation	
Blue Mesa	336,102,400
Crystal	221,721,000
Flaming Gorge	878,160,000
Fontenelle	73,159,600
Glen Canyon	6,807,615,000
Morrow Point	464,112,000
Subtotal-Net Generation	8,780,870,000
Purchases	788,475,000
Miscellaneous	
Interchange Receipts	855,463,268
Energy Charges to Transmission Service Customers	259,720,000
Subtotal-Miscellaneous	1,115,183,268
Total Energy from All Sources	10,684,528,268

Disposition of Energy	**Kilowatt-hours**
Firm Energy Sales	7,018,637,761
Nonfirm Energy Sales Emergency	13,874,496
Fuel Replacement (Oil Conservation)	2,013,135,608
Interchange Deliveries	792,980,204
System Losses	845,900,199
Total Energy Distributed	10,684,528,268
Revenue	
Firm Power Sales	$60,360,833.87
Non firm Power Sales Emergency Power	246,476.25
Fuel Replacement (Oil Conservation) Energy	45,599,521.68
Reserve Capacity	104,175.00
Parker-Davis Project Firming	0
Transmission Service Revenue	2,382,433.35
Miscellaneous Revenue	312,114.64
Total Gross Revenue	$109,005,554.79

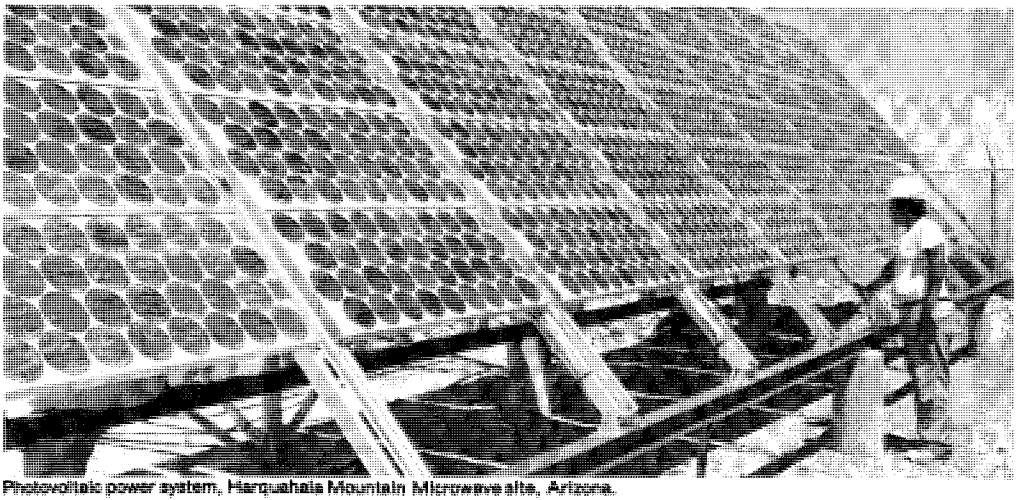
Water Year 1984 [Projected]

	Kilowatt-hours
Estimated Energy Sales	11,287,000,000
Estimated Purchases	615,000,000
Estimated Peaking Capacity Sales	
Winter 1983-84	0
Summer 1984	65,000
Estimated Revenue	$133,000,000.00

Power Operations [Cont.]

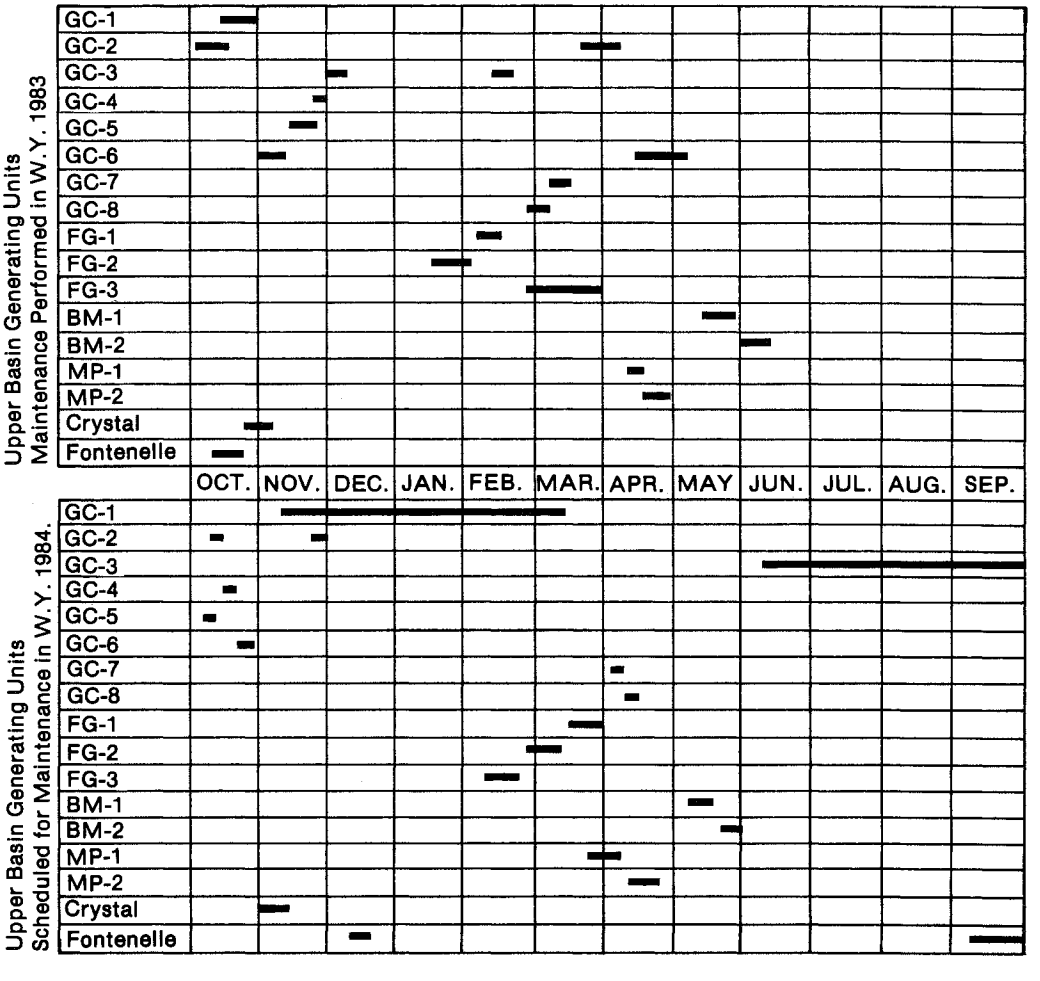


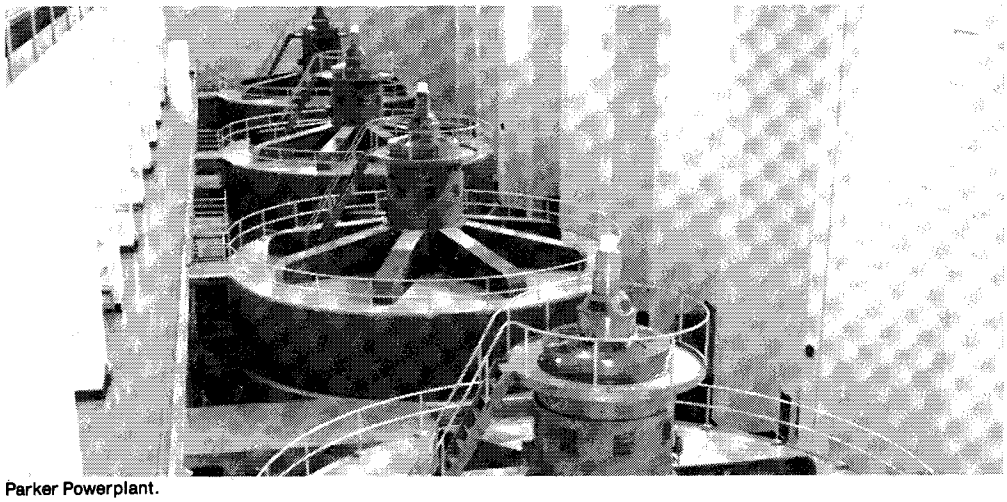
Sandbagged mobile home park near Needles, California.



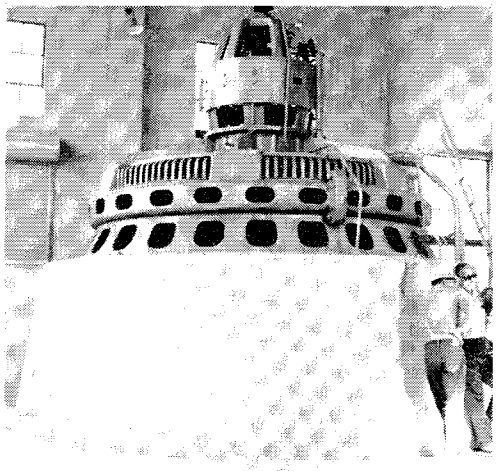
Photovoltaic power system, Harquahala Mountain Microwave site, Arizona.

Generating Unit Maintenance





Parker Powerplant.



Siphon Drop generator near Yuma, Arizona.

Lower Basin - Water Year 1983

The total energy delivery to the Hoover allottees during the 1983 operating year (June 1, 1982 - May 31, 1983) was 3,646,598,541 kilowatt-hours (kWh). There was no secondary or disputed energy delivered to the Hoover allottees during the operating year.

The remote control operation of Davis and. Parker Powerplants which first began during water year 1982 continued without event. These generator units are computer operated from the Department of Energy's Phoenix Dispatch Office, using hourly gate opening and megawatt schedules input and modified by Reclamation's Water Scheduling Branch in Boulder City, Nevada.

All necessary maintenance at Hoover, Parker, and Davis Powerplants was performed in water year 1983. The maintenance schedule at Davis Dam during water year 1983 was moved up because of anticipated high water releases during water year 1984. Davis Unit 5 was shut down during the spring of 1983 so that the draft tube and penstock gates could be reconditioned at that time. This action, along with adverse weather conditions encountered during the reconditioning of the gates on Davis Unit 3, forced rescheduling of maintenance on the other units (see chart).

Water year 1983 was the first time since Davis Dam was built that its spillway gate had to be used. It was also the first time since 1941 that the Hoover Dam spillways have been used. There was no known damage at Davis Dam, and only minor damage was done to the Hoover Nevada spillway tunnel during the high releases of 1983.

Each of the four Parker Powerplant units in turn were out of service for short periods of time during February or March 1983 for governor bailhead and oil motor vibrator installation. These modifications were modernization improvements to the governors.

Combined flows of up to 40,000 cfs through the Parker Dam spillway and generator units during water year 1983 caused considerable damage to an access road immediately downstream from the powerplant. The dam and powerplant themselves were unaffected. All generators at Parker Powerplant have experienced sustained use beginning May 5, 1983.

Water Year 1984

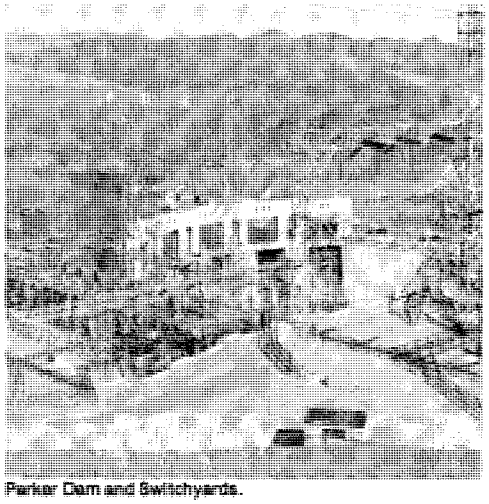
In operation studies of Lake Mead and Lake Powell for the Hoover operating year, which ends May 31, 1984, the amounts released at Hoover Dam have been projected to satisfy both downstream water requirements, including diversion by the District, while also complying with the overall requirements to meet compact, flood control and operating criteria release provisions. The water scheduled to be released will generate 100 percent of contract defined firm energy, plus secondary energy. The estimated monthly Hoover releases during the operating year total 19.55 million acre-feet. It is estimated that generation from these Hoover releases, along with the Hoover to Parker-Davis interchange, will result in delivery to the allottees of about 8.34 billion kWh of electrical energy.

Major maintenance at Davis and Parker Powerplants has not been scheduled for water year 1984 because of projected high water releases. Major maintenance is scheduled at Hoover Powerplant, but at a reduced level.

Paradox gate overhauls at Hoover Dam will require short(one or two day) penstock outages at the upper Nevada penstock and both Arizona penstocks during January, February, April and/or June 1984.

The following charts illustrate Lower Basin generator unit outage schedules for water year 1983 and projections for water year 1984.

