

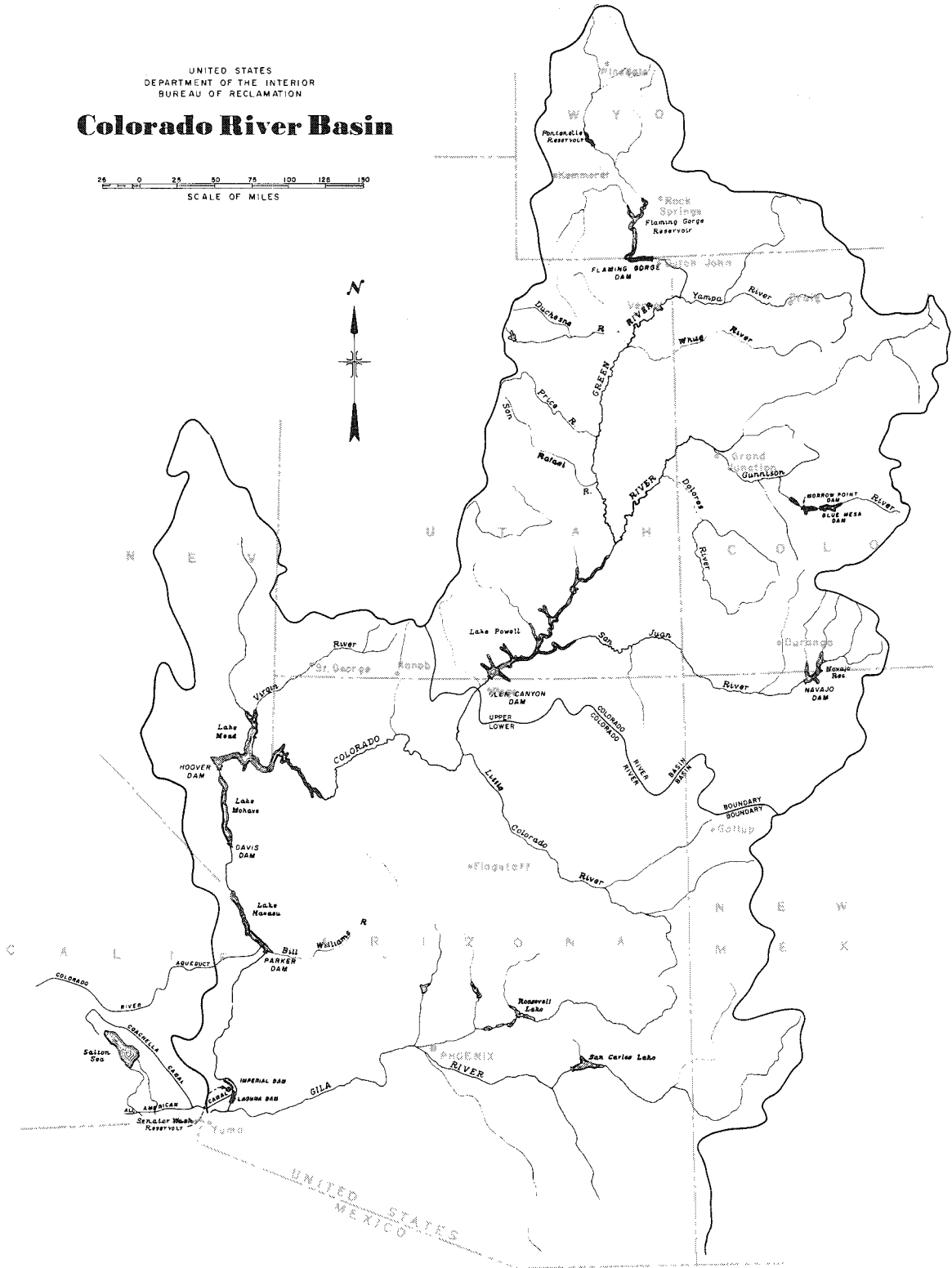
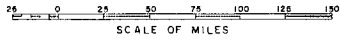
# Annual Report

## Operation of the Colorado River Basin 1976 Projected Operations 1977



UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION

# Colorado River Basin



# Annual Report

## Operation of the Colorado River Basin 1976 Projected Operations 1977

U.S. Department of the Interior  
Thomas S. Kleppe, Secretary

Bureau of Reclamation  
Gilbert G. Stamm, Commissioner

January 1977

## Table of Contents

<b>Introduction</b> .....	ii
<b>Authority for Report</b> .....	ii
<b>Actual Operations under Criteria—Water Year 1976</b> .....	1
Upper Basin Reservoirs .....	2
Lower Basin Reservoirs .....	14
<b>River Regulations</b> .....	20
<b>Beneficial Consumptive Uses</b> .....	21
Upper Basin Uses .....	21
Lower Basin Uses and Losses .....	21
<b>Water Quality Control</b> .....	22
Water Quality Operations during Water Year 1976 .....	22
<b>Enhancement of Fish and Wildlife</b> .....	23
Upper Basin .....	23
Lower Basin .....	23
<b>Preservation of Environment</b> .....	24
<b>Projected Plan of Operation under Criteria for Current Year</b> .....	26
Determination of "602(a) Storage" .....	26
<b>Lower Basin Requirements</b> .....	27
<b>Plan of Operation—Water Year 1977</b> .....	29
Upper Basin Reservoirs .....	30
Lower Basin Reservoirs .....	31

(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 operation 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.

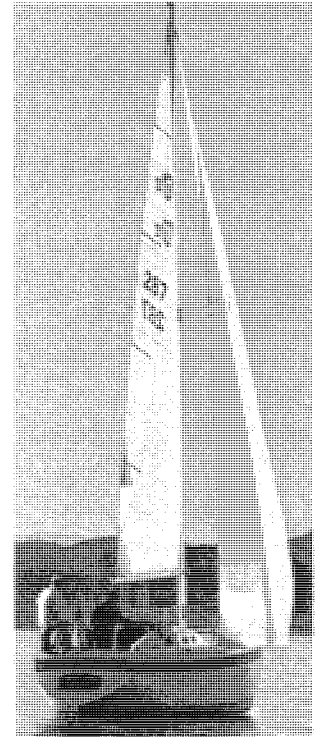
Storage and release of water from the Upper Basin reservoirs recognize all applicable laws and relevant factors governing the Colorado River, including the impoundment of water in the Upper Basin required by section 602(a) of Public Law 90-537. The operation of the Lower Basin reservoirs reflects Mexican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

## