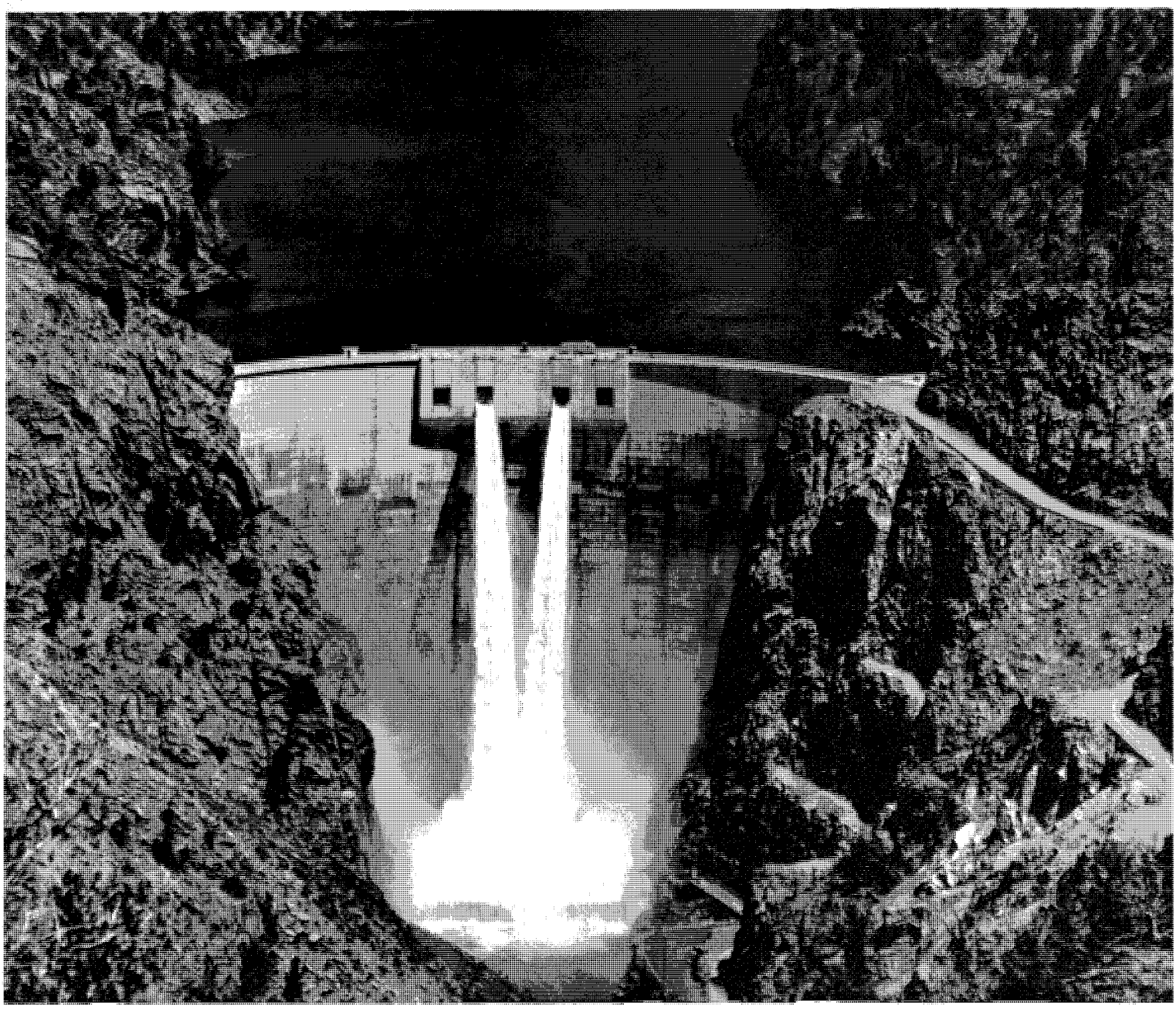
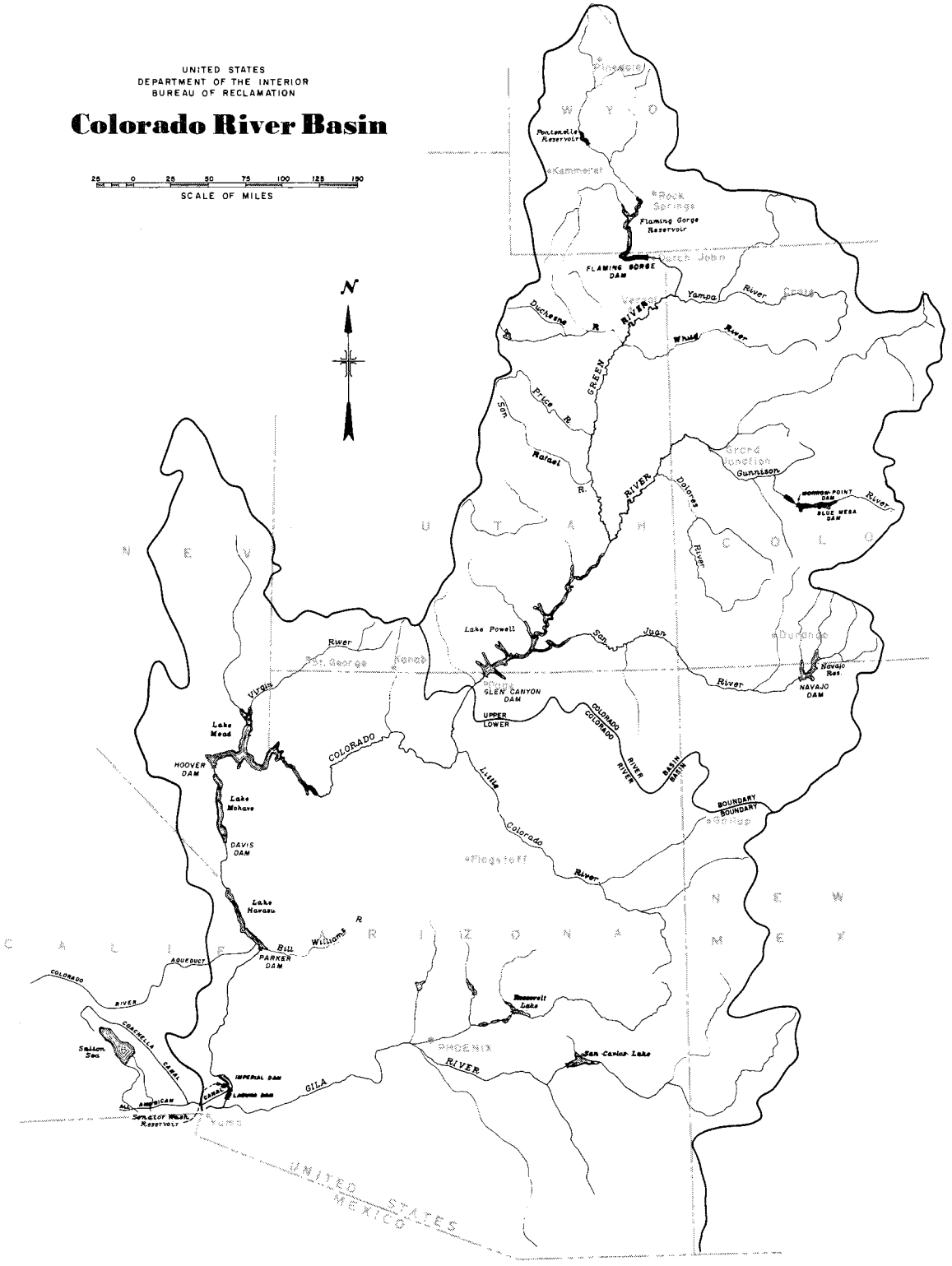
Annual Report
Operation of the Colorado River Basin 1977 Projected Operations 1978




UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Colorado River Basin
25 0 25 50 75 100 125 150
SCALE OF MILES
N
Pinedale
Pantendale Reservoir
Kemmerer
Rock Springs
Flaming Gorge Reservoir
FLAMING GORGE DAM
Green River
Yampa River
Duchesne R.
White River
GREEN RIVER
Price R.
San Rafael R.
Grand Junction
Gunnison
MORROW POINT DAM
BLUE MESA DAM
Gunnison River
Dolores River
Durango
Navajo Res.
NAVAJO DAM
Lake Powell
GLEN CANYON DAM
San Juan River
St. George
Virgin River
Lake Mead
HOOVER DAM
COLORADO RIVER
UPPER BASIN
LOWER BASIN
Little Colorado River
Lake Mohave
DAVIS DAM
Lake Havasu
Bill Williams R.
PARKER DAM
AQUEDUCT
COLORADO RIVER
CORONELLA CANAL
Salton Sea
IMPERIAL DAM
All American Canal
Laguna Dam
Senator Wash Reservoir
GILA RIVER
Roosevelt Lake
San Carlos Lake
Phoenix
Flagstaff
BOUNDARY
UNITED STATES
MEXICO
U T A H
C O L O
N E V
A R I Z O N A
N E W
M E X
C A L I F

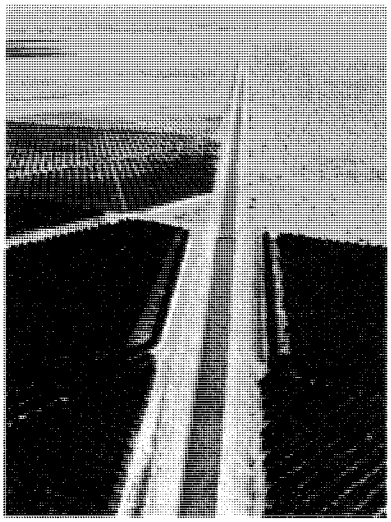
Annual Report

Operation of the Colorado River Basin 1977 Projected Operations 1978

U.S. Department of the Interior
Cecil D. Andrus, Secretary

Bureau of Reclamation
R. Keith Higginson, Commissioner

January 1978



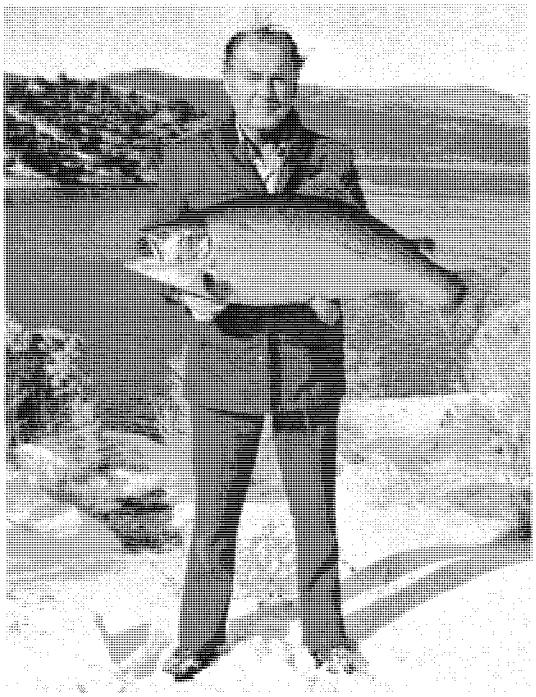
Contents

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

Introduction

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

Storage and release of water from the Upper Basin reservoirs recognize all applicable laws and relevant factors governing 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.



Record German brown trout, Flaming Gorge Reservoir, Utah-Wyoming.

Authority for Report

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 seventh 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 1977 and the projected operation of these reservoirs during water year 1978 under the "Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs," published in the **Federal Register** June 10, 1970.

Cecil D. Andrus, Secretary
U.S. Department of the Interior

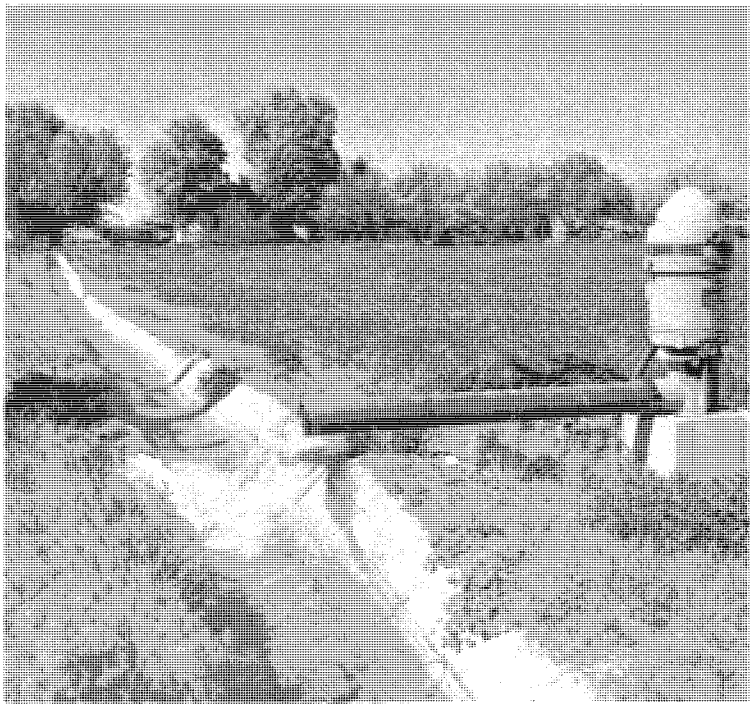
Sailing on Lake Mead, Boulder Canyon Project, Arizona-Nevada.

Actual Operations under Criteria—Water Year 1977

Operations of the Colorado River system during 1977 were greatly affected by the drought conditions in the western part of the United States that spread into the Colorado River drainage area in the fall of 1976 and continued through water year 1977. Precipitation accumulations in the Upper Basin for the first 6 months of the water year were only 39 percent of normal and snow measurements on April 1, 1977, indicated only 41 percent of a normal snowpack. Starting January 1, the snowmelt runoff forecast indicated a water supply considerably less than normal that would allow a scheduled release of only 8.23 million acre-feet from the Upper Basin at Lake Powell for the water year. Releases from the other reservoirs through September 1977 were scheduled accordingly to meet the power production and other multiple purpose requirements of the system. At the beginning of each month thereafter through June, the forecast was revised based on precipitation and snow data collected during the month and the scheduled operation was revised accordingly.

The Colorado River Basin runoff at Lake Powell for water year 1977 was 3,217,000 acre-feet, or 27 percent of the long-time average. This was the lowest recorded runoff on the Colorado River at the Lake Powell site in the 72-year period of record. Precipitation in the Colorado River Basin for water year 1977 was 65 percent of normal. The major storage reservoirs on the Colorado River system stayed within the normal operating range during water year 1977 and the downstream water requirements were met from carryover reservoir storage. Aggregate storage at the end of water year 1977 was 42,141,000 acre-feet which represented a decrease of 5,671,000 acre-feet from water year 1976.

A description of the actual operation of each of the reservoirs in the Colorado River Basin follows. Charts 1 through 10 show hydrographs of monthly outflow from the reservoirs and water surface elevation and active storage in the reservoirs for water year 1977.



Ground water for irrigation of crops.

Corn crop in the Salt River Project, Arizona; Reclamation's first large multipurpose water resources project.

Upper Basin Reservoirs

Fontenelle Reservoir

During the past year, Fontenelle Reservoir was operated for power generation, flood control, fish and wildlife enhancement, and recreation. During the fall and winter of 1976–77, the reservoir water surface elevation was reduced slowly from elevation 6,504 feet at the beginning of the water year to a low elevation of 6,483 feet prior to spring runoff in April. The minimum release during the fall and winter was 700 cubic feet per second (ft^3/s). All releases were used to generate power and maintain fish flows. Maximum inflow of 3,790 ft^3/s occurred in mid-June. Even though releases were reduced to about 500 ft^3/s in late June to conserve storage, the reservoir did not fill during the 1977 runoff season but reached a maximum elevation on September 18 of 6,501 feet and an active storage of 303,000 acre-feet. (Chart 1.)

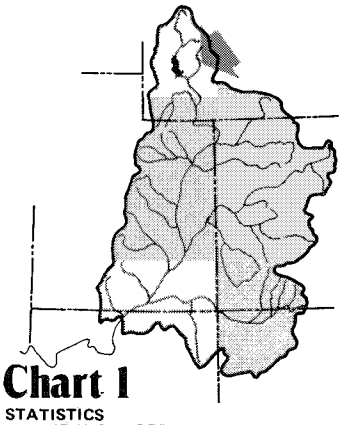
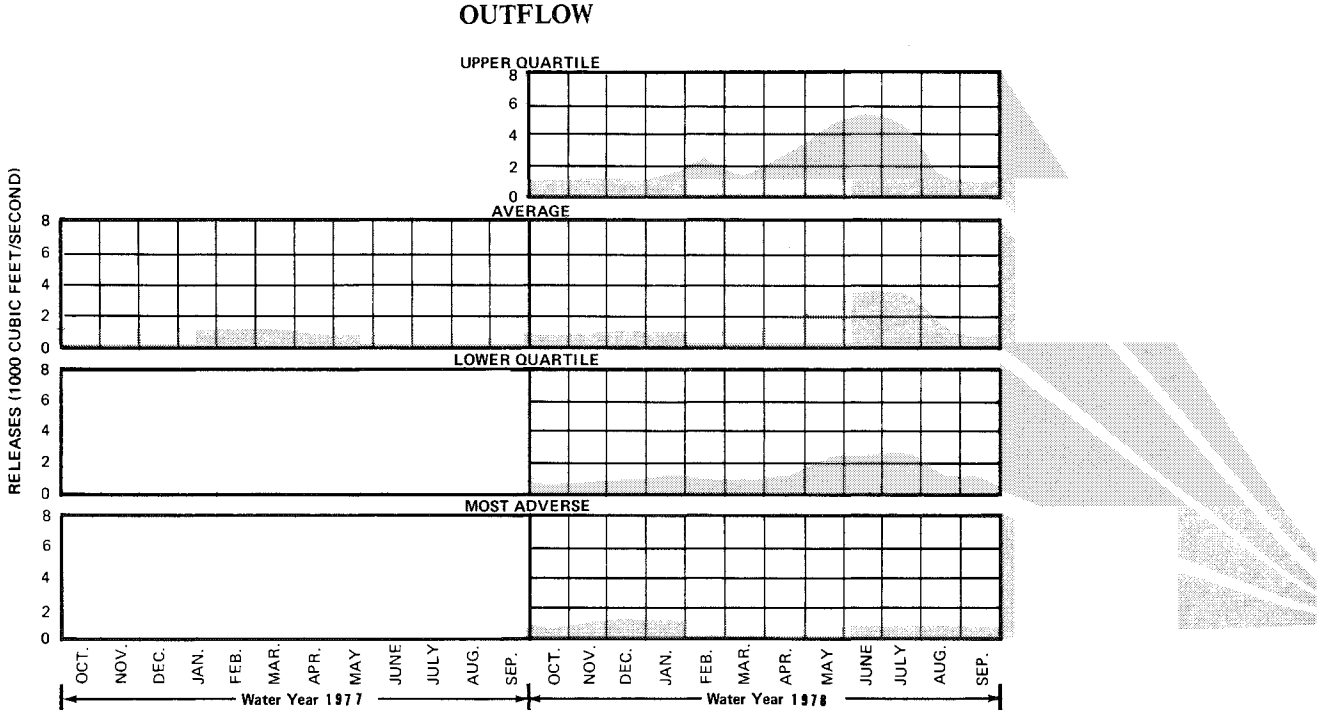