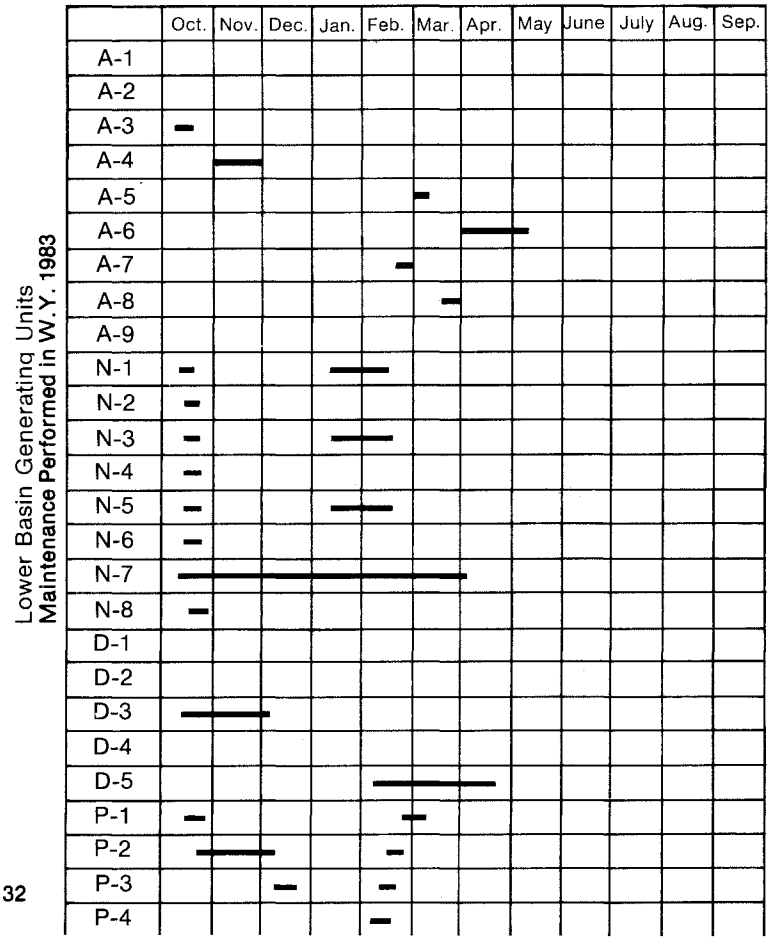
Power Operations [cont.]

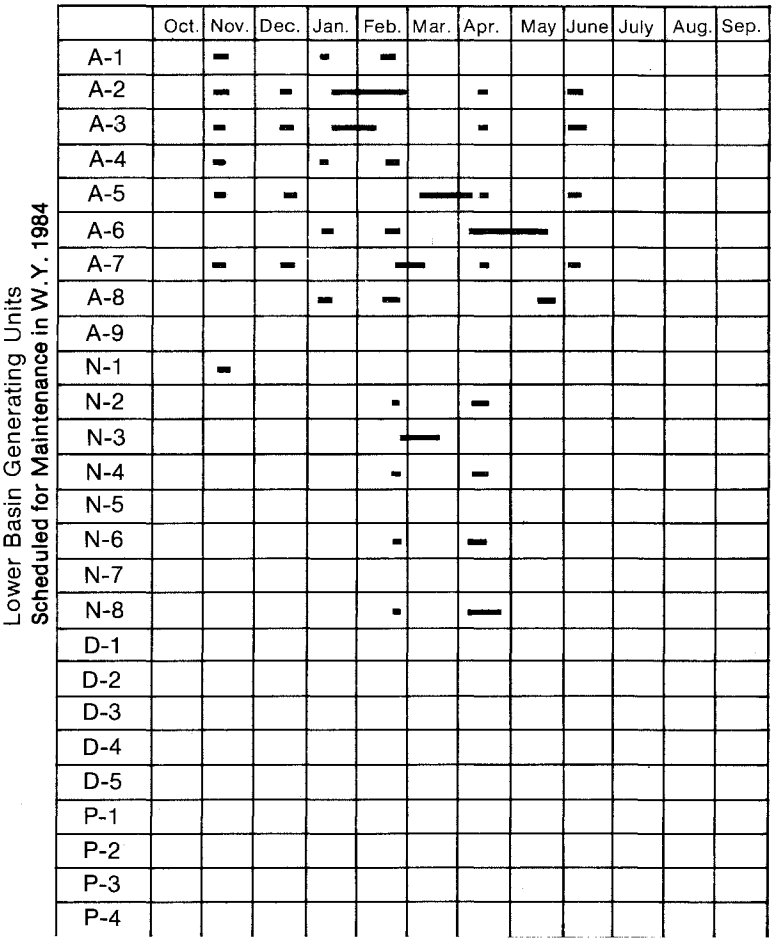


Parker Dam and Switchyards.

Erosion damage in right spillway, Glen Canyon Dam.

Generating Unit Maintenance





As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources, and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.