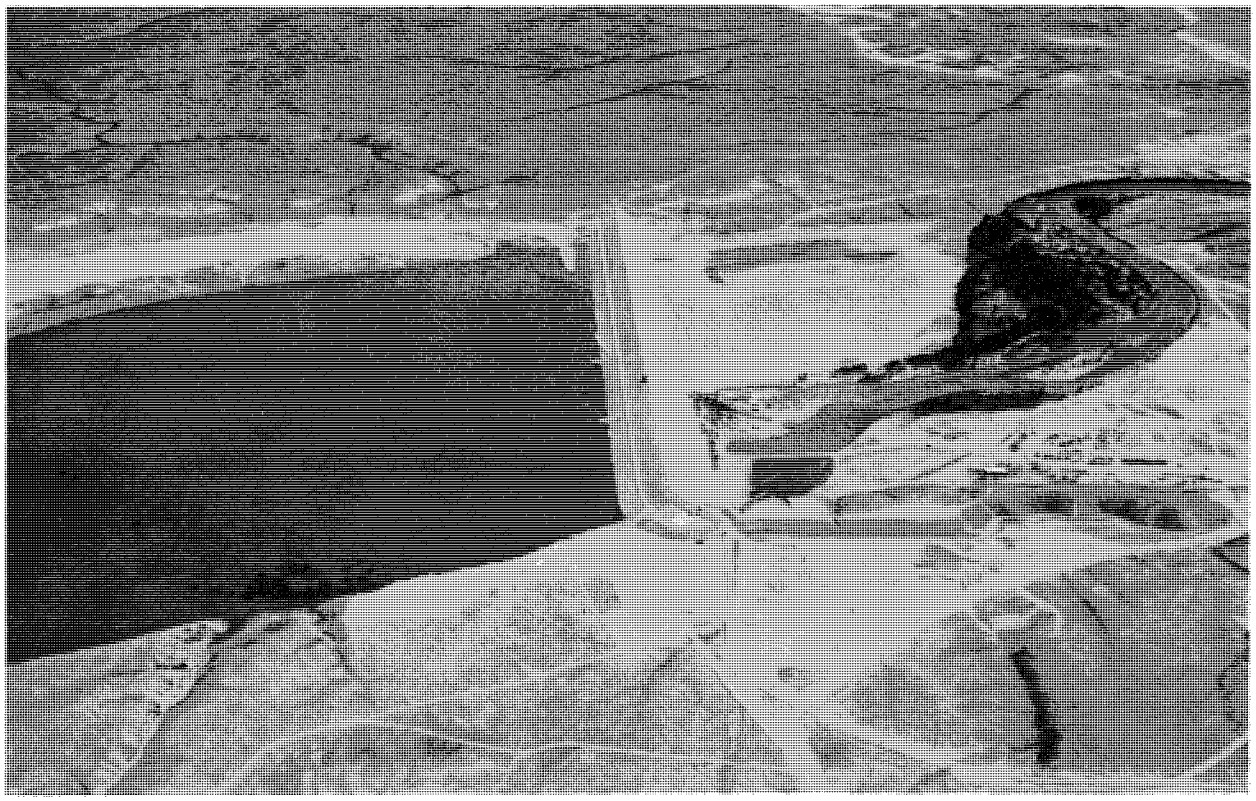
Chart 1

STATISTICS
ACTIVE STORAGE*

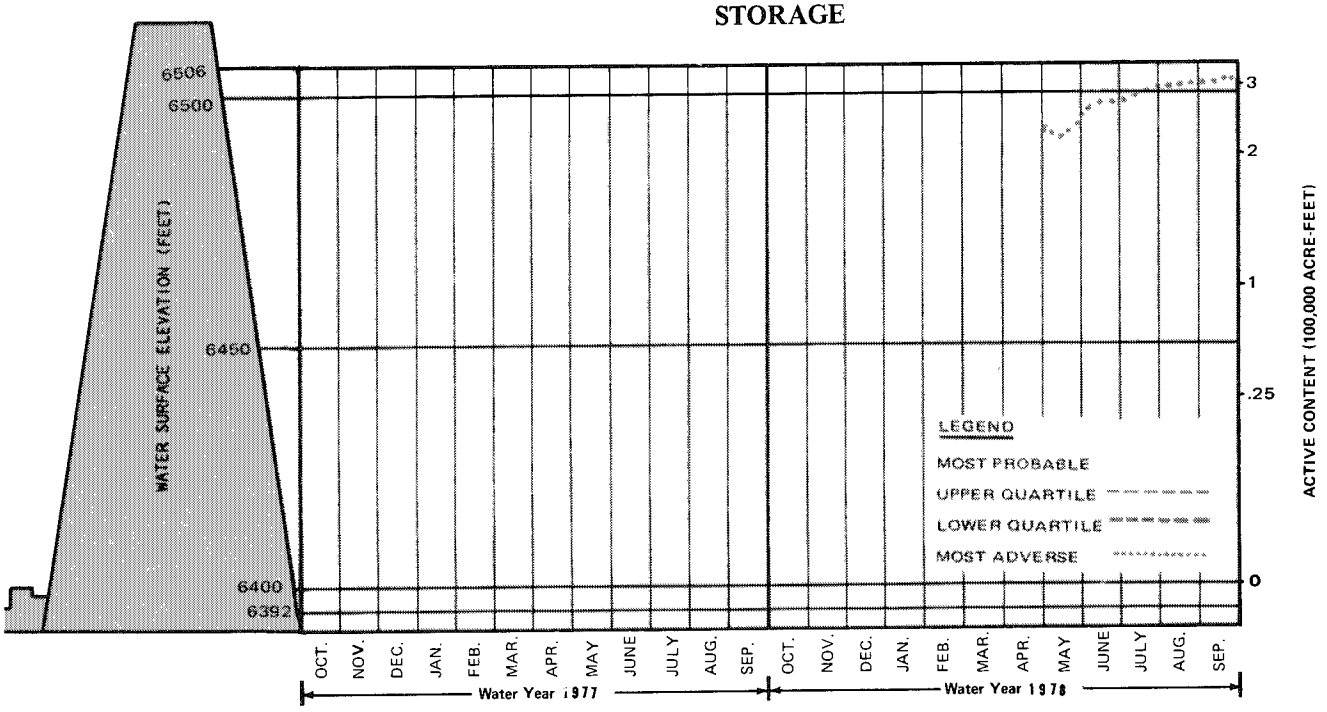
RESERVOIR	(ACRE-FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	344,834	6506
RATED HEAD	233,789	6491
MINIMUM POWER	194,962	6485
SURFACE AREA (FULL)	8058 ACRES	
RESERVOIR LENGTH (FULL)	18 MILES	
POWER PLANT		
NUMBER OF UNITS	1	
TOTAL CAPACITY	10,000 KILOWATTS	

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





Fontenelle Dam and Reservoir, Seedskadee Project, Wyoming.



Flaming Gorge Reservoir

Flaming Gorge Reservoir is operated as part of the Colorado River Storage Project (CRSP) in accordance with governing compacts and laws to provide river regulation, power production, recreation opportunities, and fish and wildlife benefits.

On September 30, 1976, the water surface was at elevation 6,033 feet. The active storage was 3,474,000 acre-feet. Water released caused the reservoir level to recede 19 feet during the fall and winter to elevation 6,014 feet. The April-July 1977 runoff above Flaming Gorge was 233,000 acre-feet, or 21 percent of the long-time average. With this low runoff, the water level continually receded to elevation 5,991 feet with an active storage of 2,080,000 acre-feet by the end of September.

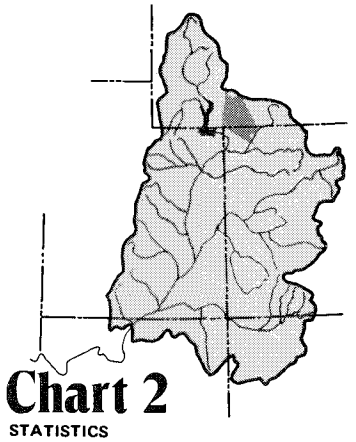


Chart 2

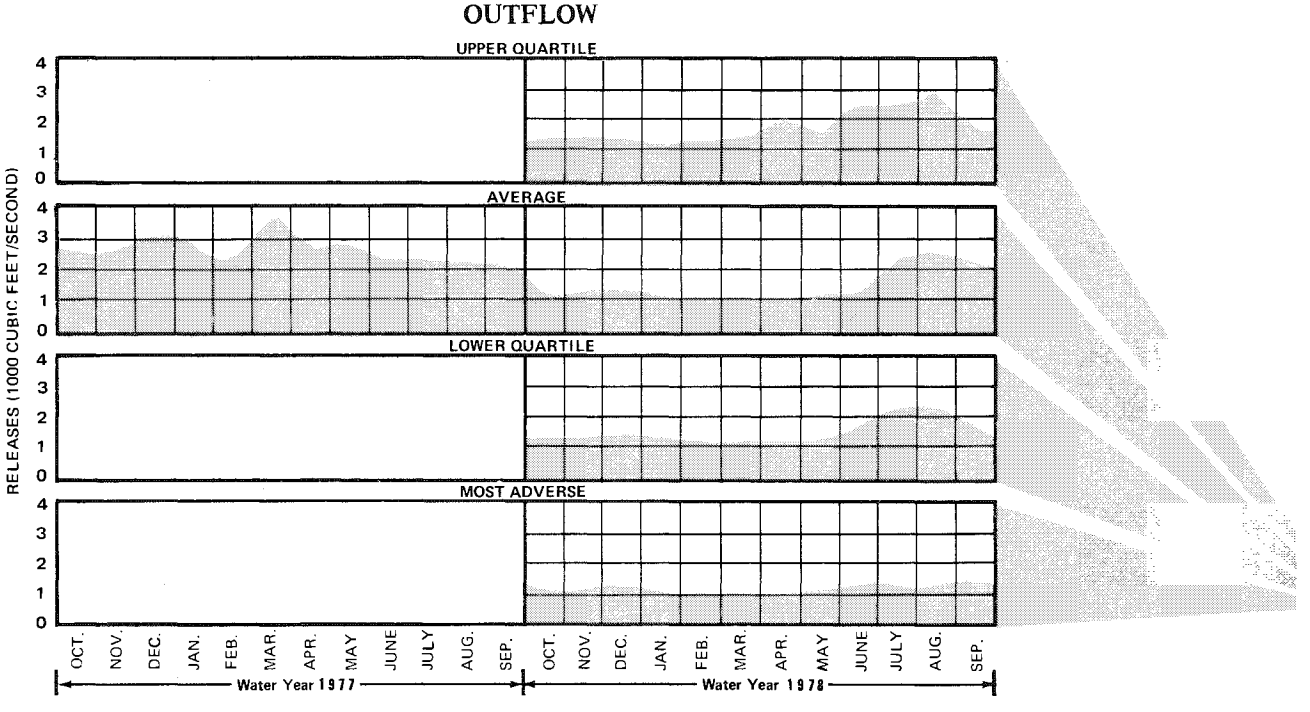
STATISTICS
ACTIVE STORAGE*

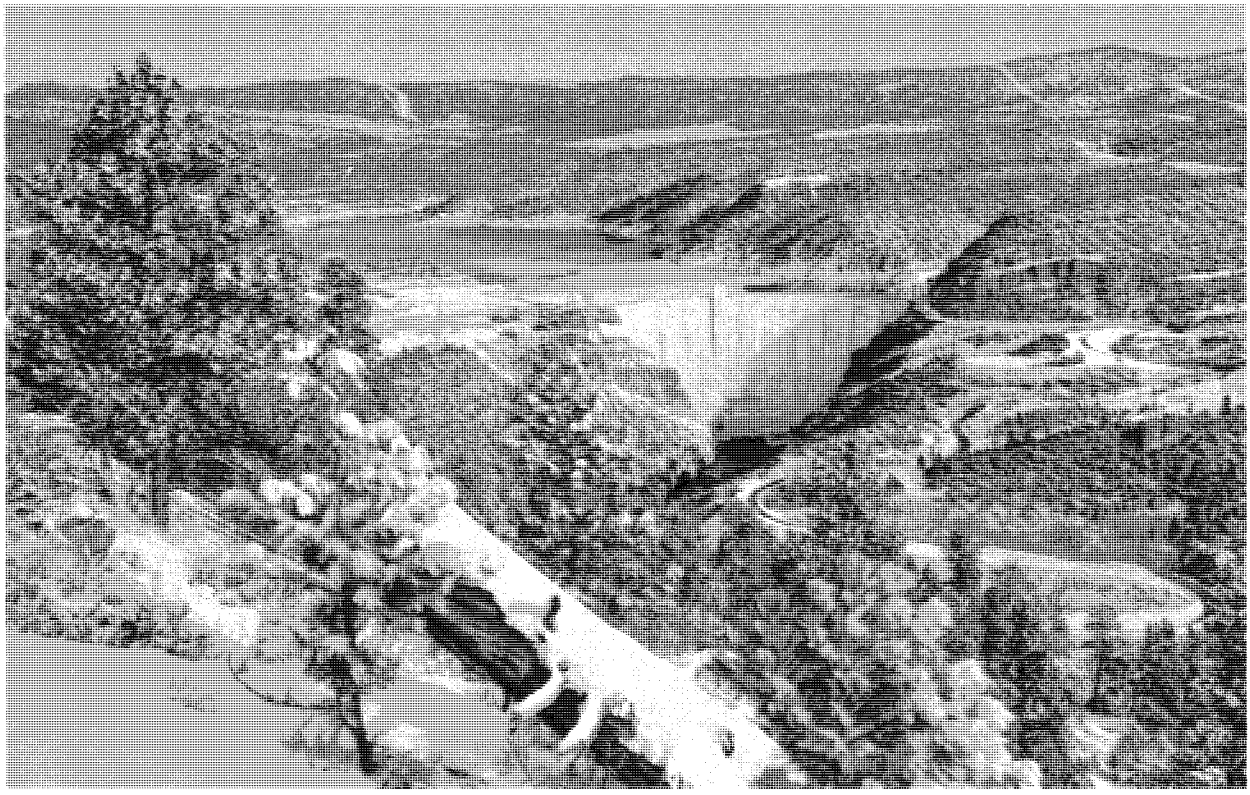
RESERVOIR	ACRE-FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	3,749,000	6040
RATED HEAD	1,062,000	5946
MINIMUM POWER	233,000	5871
SURFACE AREA (FULL)	42,020 ACRES	
RESERVOIR LENGTH (FULL)	91 MILES	

POWER PLANT

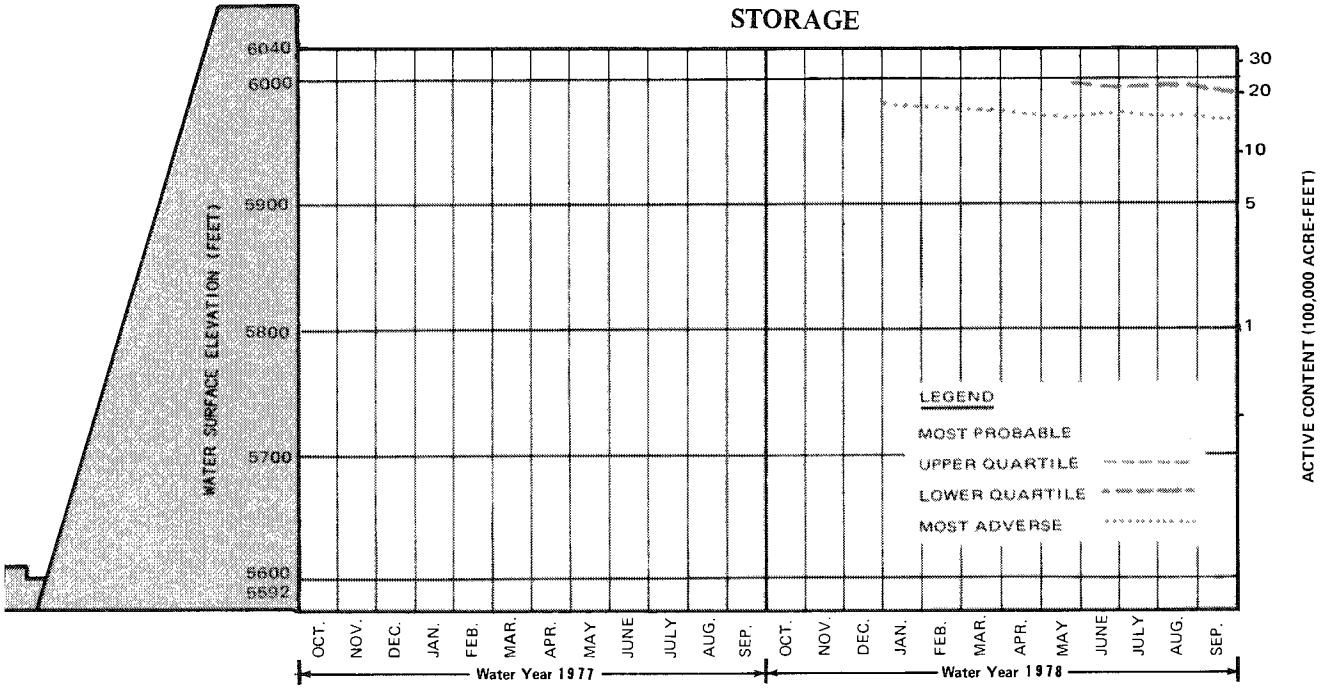
NUMBER OF UNITS	3
TOTAL CAPACITY	108,000 KILOWATTS

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





Flaming Gorge Dam and Reservoir, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming.



Curecanti Unit—Blue Mesa Reservoir

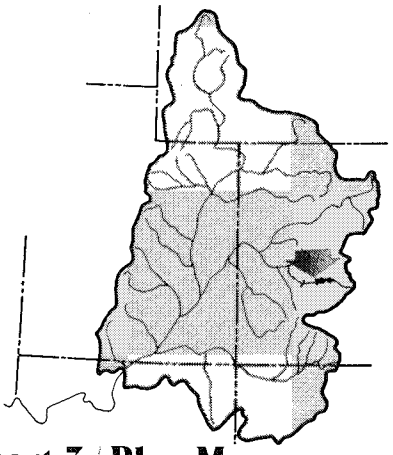


Chart 3 / Blue Mesa Reservoir

STATISTICS
ACTIVE STORAGE*

RESERVOIR	(ACRE-FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	829,523	7519
RATED HEAD	249,395	7438
MINIMUM POWER	81,070	7393
SURFACE AREA (FULL)	9180 ACRES	
RESERVOIR LENGTH (FULL)	24 MILES	

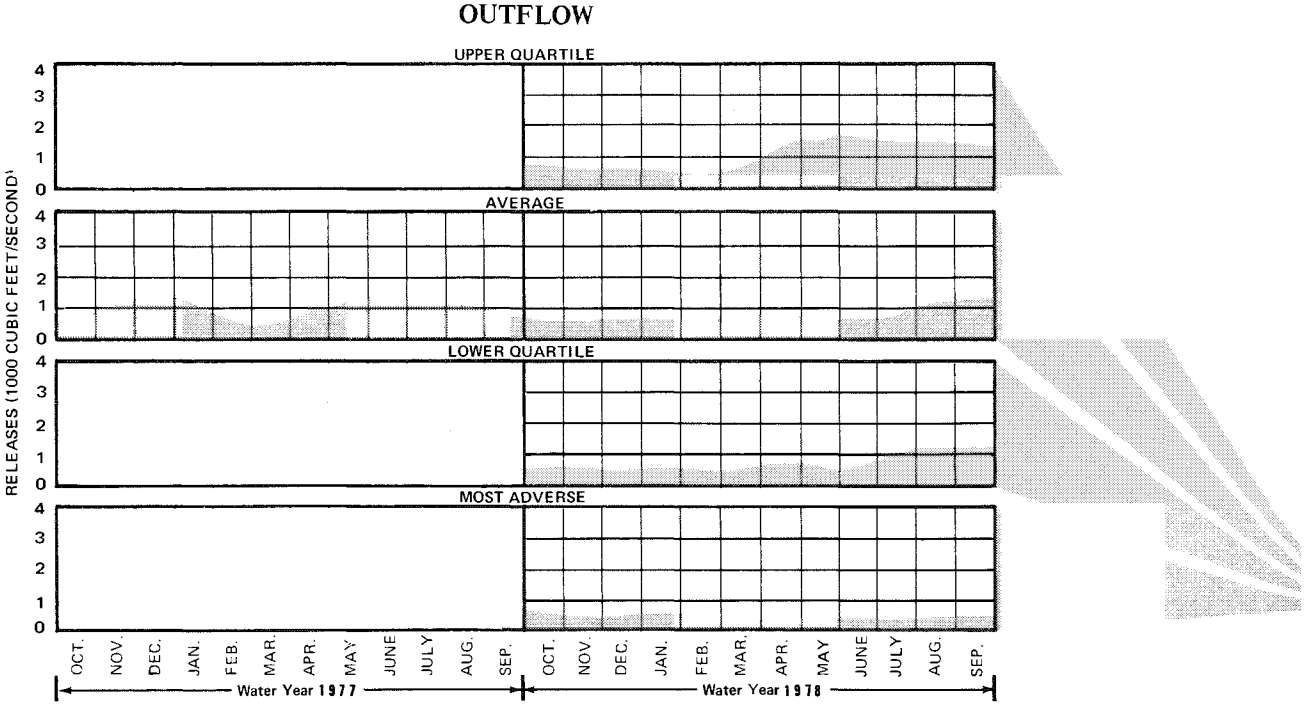
POWER PLANT

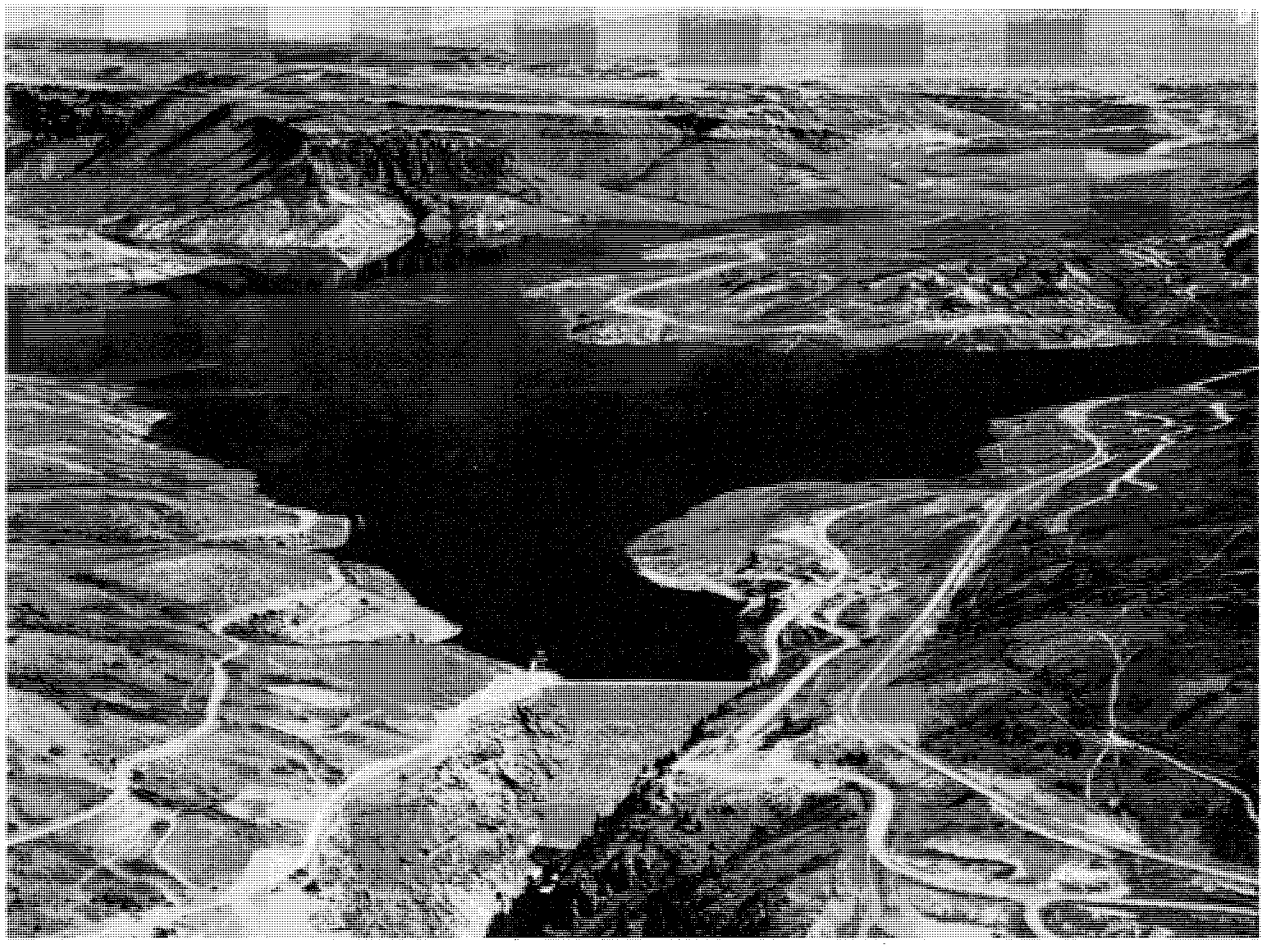
NUMBER OF UNITS	2
TOTAL CAPACITY OF UNITS	60,000 KILOWATTS

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

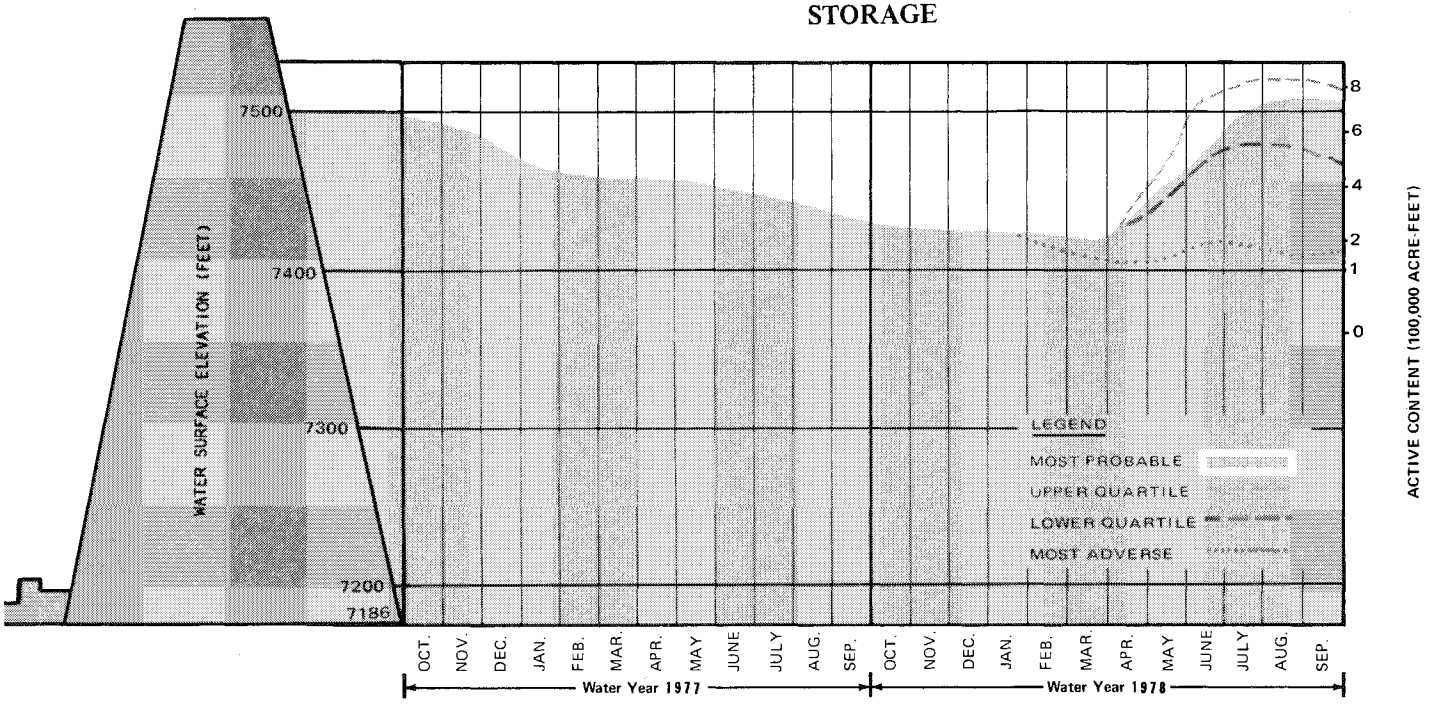
At the end of September 1976, Blue Mesa Reservoir contained 606,000 acre-feet of active water storage, with a water surface elevation of 7,493 feet. During April-July 1977, inflow to Blue Mesa was 149,000 acre-feet, or about 19 percent of normal, with a 1977 water year total of 294,000 acre-feet. Low inflow caused the reservoir to drop through the summer to elevation 7,432 feet with a content of 221,000 acre-feet by the end of September 1977. During water year 1977, a minimum flow of 200 ft^3/s was maintained below the Gunnison Tunnel diversion to protect the fishery resource in the river.

The March 1, 1977, forecast of the April-July 1977 inflow to Blue Mesa was 280,000 acre-feet. The flood control regulations did not require evacuation of space during the snowmelt season; consequently, the operation of Blue Mesa did not include releases for flood control. (Chart 3.)





Blue Mesa Dam, Curecanti Unit, Colorado River Storage Project, Colorado.



Curecanti Unit—Morrow Point Reservoir

Morrow Point Reservoir was essentially full during all of water year 1977. On September 30, 1976, the reservoir contained 115,000 acre-feet of active storage at a water-surface elevation of 7,158 feet. Its inflow is extensively controlled by Blue Mesa Reservoir, which is upstream.

Normally, Morrow Point Reservoir can be expected to be operated at or near full capacity regardless of the amount of snowmelt runoff. (Chart 4.)

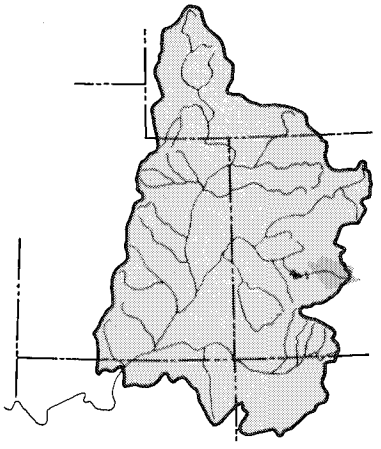


Chart 4 / Morrow Point Reservoir

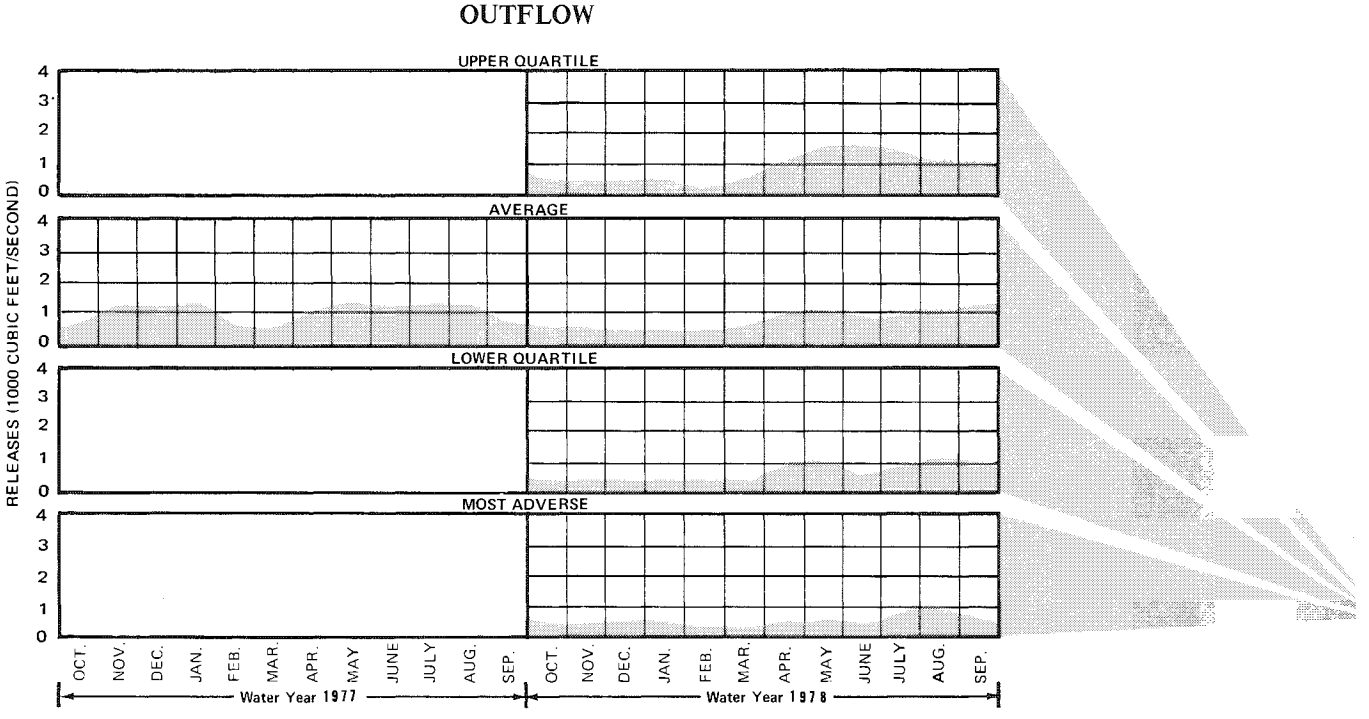
STATISTICS

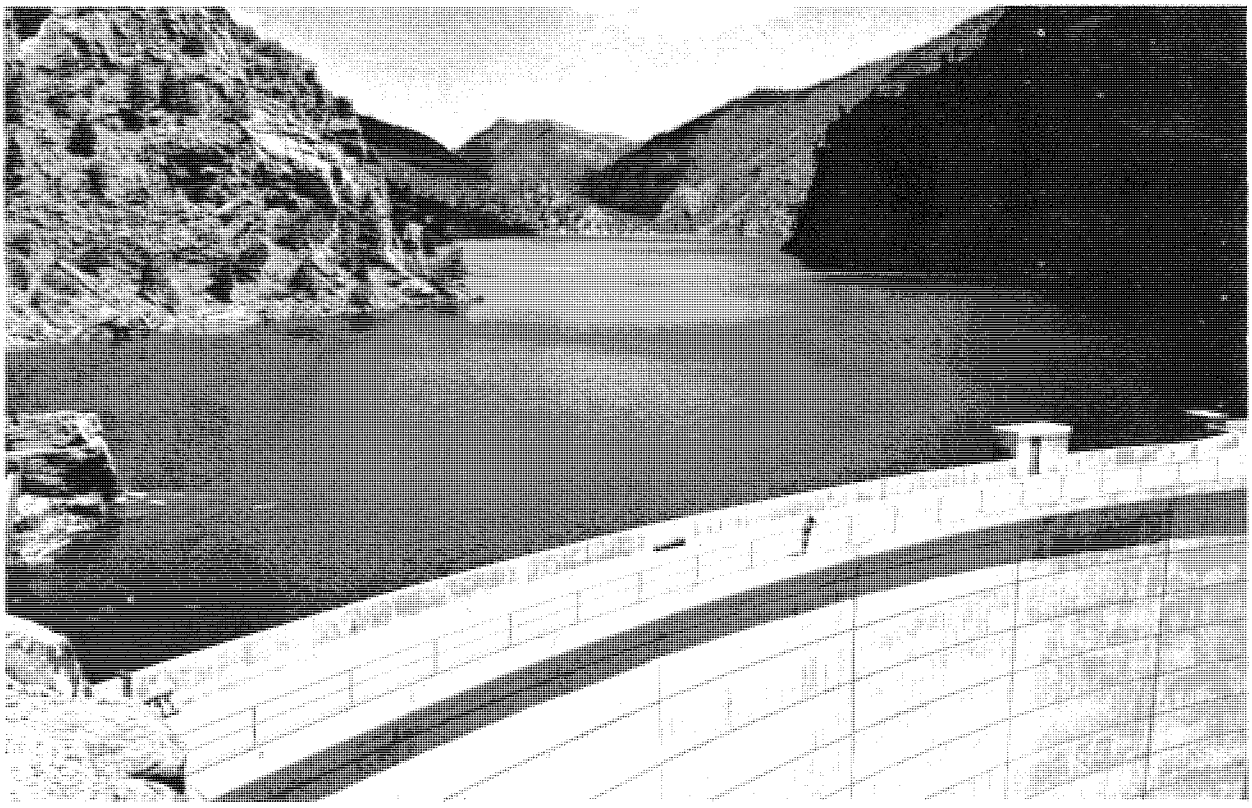
ACTIVE STORAGE* RESERVOIR	(ACRE-FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	117,025	7160
RATED HEAD	79,805	7108
MINIMUM POWER	74,905	7100
SURFACE AREA (FULL)	817 ACRES	
RESERVOIR LENGTH (FULL)	11 MILES	

POWER PLANT

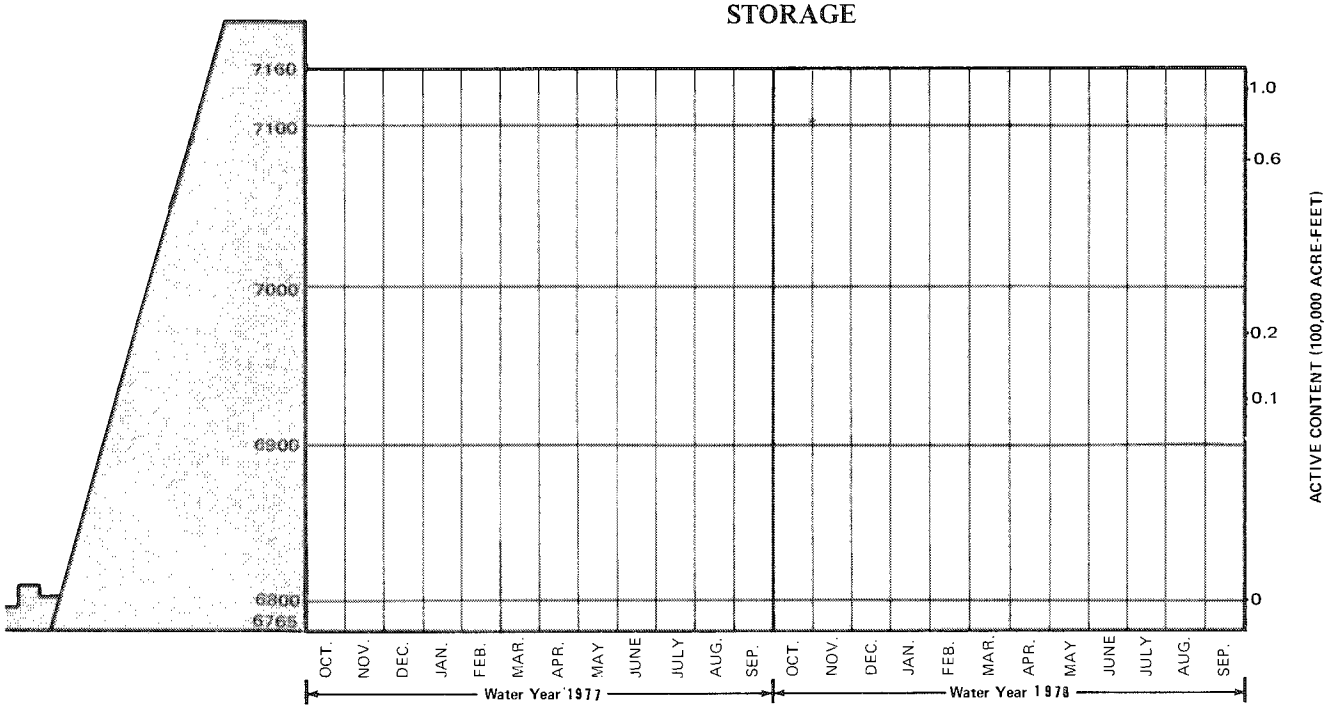
NUMBER OF UNITS	2
TOTAL CAPACITY OF UNITS	120,000 KILOWATTS

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





Morrow Point Dam and Reservoir, Curecanti Unit, Colorado River Storage Project, Colorado.



Curecanti Unit—Crystal Dam and Reservoir

The initial filling of the recently completed Crystal Dam, downstream from Morrow Point Dam, was started on March 14, 1977. The primary function of this reservoir is to reregulate variable releases from Morrow Point to a more even flow in the Gunnison River downstream. On September 30, 1977, Crystal Dam had an active content of 14,000 acre-feet at elevation 6,742 feet. Maximum elevation for the reservoir is elevation 6,755 feet. A 28,000 kW powerplant is scheduled to begin commercial power production during March 1978. (Chart 5.)

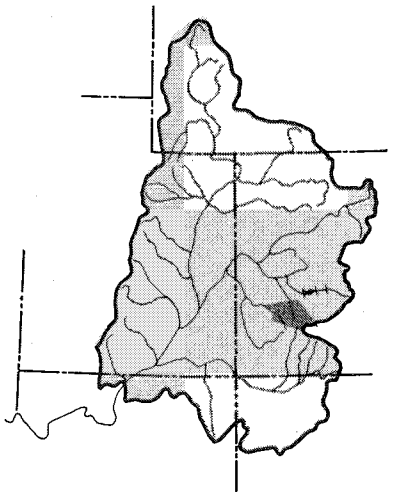
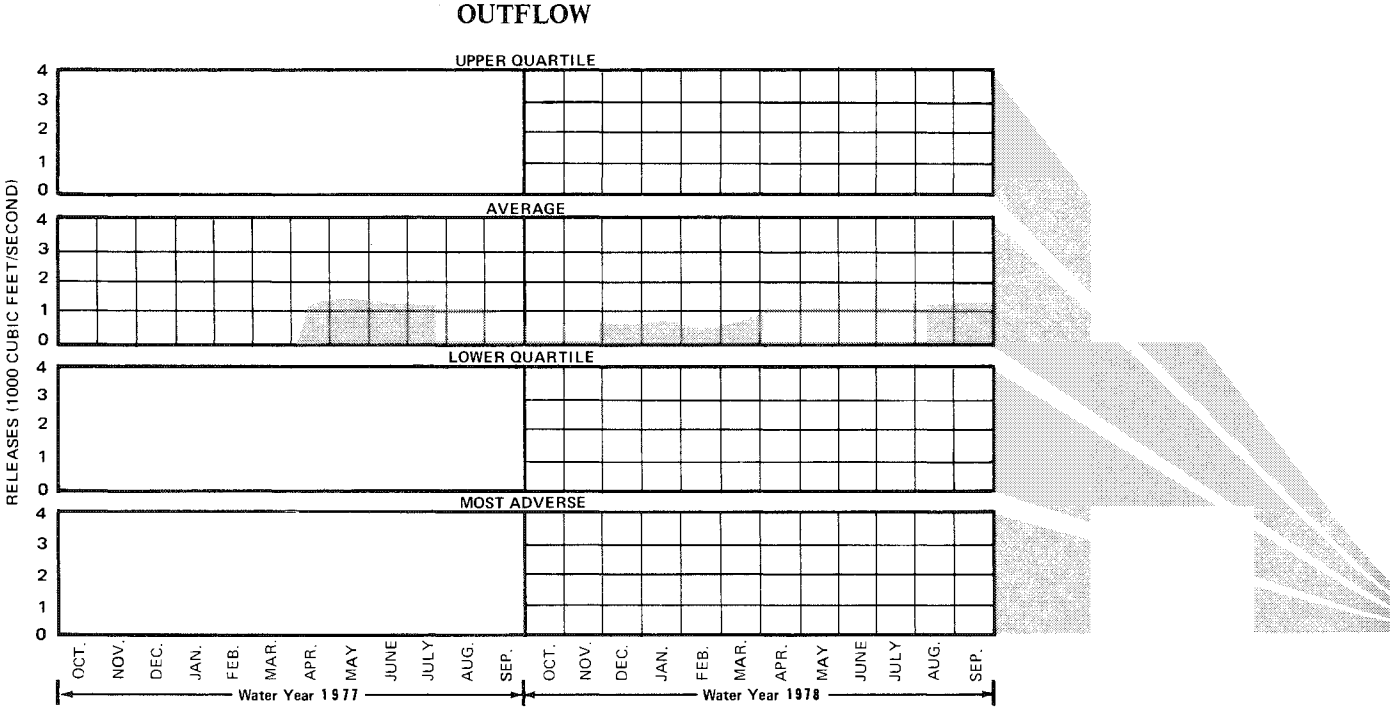
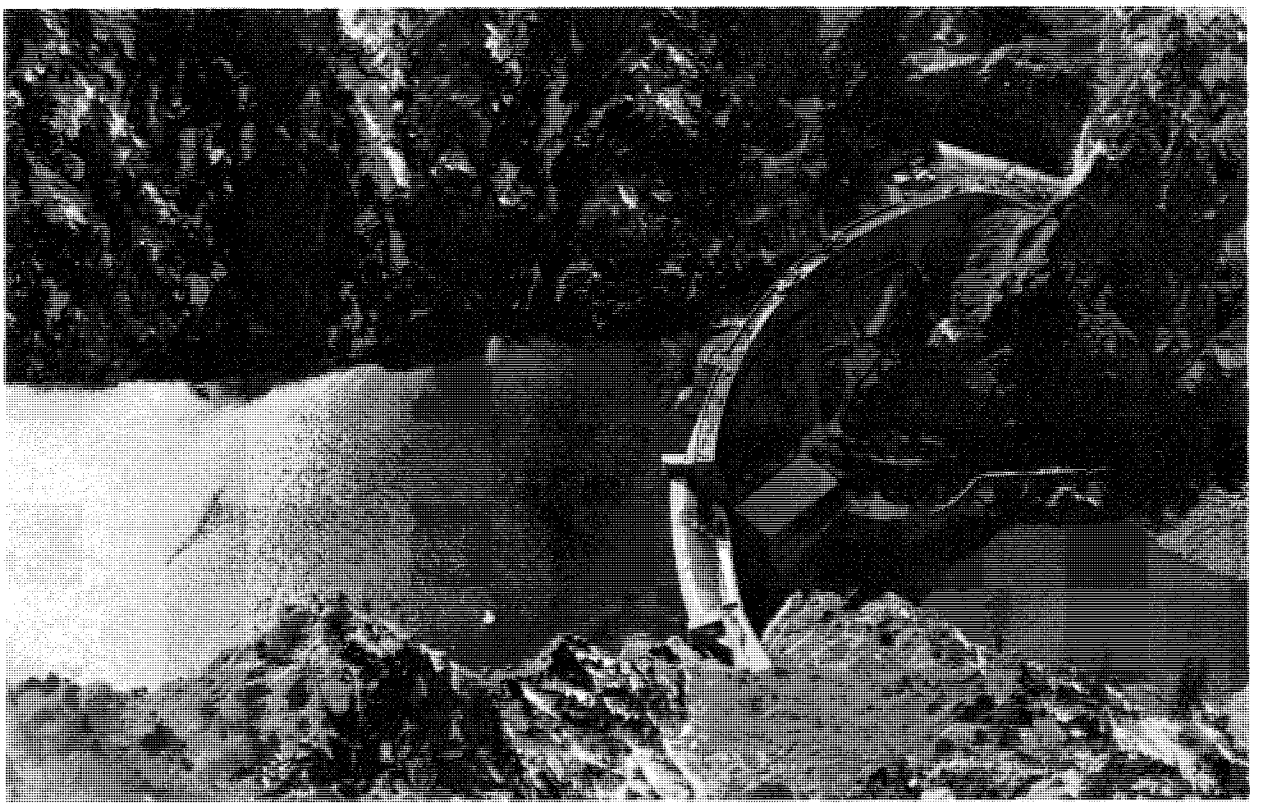


Chart 5/Crystal Reservoir

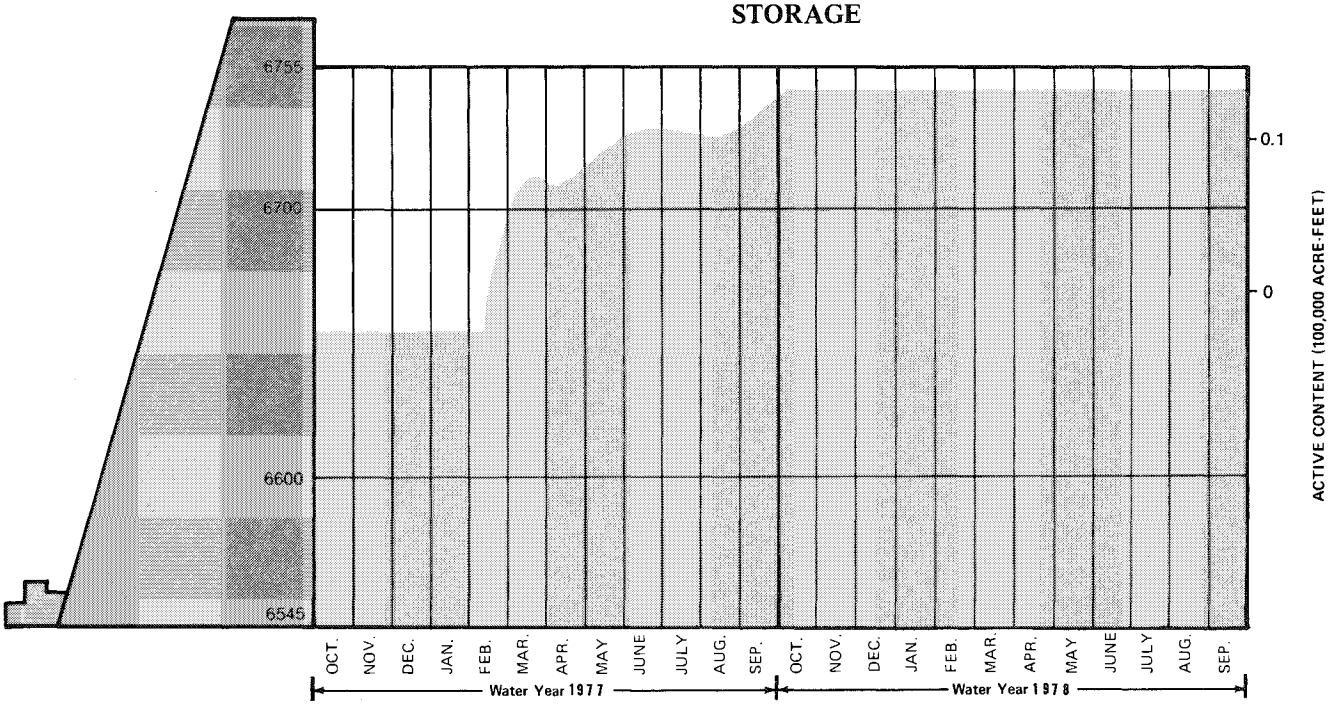
STATISTICS ACTIVE STORAGE* RESERVOIR	(ACRE-FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	17,573	6755
RATED HEAD	13,886	6742
MINIMUM POWER	10,619	6729
SURFACE AREA (FULL)	301 ACRES	
RESERVOIR LENGTH (FULL)	7 MILES	
POWER PLANT		
NUMBER OF UNITS	1	
TOTAL CAPACITY OF UNITS	28,000 KILOWATTS	

**does not include 8,200 acre feet of dead storage below 6670 feet.*





Aerial view looking down on Crystal Dam, Curecanti Unit, Crystal Dam, Colorado.



Navajo Reservoir

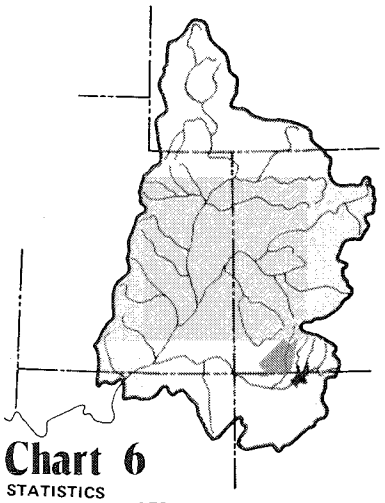


Chart 6

STATISTICS
ACTIVE STORAGE*

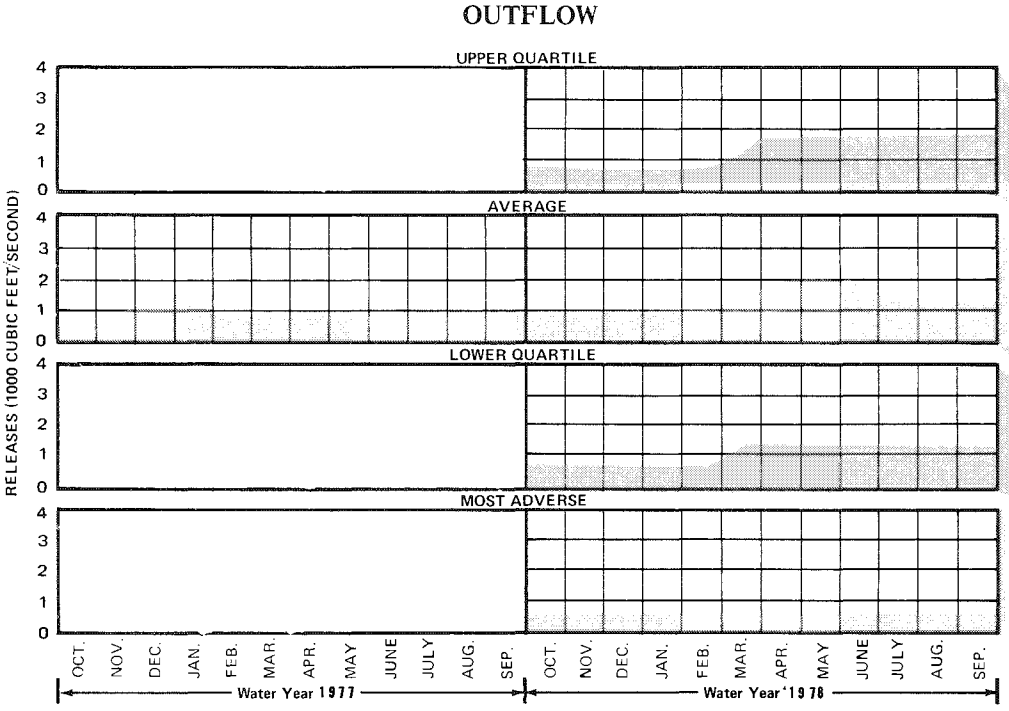
RESERVOIR	(ACRE FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	1,696,400	6085
INACTIVE STORAGE	660,500	5990
SURFACE AREA (FULL)	15,610 ACRES	
RESERVOIR LENGTH (FULL)	33 MILES	

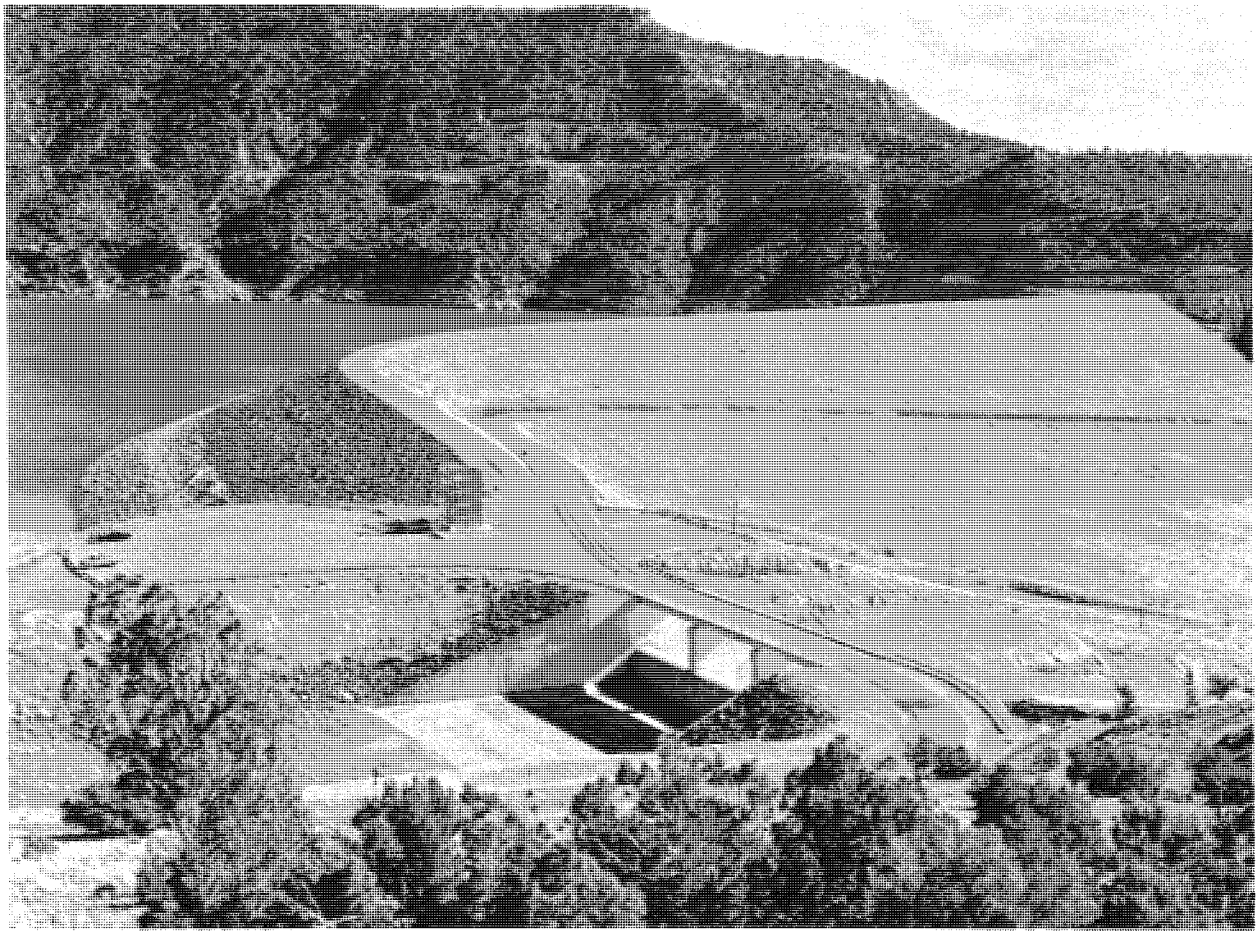
**does not include 12,600 acre feet of dead storage below elevation 5775 feet*

During water year 1977, Navajo Reservoir was kept within the limits specified by the Bureau of Reclamation in its interim operation rules. The reservoir water surface was lowered to elevation 6,039 feet during the winter of 1976 and spring of 1977. The actual April-July inflow to Navajo Reservoir was 119,000 acre-feet, or 15 percent of the long-time April-July runoff average above Navajo. Releases for downstream requirements and inflow into Navajo were about the same, which caused the reservoir to be level during the recreation season.

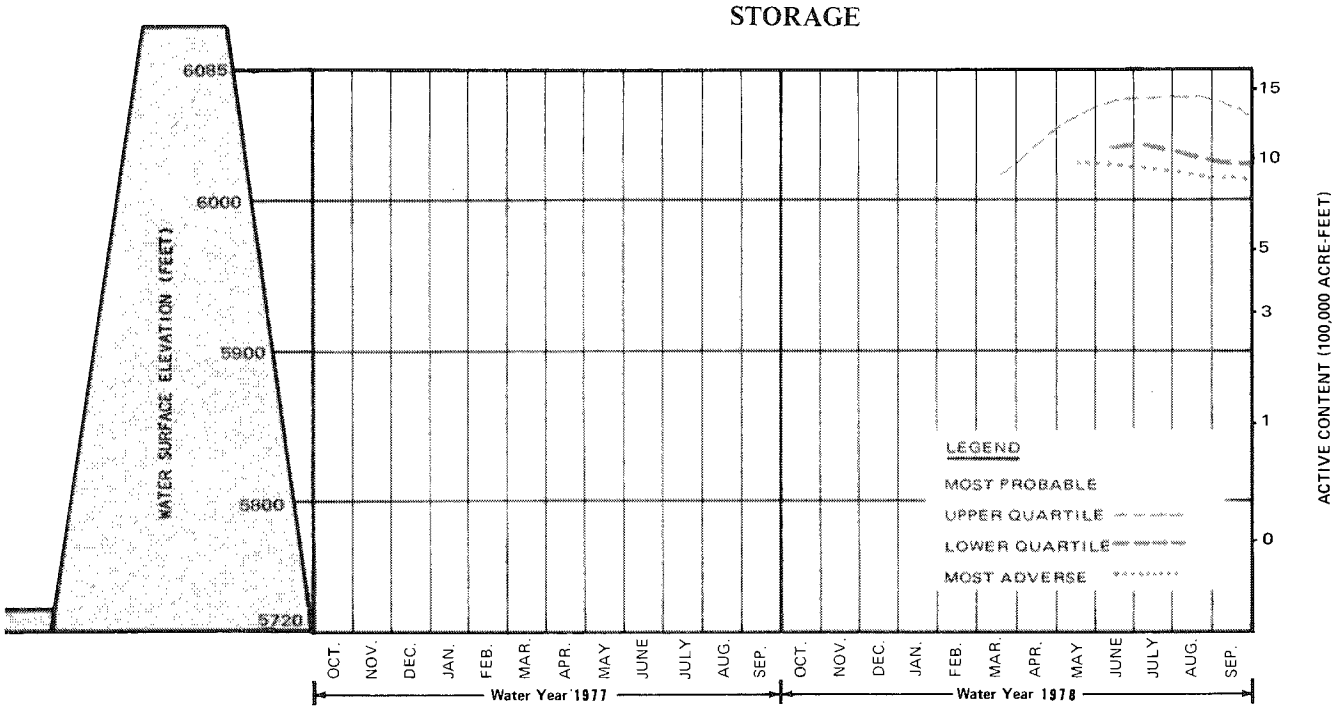
Navajo Reservoir is operated under a formal flood control plan. On March 1, 1977, Navajo Reservoir had 1,120,000 acre-feet of water in storage. The April-July inflow forecast on March 1 was 200,000 acre-feet. Based on the March 1 forecast, the current flood control rules allowed the reservoir to be full, and the scheduled operation of the reservoir did not include any releases specifically for flood control. (Chart 6.)

Releases were scheduled to conserve water in storage while providing for minimum downstream flows at points of diversion for consumptive use and for maintenance of fish and wildlife resources.





Navajo Dam and Reservoir, Navajo Unit, Colorado River Storage Project, New Mexico-Colorado.



Glen Canyon Dam, Lake Powell

During water year 1977, Lake Powell was operated as part of the Colorado River Storage Project in accordance with governing compacts and laws to provide river regulation, optimum power production, recreation opportunities, and fish and wildlife benefits.

On September 30, 1976, Lake Powell water surface elevation was at 3,664 feet with an active storage of 19,640,000 acre-feet. During the fall and winter months of 1976–77, the reservoir water level dropped about 13 feet to elevation 3,651 feet. Low releases from Glen Canyon Dam during April, May, and June allowed the Bureau to integrate purchased power into the Colorado River Storage Project system when it was more readily available. The April-July 1977 runoff of the Colorado River at Lees Ferry, Ariz., was 1.1 million acre-feet, or 14 percent of the long-time average. By the end of water year 1977, the level of Lake Powell had receded a total of 27 feet to elevation 3,637 feet. (Chart 7.)

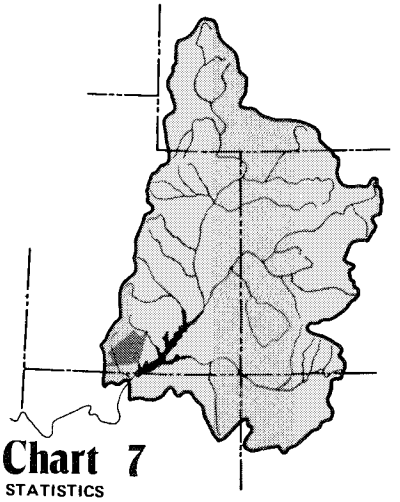
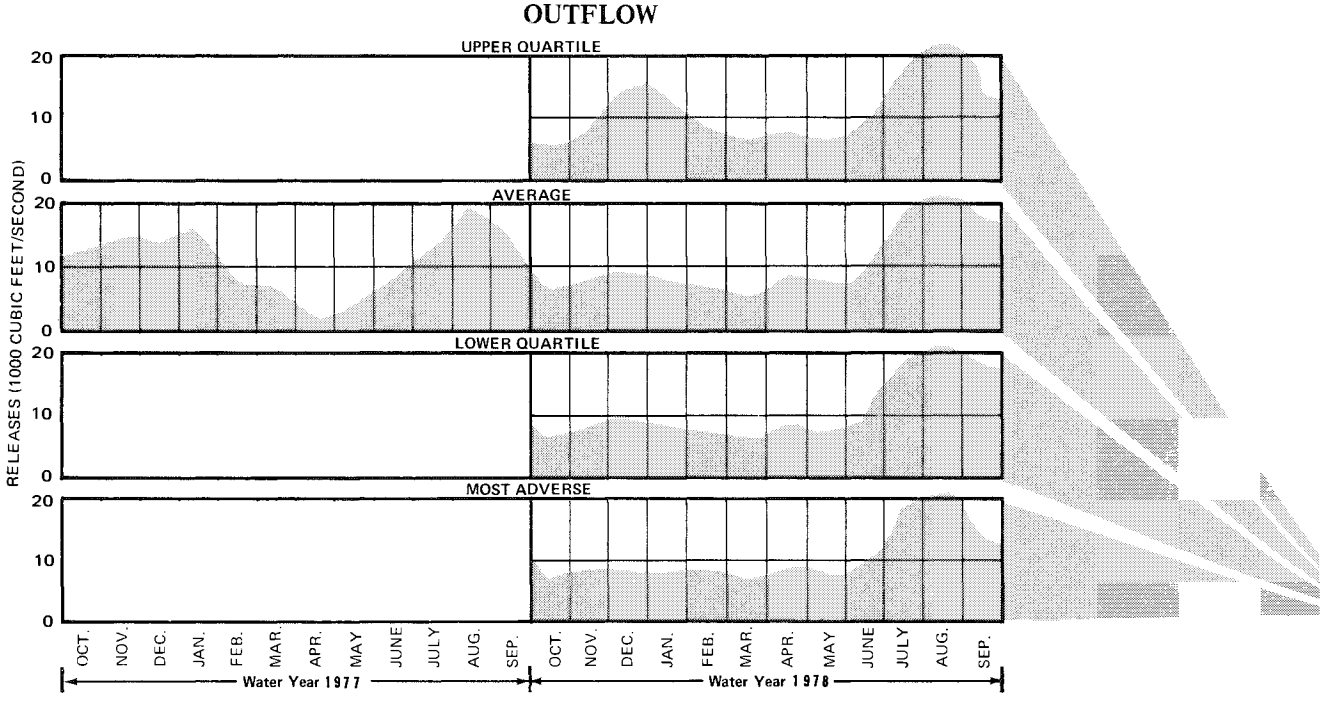


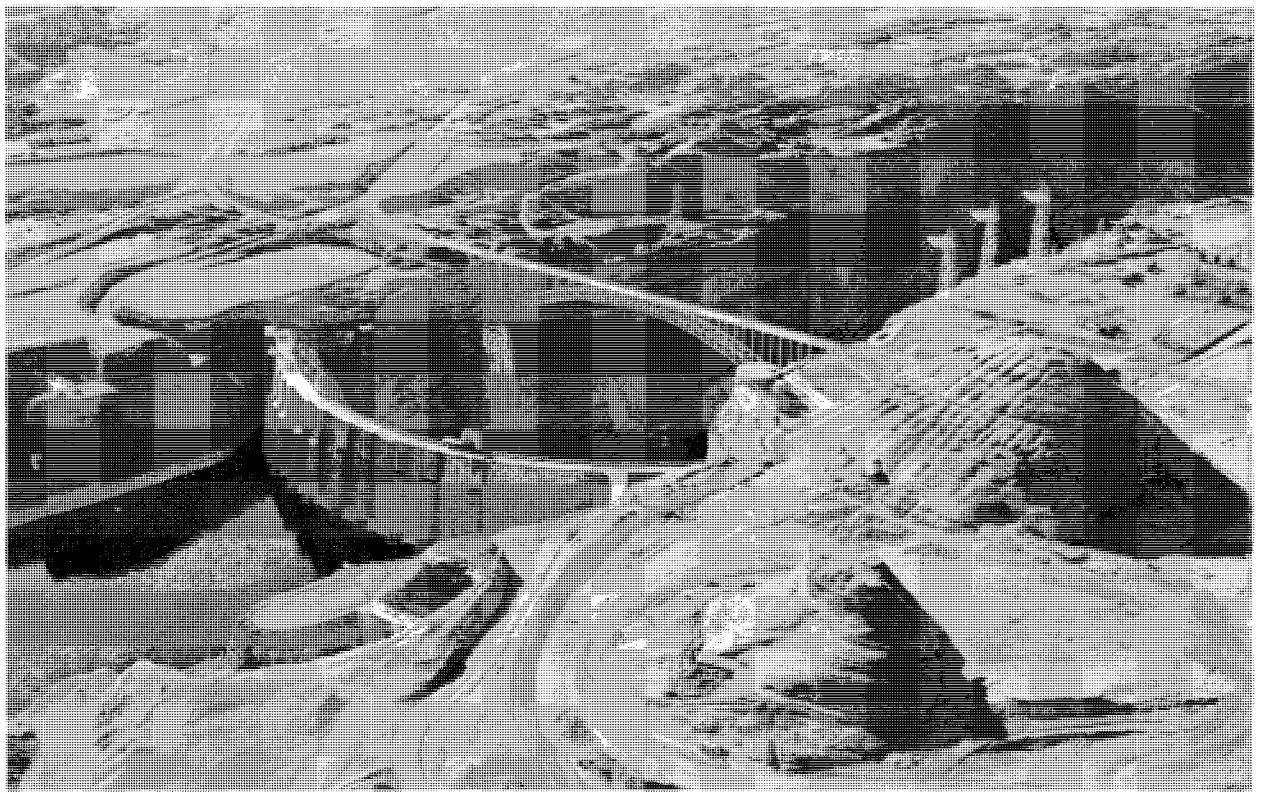
Chart 7

STATISTICS
ACTIVE STORAGE*

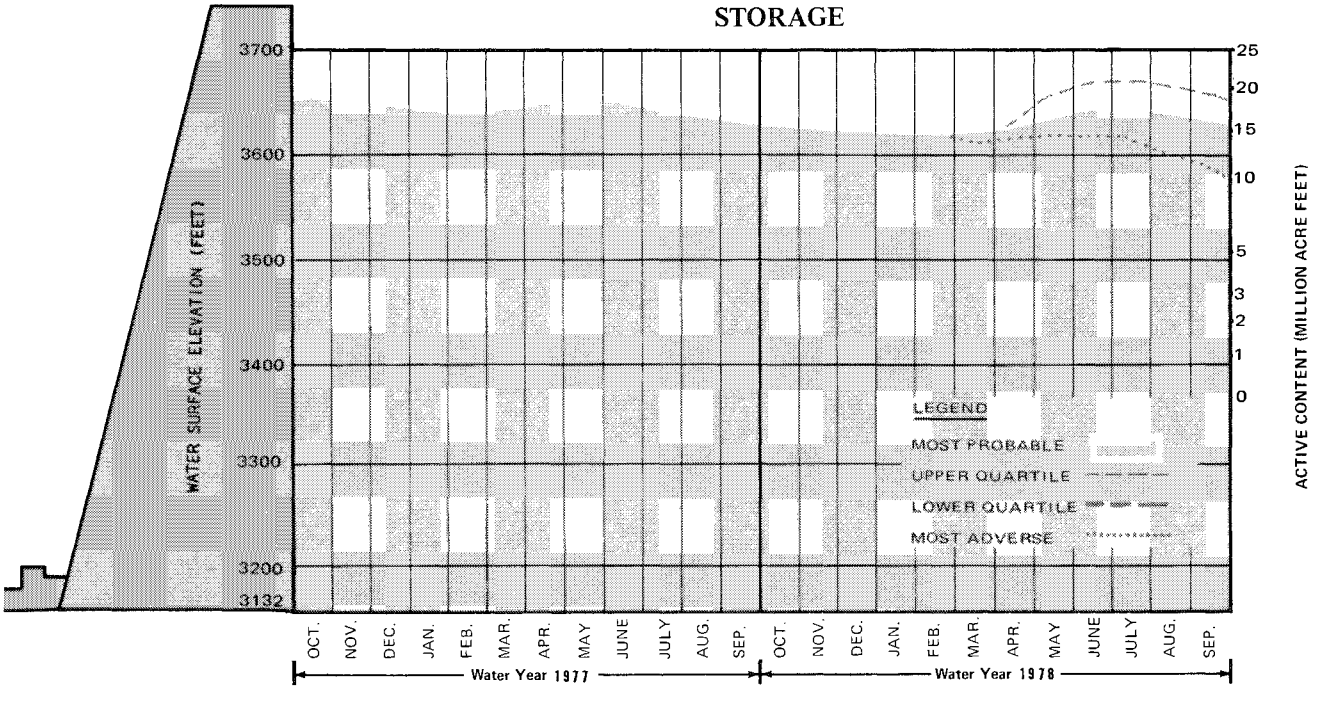
RESERVOIR	(ACRE-FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	25,002,000	3700
RATED HEAD	9,428,000	3570
MINIMUM POWER	4,126,000	3490
SURFACE AREA (FULL)	161,390 ACRES	
RESERVOIR LENGTH (FULL)	186 MILES	
POWER PLANT		
NUMBER OF UNITS	8	
TOTAL CAPACITY OF UNITS	900,000 KILOWATTS	

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





Glen Canyon Dam and Lake Powell, Glen Canyon Unit, Colorado River Storage Project, Arizona-Utah.



Lower Basin Reservoirs

Hoover Dam, Lake Mead

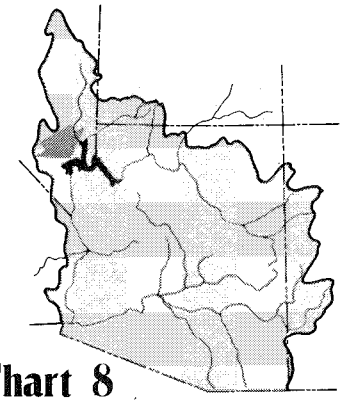


Chart 8

STATISTICS
ACTIVE STORAGE*

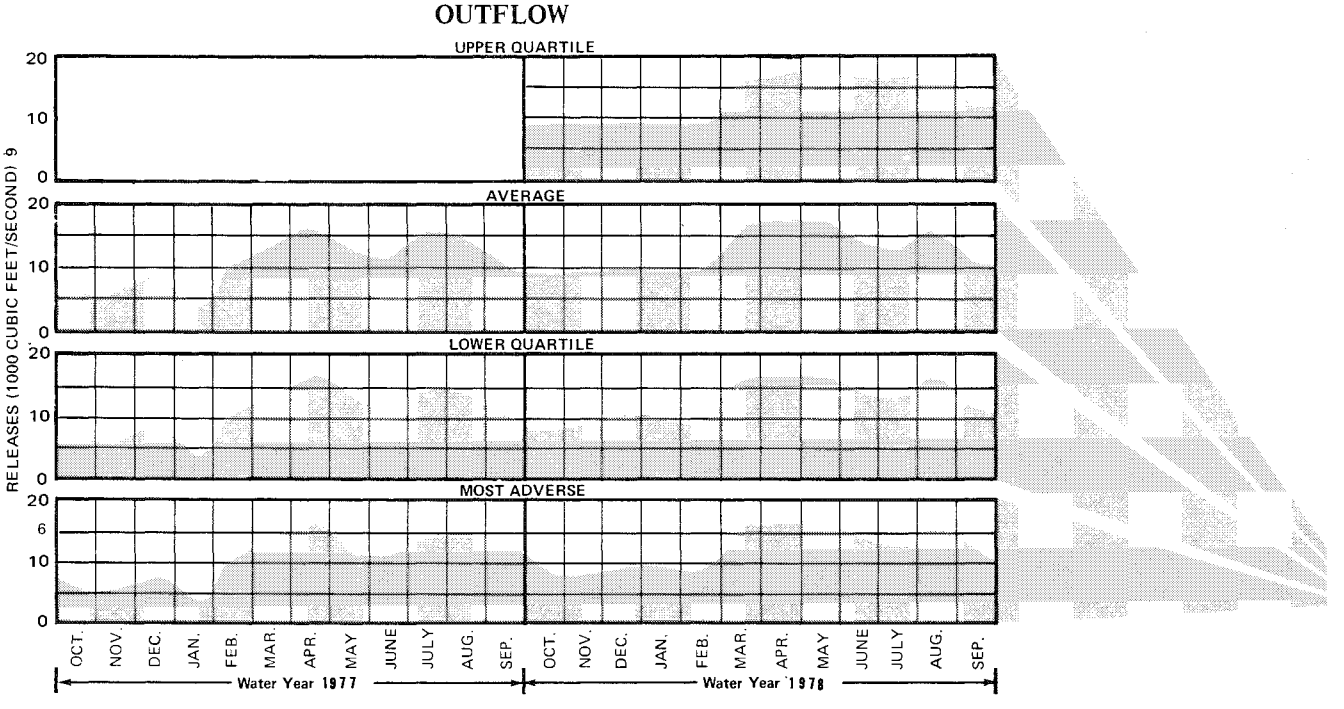
RESERVOIR	(ACRE-FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	27,377,000	1229
RATED HEAD	13,653,000	1123
MINIMUM POWER POOL	10,024,000	1083
SURFACE AREA (FULL)	162,700 ACRES	
RESERVOIR LENGTH (FULL)	115 MILES	
POWER PLANT		
NUMBER OF UNITS	17	
TOTAL CAPACITY OF UNITS	1,344,800 KILOWATTS	

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

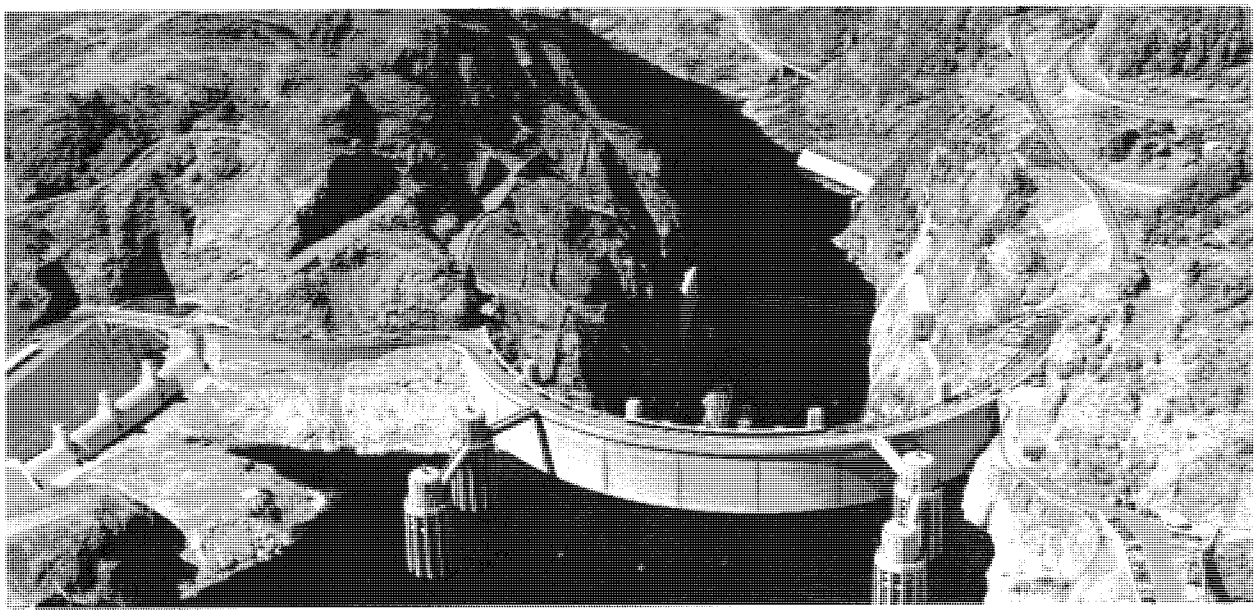
At the beginning of water year 1977, Lake Mead had a water-surface elevation of 1,179 feet and an active storage of 20,062,000 acre-feet. During the water year, releases were made to meet downstream water use requirements in the United States and Mexico, programmed levels of Lakes Mohave and Havasu, 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 was 7,562,000 acre-feet. At the end of the water year, Lake Mead had a water-surface elevation of 1,180 feet and an active storage of 20,205,000 acre-feet, which reflect an increase in storage during the water year of 143,000 acre-feet.

On September 30, 1977, the active storage of Lake Mead was 4,061,000 acre-feet more than the active storage in Lake Powell.

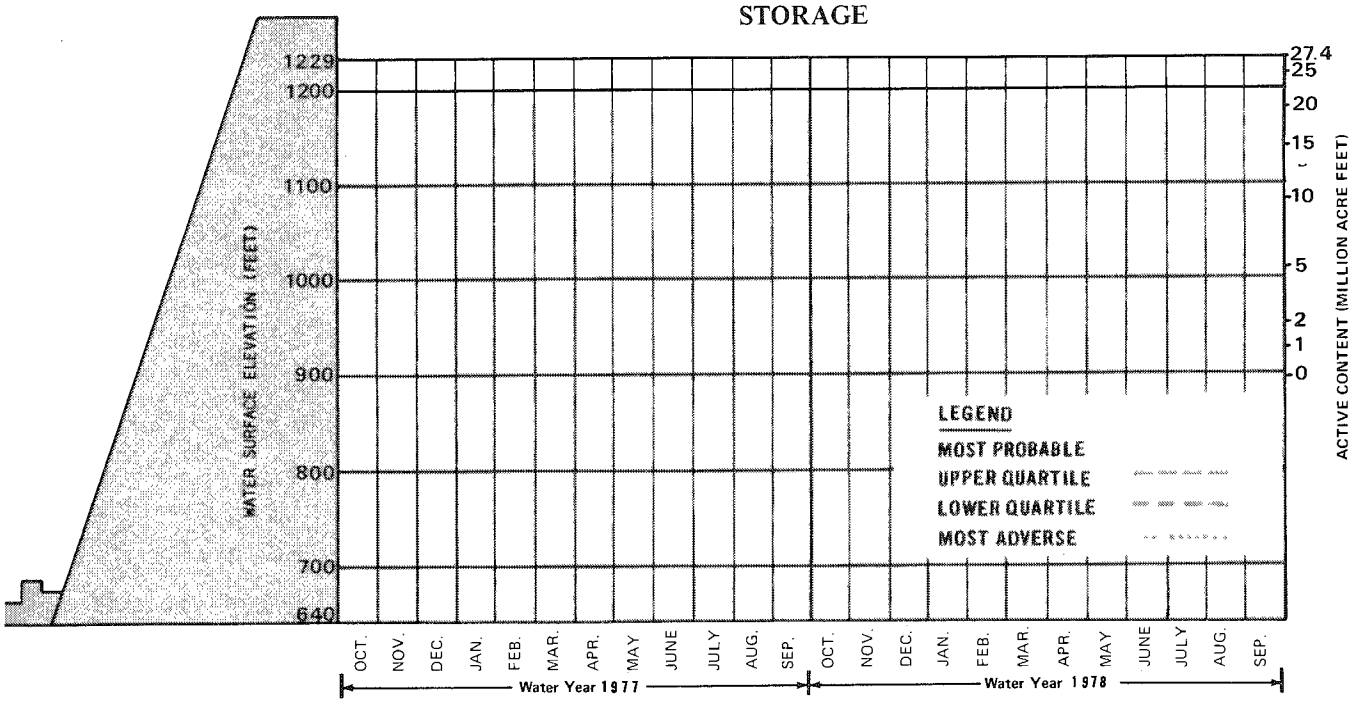
Because adequate space in Lake Mead and CRSP reservoirs was available during water year 1977, no additional releases at Hoover Dam were required pursuant to the flood control regulations. (Chart 8.)



Lake Mead is the only reservoir on the Colorado River in which a specified space is exclusively allocated for mainstream flood control. Flood control regulations for Hoover Dam are being updated and revised by the Bureau of Reclamation and the Army Corps of Engineers with the consultation and advice of State and local interests.



Hoover Dam and Lake Mead, Boulder Canyon Project, Arizona-Nevada.



Davis Dam, Lake Mohave

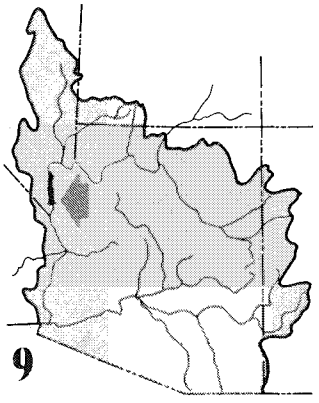


Chart 9

STATISTICS
ACTIVE STORAGE*

RESERVOIR	(ACRE-FEET)	ELEVATION FEET
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)	6 7 MILES	

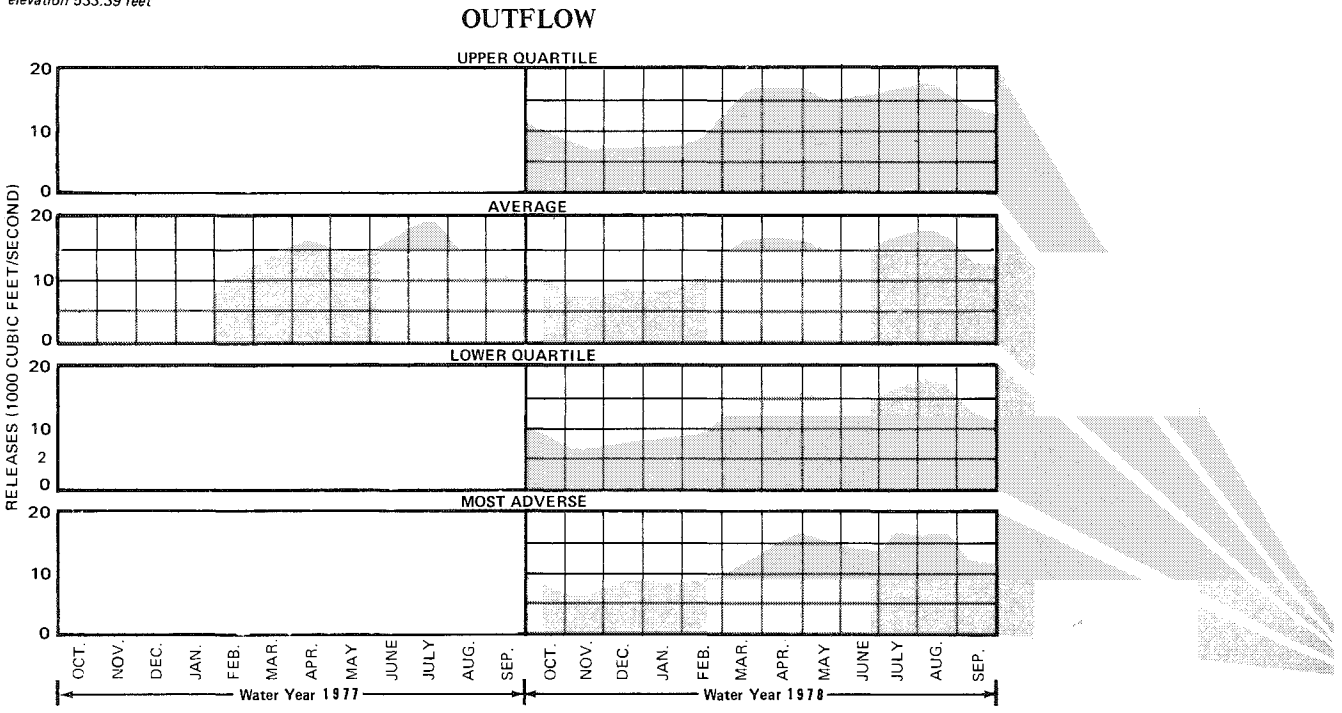
POWER PLANT

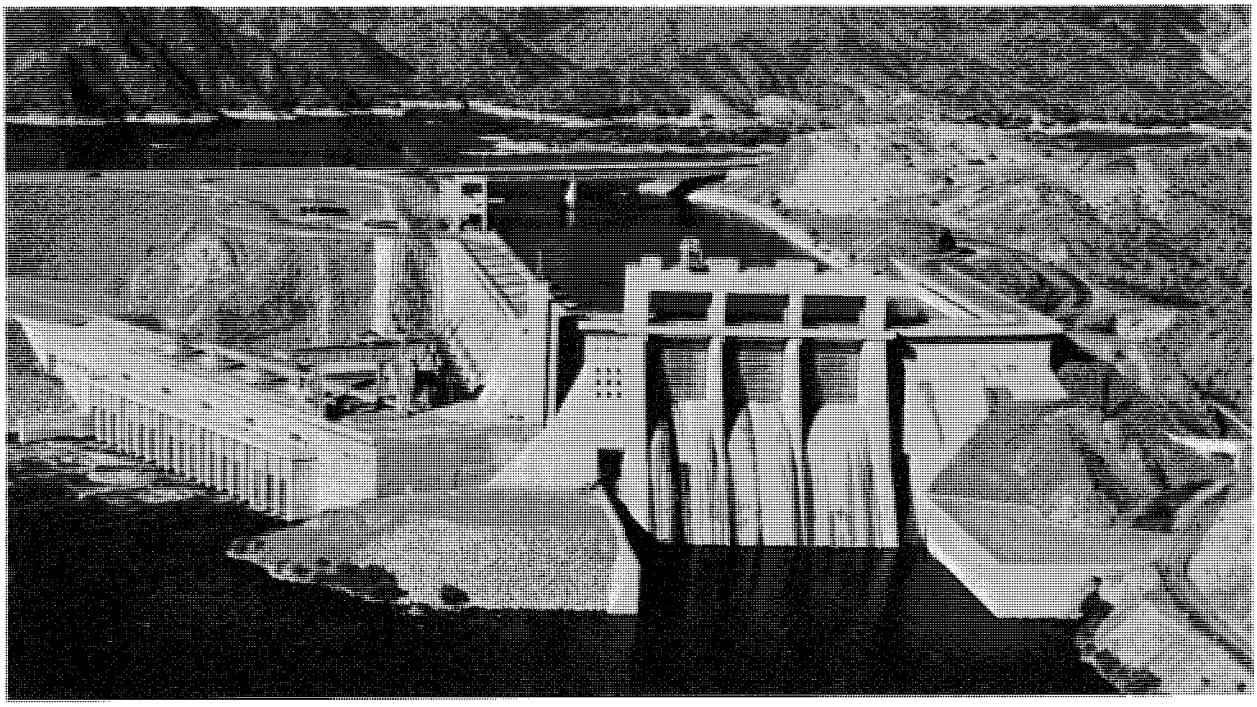
NUMBER OF UNITS	5
TOTAL CAPACITY OF UNITS	225,000 KILOWATTS

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

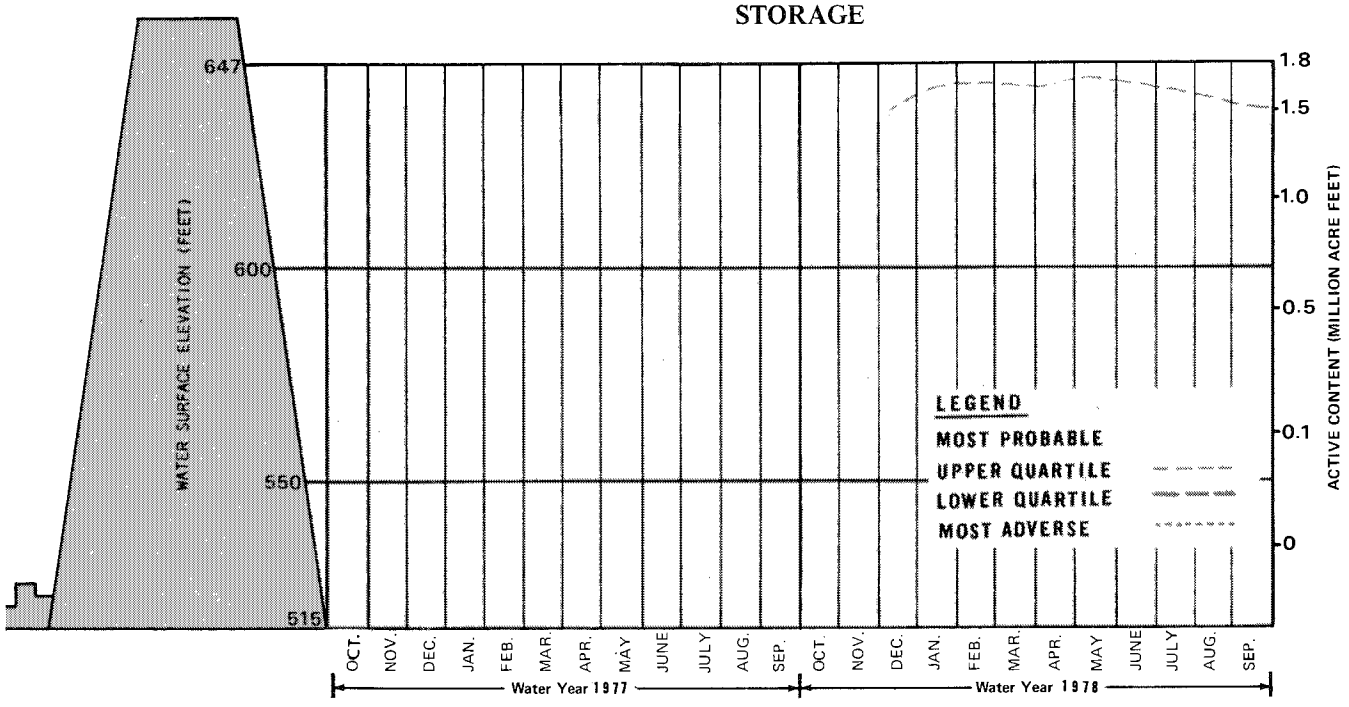
At the beginning of water year 1977, the water surface elevation of Lake Mohave was 644 feet, with an active storage of 1,721,000 acre-feet. During the spring months, the water level was raised to approximately 645 feet at the end of April and maintained between that level and 631 feet through September. The highest water level was 646 feet, with an active storage of 1,794,000 acre-feet on May 18, 1977, which is about the beginning of the heavy irrigation season. The water level was drawn down during the summer months to elevation 631 feet, with an active storage of 1,465,000 acre-feet at the end of the water year.

Lake Mohave releases were made monthly to satisfy downstream requirements, with a small amount of reregulation at Lake Havasu. During the water year, 8,058,000 acre-feet were released at Davis Dam, all of which passed through the turbines for power production. (Chart 9.)





Davis Dam and Lake Mohave, Parker-Davis Project, Arizona-Nevada.



Parker Dam, Lake Havasu

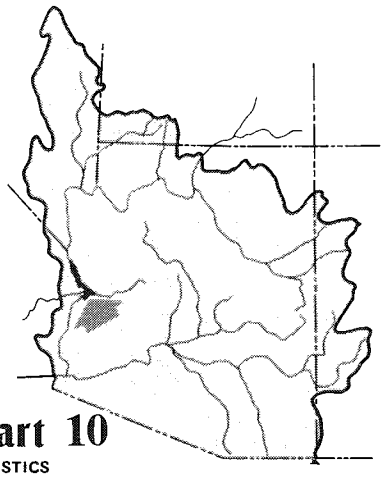


Chart 10

STATISTICS
ACTIVE STORAGE*

RESERVOIP	(ACRE-FEET)	ELEVATION (FEET)
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

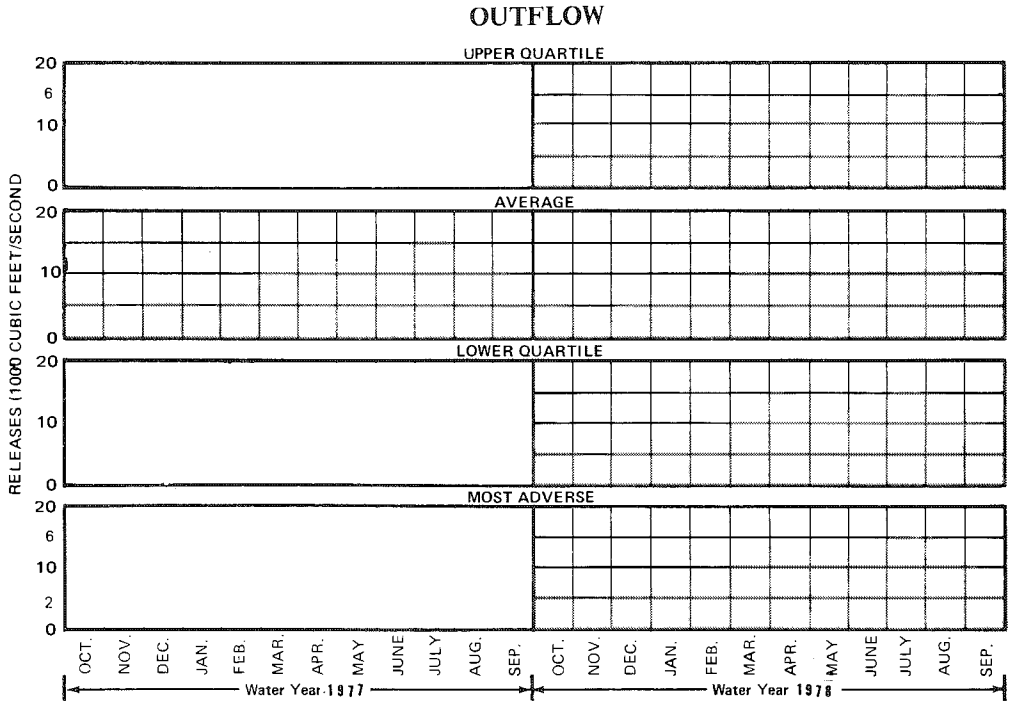
NUMBER OF UNITS	4
TOTAL CAPACITY OF UNITS	120,000 KILOWATTS

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

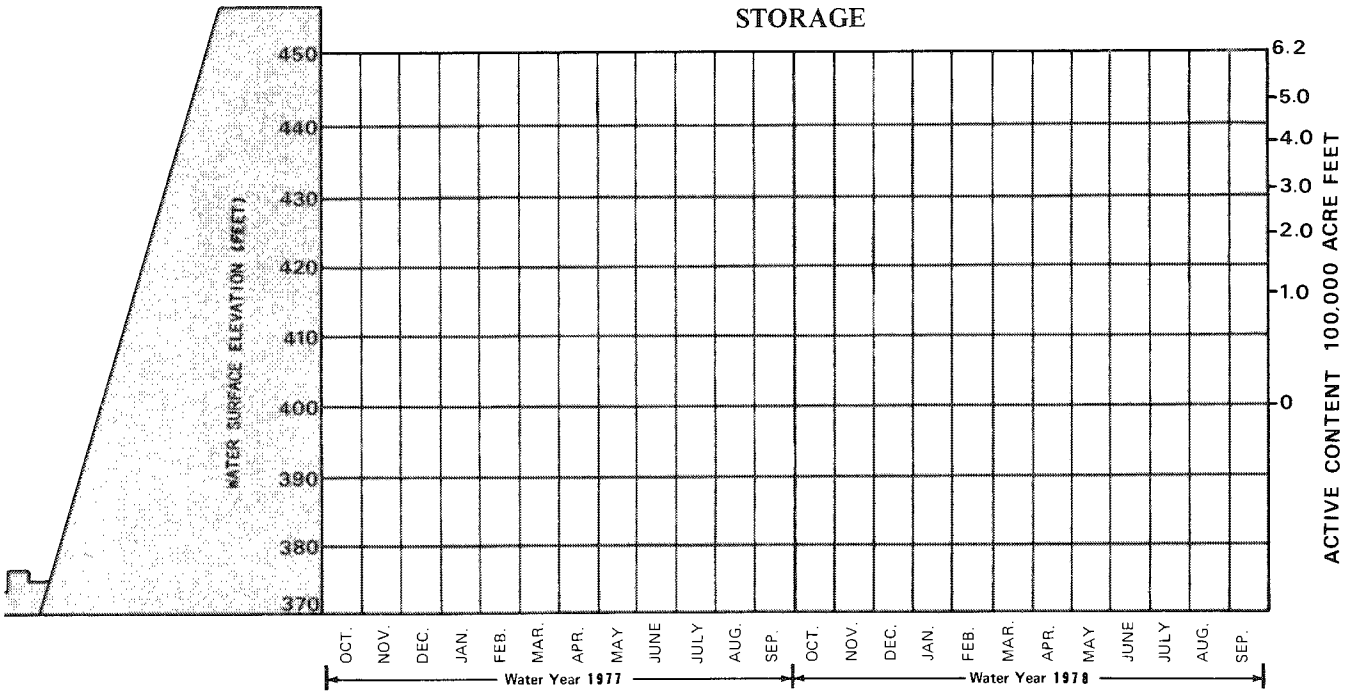
At the beginning of water year 1977, the water level of Lake Havasu was at elevation 448 feet, with an active storage of 581,000 acre-feet. The reservoir was drawn down to about elevation 446 feet, with an active storage of about 541,000 acre-feet in November, and remained near that level through mid-March to provide flood control space for run-off from the drainage area between Davis and Parker Dams. The water level was then raised to about elevation 450 feet by mid-May. During mid-May through June, the reservoir water level was maintained near maximum, with an active storage of about 605,000 acre-feet, and by the end of the water year was drawn down to 447 feet with an active storage of 566,000 acre-feet.

During the water year, 6,718,000 acre-feet were released at Parker Dam, all of which passed through the turbines for power production.

Joint-use 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 Alamo Reservoir on the Bill Williams River has been in operation. (Chart 10.)



Parker Dam, Parker-Davis Project, Arizona-California.



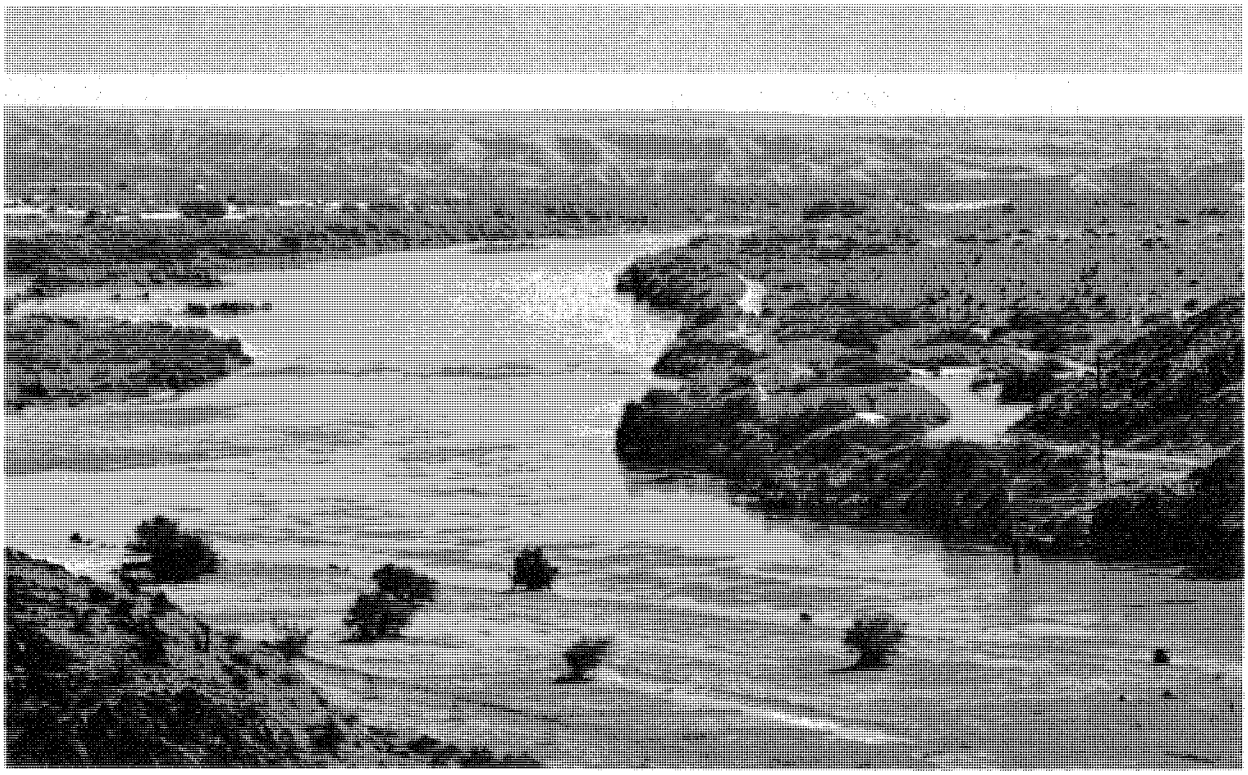
River Regulation

During water year 1977, 8,226,000 acre-feet were released from Glen Canyon Dam based on measurements at the gaging station at Lees Ferry, Ariz. For the 1-year and 10-year periods ending September 30, 1977, 8,234,000 acre-feet and 88,272,000 acre-feet, respectively, passed the compact point at Lee Ferry, Ariz. The expected release of 8,230,000 acre-feet from Lake Powell scheduled for the year ending September 30, 1978, is based on the most probable runoff. When added to the flow of the Paria River, this will result in Upper Basin delivery of about 88.1 million acre-feet for the 10-year period ending September 30, 1978.

Water releases scheduled for the Colorado River Storage Project and participating projects reservoirs were planned to accommodate all of the multiple purposes for which the project was designed, in addition to the many day-to-day demands which developed throughout the year.

Normally, daily releases are made from the storage reservoirs in the Lower Basin to meet the incoming orders of the water user agencies. 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 flows are provided in the river to maintain fishery habitat. Adjustments to the normal releases are made when conditions permit to provide more satisfactory conditions for water-oriented recreation activities, to provide transport for riverborne sediment to desilting facilities, and to provide a degree of control of water quality. Releases from Lake Powell during April, May, and the first part of June for an integrated power operation were not sufficient to maintain the normal riverflows through the Grand Canyon for this period nor to regulate for the Lake Mead bass fishery. Flows in the Grand Canyon during the remainder of the year were similar to those in past years and proved to be satisfactory.

River regulation below Hoover Dam was accomplished in a manner which resulted in delivery to Mexico of 277,913 acre-feet in excess of minimum treaty requirements during water year 1977. Of that quantity, 209,412 acre-feet were delivered for salinity control pursuant to provisions of Minute No. 242 of the Mexican Treaty.



Colorado River below Davis Dam, California.

Beneficial Consumptive Uses

Upper Basin Uses

The three largest categories of depletion in the Upper Basin are agricultural use within the drainage basin, diversions for all purposes to adjacent drainage basins, and evaporation losses from all reservoirs.

During water year 1977, agricultural and M&I diversions in the Upper Basin were estimated at 2,300,000 acre-feet. Approximately 540,000 acre-feet of water were diverted to adjacent drainage basins and approximately 590,000 acre-feet evaporated from main-stem reservoirs in the Upper Basin. It is estimated that an additional 150,000 acre-feet evaporated from other reservoirs and stockponds in the Upper Colorado Basin for a total depletion of 3,580,000 acre-feet.

This compares to the following consumptive uses and losses in the Upper Basin as published in the "Colorado River System Consumptive Uses and Losses Report" for the 5-year period ending in 1975.

Upper Basin Uses and Losses

	1,000 acre-feet
1971	3, 413
1972	3, 500
1973	3, 403
1974	3, 819
1975	3, 606

Water is being stored in the Upper Basin reservoirs and will be released to the Lower Basin as specified by the Colorado River Basin Project Act and the laws, compacts, and treaties upon which the operating criteria promulgated pursuant to section 602(a) of the act are based.

Pressure sprinkler system for farm irrigation, Utah.

Lower Basin Uses and Losses

During water year 1977, releases of 6,714,000 acre-feet of water from Lake Havasu were made to meet the requirements for water deliveries at Imperial Dam, as well as those of the Colorado River Indian Reservation near Parker, Ariz., the Palo Verde Irrigation District near Blythe, Calif., other miscellaneous users along the river, and transit losses between Parker Dam and Imperial Dam. Deliveries to Mexico consisted of river water delivered to Imperial Dam and waste and drainage return flows from water users below Imperial Dam. Beneficial use of the small amount of regulatory storage space in Imperial, Laguna, and Senator Wash Reservoirs resulted in limiting the regulatory waste to 68,501 acre-feet.

The major water diversion above Parker Dam was by Metropolitan Water District (MWD) of southern California. MWD pumped 1,085,000 acre-feet from Lake Havasu during water year 1977, which included 9,655 acre-feet for delivery to the city of Tijuana, pursuant to a contract for temporary emergency delivery of a portion of Mexico's treaty entitlement. The higher diversions by MWD were necessitated by the severe drought in California. During water year 1977, releases of 8,042,000 acre-feet were made from Lake Mohave to provide for releases at Parker Dam; to supply diversion requirements of the MWD, 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 1977, releases of 7,562,000 acre-feet were made from Lake Mead at Hoover Dam to regulate the levels of Lake Mohave and to provide for the small uses and the losses from this reservoir. In addition, 89,760 acre-feet were diverted from Lake Mead for use by Lake Mead National Recreation Area, Boulder City, Basic Management, Inc., and contractors of the Division of Colorado River Resources, State of Nevada. During water year 1977, the total releases and diversions from Lake Mead were 7,651,800 acre-feet.

Lower Basin consumptive uses and losses for the 5-year period ending in 1975, as published in the "Colorado River System Consumptive Uses and Losses Report" were as follows:

Year	Mainstream [1]	Tributaries [2]	Lower Basin total	Water passing to Mexico
		(1,000 acre-feet)		
1971	7,795	3,759	11,554	1,561
1972	7,959	4,096	12,055	1,600
1973	7,766	4,267	12,033	1,594
1974	8,315	4,470	12,785	1,721
1975	7,693	4,482	12,175	1,656

[1] Includes reservoir and channel losses.
[2] Includes uses supplied from ground water overdraft.

Water Quality Control

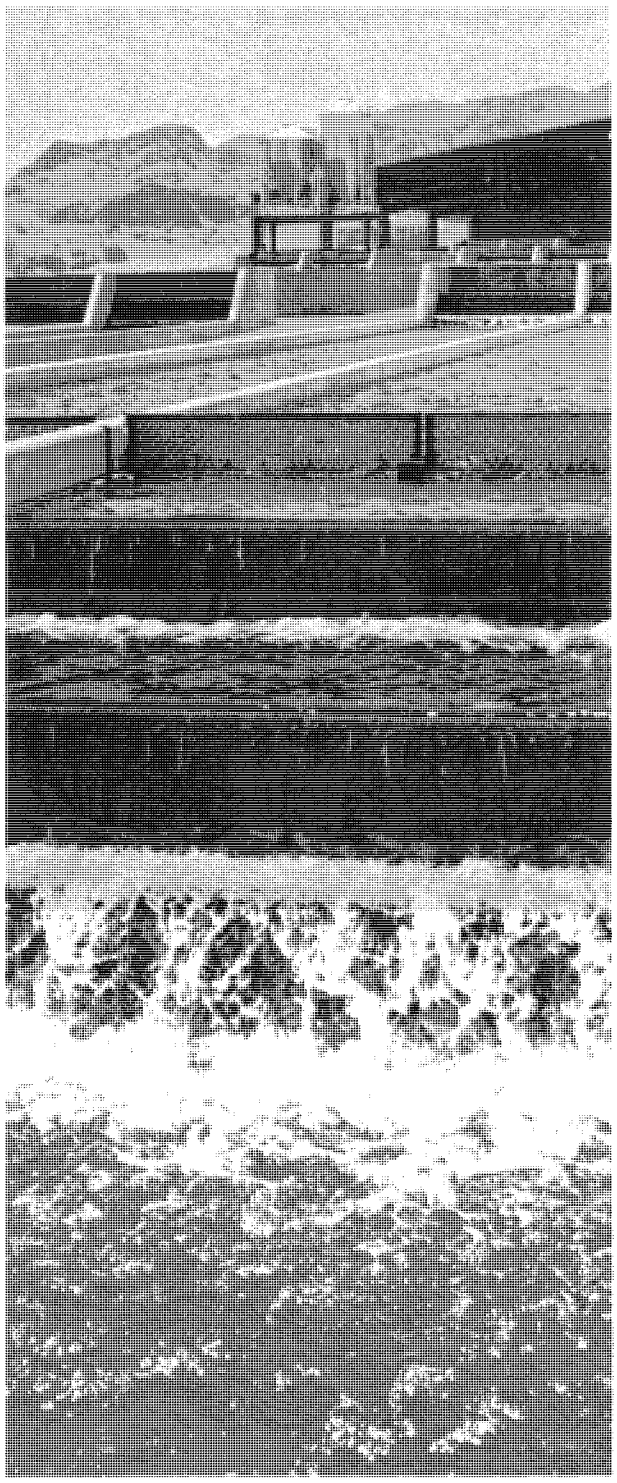
Water Quality Operations During Water Year 1977

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. 9 of the biennial series will be issued in January 1979.

The Bypass Drain, a feature of the Colorado River Basin Salinity Control Act, was constructed and became operational in June 1977. Subsequently, Wellton-Mohawk drainage waters have not been discharged back to the Colorado River below Morelos Dam but have been conveyed via the Bypass Drain to the Santa Clara Slough in Mexico. This action will prevent the poor quality waters from seeping into the ground water which then migrates toward the Mexican irrigation wells in the Mexicali Valley. During water year 1977, the United States bypassed 155,163 acre-feet to the Colorado River below Morelos Dam and 54,249 acre-feet through the Bypass Drain for a total of 209,412 acre-feet which was replaced with a like amount of other water, pursuant to Minute No. 242 of the Treaty with Mexico.

Although water quality control is not generally recognized as a beneficial use of surface water, water released for other purposes during normally low flow periods can enhance the quality of water during those periods.

In recognizing the need to manage water quality of the Colorado River, it has been recommended that salinity increases in the river be controlled through a water quality improvement program generally described in the Bureau of Reclamation's 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 basinwide 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 (Public Law 93–320) of the Colorado River Basin Salinity Control Project, June 24, 1974.



Nevada Department of Fish and Game's Lake Mead fish hatchery.

Enhancement of Fish and Wildlife

Upper Basin

For the benefit of fish habitat, the interim operating rules for Fontenelle Reservoir provide a continuous flow of at least 300 ft^3/s in the channel immediately below Fontenelle Dam. During water year 1977, releases for power production and other purposes provided flows of at least 500 ft^3/s.

Fishing below Flaming Gorge Dam has been enhanced by maintaining a minimum 800 ft^3/s release to the river.

A release at least 76 ft^3/s throughout the winter of 1976–77 assured good fish habitat in the river below Taylor Park and Blue Mesa Reservoirs. Coordinated operation between Taylor Park and Blue Mesa Reservoirs in delivering irrigation water to the Uncompahgre Project provided additional fishery and recreation opportunities between the two reservoirs. The interim operating rules specify a minimum of 200 ft^3/s to maintain fish habitat below Crystal Dam and below the Gunnison Tunnel.

A continuous flow of at least 530 ft^3/s was maintained throughout the year immediately below Navajo Dam for fish propagation.

Clear water and a minimum release of 1,000 ft^3/s provided good habitat for introduced species of fish in the river below Glen Canyon Dam.

Topock Marsh on the Colorado River near Needles, Calif. (Double-Crested Cormorants nesting).

Lower Basin

During the 1977 bass spawning season (March–June), the Lake Mead water level declined approximately 13 feet. This decline in water level contributed to a very poor black bass reproduction season in 1977. The drought throughout the Colorado River watershed and subsequent lack of spring runoff resulted in lower releases from Glen Canyon Dam. Consequently, Lake Mead could not be sufficiently regulated to provide the stable or rising water surface conducive to the bass spawn.

To provide satisfactory fish habitat along the lower river and in Lake Havasu, releases from Lakes Mohave and Havasu were regulated so that minimum flows were 1,960 ft^3/s and the level of Lake Havasu remained stable during the spring spawning season.

Wild horses near Lake Havasu, Arizona-California.

Preservation of Environment

Preservation or enhancement of environment is a matter of the highest importance in the planning, construction, and operation of all Colorado River storage features. Contracts for water services, grants of rights-of-way and indentures of leases for use of Federal land, supply contracts, and participating agreements approved by the Secretary of the Interior include language to control water and air pollution, to require restoration and reseeding of lands scarred by construction and operation activities, and to encourage conservation of the aesthetic beauty of nature.

In operating the reservoirs of the Colorado River system, releases from Fontenelle Reservoir are scheduled so the flow pattern will not adversely affect the downstream goose-nesting areas. Minimum flows are maintained below all dams to provide a desirable habitat for fish, animal, and plant life. Flood control operations at Navajo Reservoir and Lake Mead protect the downstream channels and flood plains from erosion and scouring during periods of high flow. Recent proposals for several large thermal-electric generating plants cooled with water and for coal gasification plants utilizing water from Reclamation facilities in the Colorado River system have required special consideration to protect the environment of the area. The Secretary of the Interior's responsibility for water pollution control has been delegated to the Commissioner of Reclamation and redelegated to the Regional Director of the Upper Colorado Region. The Regional Director of the Lower Colorado Region has been delegated responsibility for water pollution control at the Mohave Powerplant.

Reclamation is presently involved in a Federal-State study to evaluate, among other things, the effects of reservoir operation on the Lake Mead bass fishery. The study is scheduled for completion in 1982 and should provide valuable information pertaining to the future management of the Lake Mead bass fishery.

Periodic dredging in Topock Marsh, part of Havasu National Wildlife Refuge, provides improved habitat for waterfowl and for endangered species such as the Yuma clapper rail and bald eagle. Topock Marsh is one of many created along the river by Reclamation projects.

The Bureau of Reclamation is also considering the preparation of comprehensive environmental statements for the Colorado River Basin. It is anticipated that this effort will focus on the historical development of the river, present environmental conditions (1976 base), and the impact of future Bureau projects on the Colorado River, and its tributaries, up to the year 2000.

Fishing below Flaming Gorge Reservoir.

Springtime ice and snowmelt provide high quality water.

Projected Plan of Operation under Criteria for Current Year

Looking upstream from east shore near Flaming Gorge Dam.

Determination of "602(a) Storage"

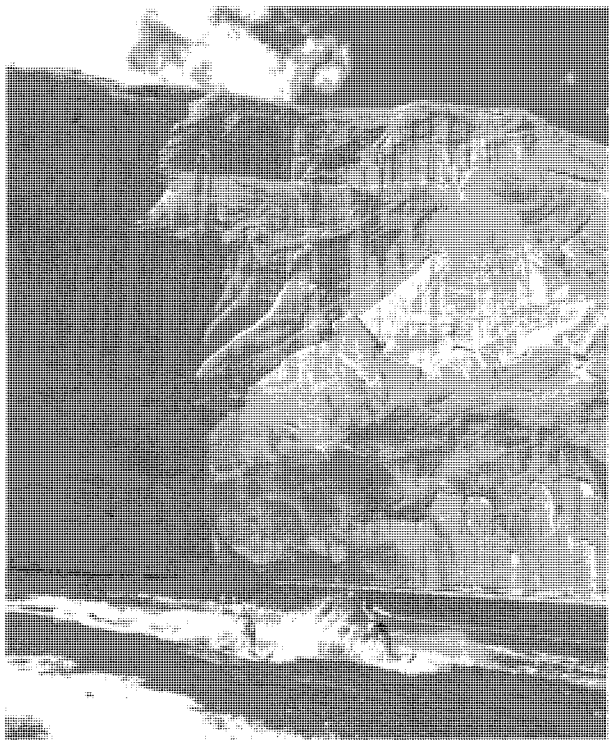
Section 602(a)(3) of the Colorado River Basin Project Act of September 30, 1968 (Public Law 90–537), provides for the storage of Colorado River water not required to be released under article III(c) and III(d) of the Colorado River Compact in Upper Basin reservoirs to the extent the Secretary finds it to be reasonably 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," pursuant to the act, provides that the annual plan of operation shall include a determination by the Secretary of the quantity of water considered necessary as of September 30 of the current year to be in storage as required by section 602(a) of Public Law 90–537 after consideration of all applicable laws and relevant factors including, but not limited to: (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 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.

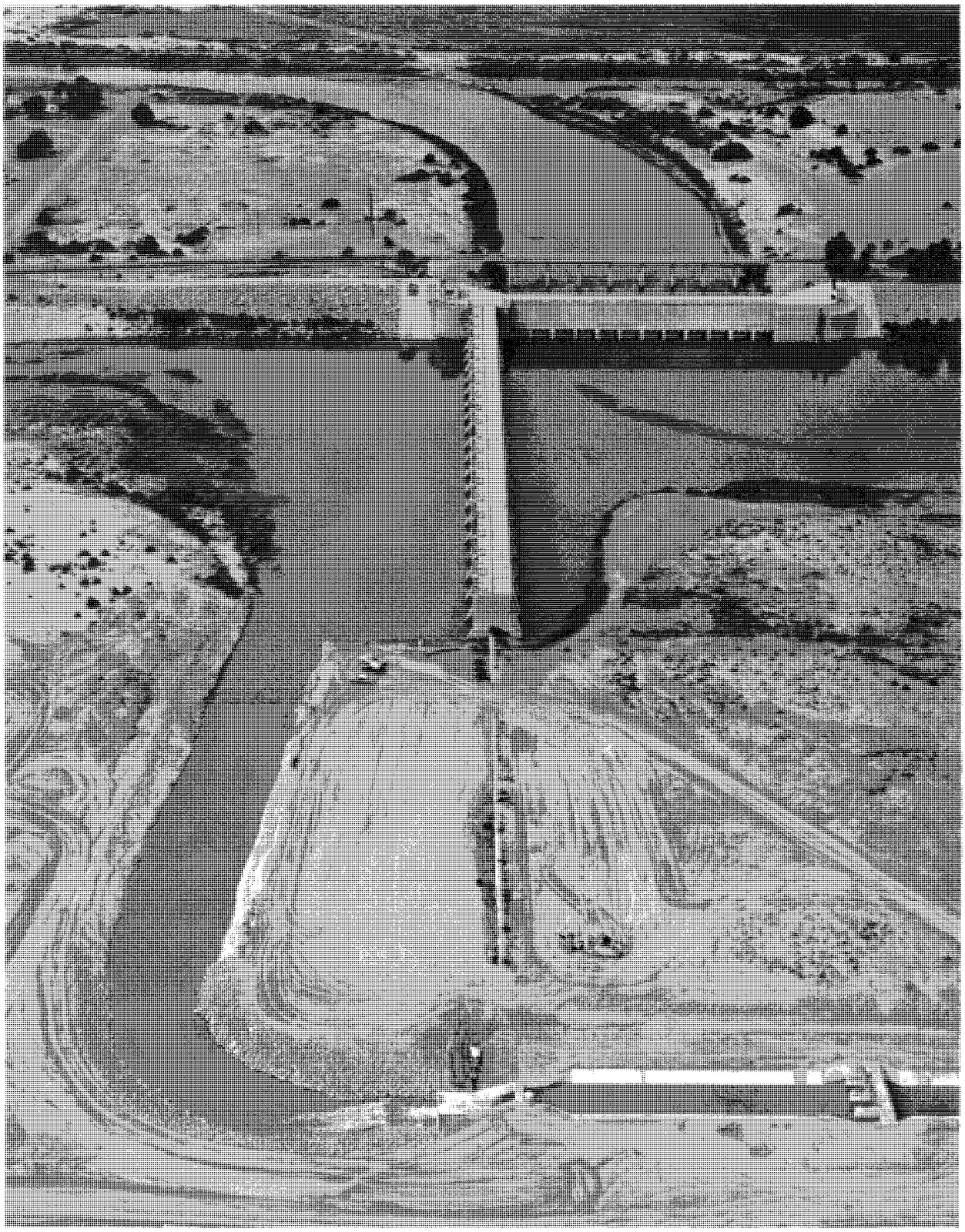
Taking into consideration these and other relevant factors, the Secretary has determined that the active storage in Upper Basin reservoirs forecast for September 30, 1978, on the basis of average runoff during the current year exceeds the "602(a) Storage" requirement under any reasonable range of assumptions which might be realistically applied to those items which he is directed to consider in establishing this storage requirement. Therefore, the accumulation of "602(a) Storage" is not the criterion governing the release of water during the current year.

Storage in Lake Powell on September 30, 1977, was 4.1 million acre-feet less than the storage in Lake Mead on that date. Even with a minimal scheduled release from Lake Powell of 8.23 million acre-feet and assuming average runoff for water year 1978, the Lake Powell active storage forecast for September 30, 1978, is about 2.9 million acre-feet less than the Lake Mead active storage forecast for that date.

Therefore, the plan of operation during the current year is based on a minimal release of 8,230,000 acre-feet of water from Lake Powell, in accordance with section 602(a)(3) of Public Law 90–537.

Water skiing on Lake Powell, Utah-Arizona.





Delivery of water to Mexico.

Lower Basin Requirements

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, 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 of the monthly quantity. In addition to the 1.5 million acre-feet of scheduled Treaty deliveries, approximately 15,000 acre-feet are projected for regulatory wastes and approximately 206,000 acre-feet of Wellton-Mohawk drainage water will be bypassed around Morelos Dam, Mexico's diversion structure, pursuant to Minute No. 242.

Consumptive Uses and Losses—1978

For water year 1978, a release of 6,862,000 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, and Treaty deliveries to Mexico.

During water year 1978, the Metropolitan Water District of Southern California is expected to divert 1,297,800 acre-feet by pumping from Lake Havasu, including a contract delivery of 8,800 acre-feet to the city of Tijuana as a part of Mexico's Treaty delivery.

Consumptive uses by small users, river losses or gains, and reservoir losses between Davis Dam and Parker Dam are projected to be 382,000 acre-feet.

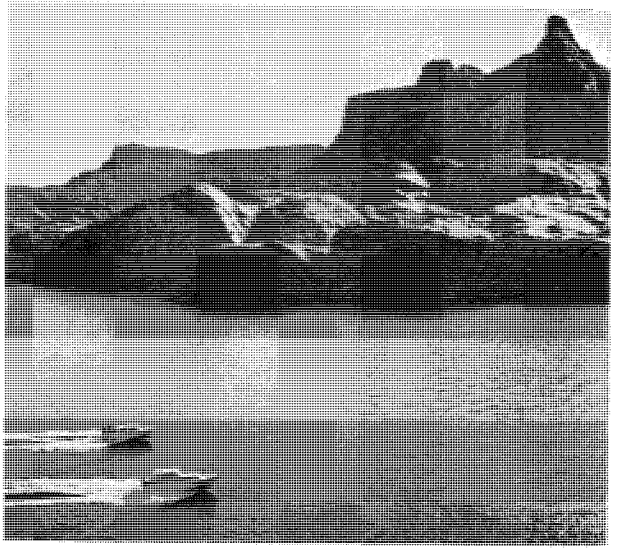
There are no major users between Hoover Dam and Davis Dam. During water year 1978, consumptive uses by small users, river losses or gains, and reservoir losses between Hoover Dam and Davis Dam are projected to be a net gain of 74,000 acre-feet. The net diversions from Lake Mead are projected at 103,000 acre-feet. Evaporation from Lake Mead is expected to be about 857,000 acre-feet, and net gain between Glen Canyon Dam and Lake Mead is expected to be about 879,000 acre-feet.

Regulatory Wastes

A regulatory waste of 15,000 acre-feet has been projected as being lost from the Lower Colorado River for water year 1978, as indicated in this section under Mexican Treaty obligations.

The guides set forth in the "Report on Reservoir Regulations for Flood Control Storage at Hoover Dam and Lake Mead" were in effect, but no flood control releases were necessary during water year 1977.

On June 1, 1977, the Corps of Engineers and the Bureau of Reclamation entered a field working agreement to permit removal of 11 of the 23 needle valves and paradox gates from the Hoover Dam outlet works. This field working agreement outlines the flood control operations for Hoover Dam and shall remain in effect until revised flood control regulations are published.



Boating on Lake Powell.

Plan of Operation—Water Year 1978

For average runoff conditions during water year 1978, the projected operation of each of the reservoirs in the Colorado River Basin is described in the following paragraphs. Charts 1 through 10 show hydrographs of the projected monthly outflow from the reservoirs and the projected end-of-month elevation and active storage in the reservoirs for average and three other assumptions of 1978 modified runoff from the Basin. The four assumptions are: (1) AVERAGE based on the 1906-68 record of runoff, (2) UPPER QUARTILE based on the level of annual streamflow which has been exceeded 25 percent of the time during 1906–68, (3) LOWER QUARTILE based on flows exceeded 75 percent of the time during 1906–68, and (4) MOST ADVERSE based on the lowest year of record, which occurred in 1977.

Because of the record low inflow during water year 1977, the water year 1978 projected releases from Lake Powell are 8.23 million acre-feet for all four assumed runoff conditions.

The projected operations of Lake Mead, Lake Mohave, and Lake Havasu are the same under all four of the runoff assumptions.

ALTERNATIVE PLAN OF OPERATION

A review is currently being made of the terms and conditions of the merits of alternative plans of operation associated with the release of water from Lake Mead in excess of downstream requirements for beneficial consumptive use. Also included is the joint study by the Bureau of Reclamation and the Corps of Engineers to determine the best flood control operation for Lake Mead and Hoover Dam. Because of the extreme drought conditions during 1976 and 1977, no releases in excess of downstream requirements are anticipated during water year 1978. However, such additional releases are recognized as a possibility before 1985, when the Central Arizona Project is scheduled to begin diversions.

Snowmobile races, Blue Mesa Reservoir, Colorado.

Upper Basin Reservoirs

Fontenelle

To conserve water to meet municipal and industrial contractual obligations, provide for tailwater fishery and wildlife requirements, and for electric power generation, releases will be maintained at 600 ft^3/s until forecasts based on accumulated precipitation and snowpack provide reasonable assurance of normal or above normal runoff for water year 1978. Then the reservoir water level will be lowered until a water surface elevation of about 6,480 feet is reached prior to the spring runoff. With average runoff during the spring months, Fontenelle Reservoir will fill by the end of June. After the spring runoff, the reservoir level will be controlled by adjusting the releases through the powerplant to slowly reduce the elevation to 6,504 feet by the end of the summer of 1978. (Chart 1.)

Flaming Gorge

At the beginning of water year 1978, the active storage in Flaming Gorge Reservoir was 2,080,000 acre-feet, with a water surface at elevation 5,991 feet. The reservoir level will stay about level until the spring of 1978, and should remain high enough so boats can be launched from seven of the nine boat ramps. Average inflow would cause the reservoir to reach elevation 6,007 feet with an active storage of 2,556,000 acre-feet during July. Summertime flow in the river below the dam should not exceed 4,500 ft^3/s and would not be less than 800 ft^3/s. Releases should average about 90,000 acre-feet per month through September 1978 for a water year total of about 1,070,000 acre-feet. (Chart 2.)

Curecanti Unit

During the current year, the water level in Blue Mesa Reservoir should reach a low in March 1978 at elevation 7,418 feet and the active storage would be 162,000 acre-feet. With average inflow during the spring of 1978, the reservoir should reach elevation 7,508 feet with an active storage of 732,000 acre-feet. At that elevation the reservoir has a surface area of 8,583 acres and a reservoir length of 23 miles. (Charts 3, 4, and 5.)

Morrow Point Reservoir will be operated during the current year at or near its total storage capacity. Crystal Reservoir will be operated nearly full except for daily fluctuations as required to reregulate releases from Morrow Point to meet the diversion requirements of the Gunnison Tunnel as well as requirements downstream from the Gunnison Tunnel.

Navajo Reservoir

On September 30, 1977, Navajo Reservoir had an active storage of 1,038,000 acre-feet with water surface elevation at 6,033 feet. During October through February releases will be maintained at 530 ft^3/s to conserve storage in the reservoir. The elevation of the reservoir is expected to drop to 6,030 feet prior to spring runoff. At elevation 6,030 feet, Navajo Reservoir will leave about 320,000 acre-feet of active storage to assure the full water supply to the Navajo Indian Irrigation Project. Average inflow would cause the reservoir to reach elevation 6,057 feet, with an active storage of 1,305,000 acre-feet by July 1978. The reservoir will be maintained at or near this level throughout the remainder of the summer to enhance recreation use. (Chart 6.)

Glen Canyon—Lake Powell

For the current year, the level of Lake Powell should drop about 11 feet during the fall and winter months to elevation 3,626 feet. The active storage would be 14.9 million acre-feet in February 1978. Assuming an average April-July 1978 runoff, the resulting inflow of about 8.0 million acre-feet should cause the lake to reach 3,651 feet elevation during June, with an active storage of 17.9 million acre-feet, or approximately 72 percent of the active capacity of the reservoir. The lake would have a length of 183 miles and a water surface area of 128,480 acres. Assuming average conditions during water year 1978, a total release of 8.2 million acre-feet is scheduled from Lake Powell to satisfy storage requirements for Lake Mead and Lake Powell, in compliance with section 602 of Public Law 90–537. The scheduled release will pass through the turbines to generate power for customers in the Colorado River Basin States. (Chart 7.)

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Lower Basin Reservoirs

Lake Mead

During the 1978 water year, the Lake Mead water level is scheduled to rise to elevation 1,184 feet at the end of February 1978, then be drawn down to a low elevation of 1,173 feet at the end of June 1978. At that level, the lake will have an average active storage of about 20.0 million acre-feet. During water year 1978, a total of 8.4 million acre-feet is scheduled to be released from Lake Mead to meet all downstream requirements. All releases are scheduled to pass through the turbines for electric power production. (Chart 8.)

Lake Mohave

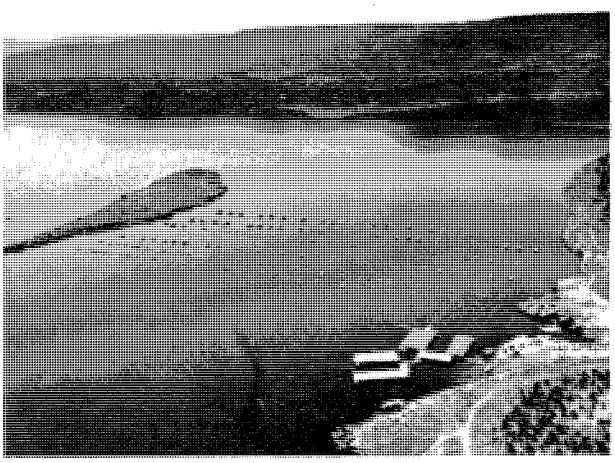
The water level of Lake Mohave is scheduled to rise through the fall and winter months and reach elevation 643 feet by the end of January 1978. It should remain near that yearly high elevation through May 1978. Because of the heavy irrigation use during the summer months, the water level in Lake Mohave is expected to be drawn down to elevation 631 feet by the end of water year 1978. During that time a total of 8.5 million acre-feet is scheduled to be released from Lake Mohave to meet all downstream requirements. All releases are scheduled to pass through the turbines for electric power production. (Chart 9.)

Lake Havasu

Lake Havasu is scheduled at the highest levels consistent with the requirements for maintaining flood control space. The yearly low elevation of 446 feet is scheduled for the December through February high flood-hazard period. The yearly high of 449 feet is scheduled for the low flood-hazard months of May and June. During water year 1978, a total of 6.9 million acre-feet is scheduled to be released from Lake Havasu to meet all downstream requirements. All releases are scheduled to pass through the turbines for electric power production. (Chart 10.)

Sailing on Lake Mead, Nevada-Arizona.

Curecanti Unit, Crystal Dam, Colorado.



Pine River boat marina, Navajo Reservoir.

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.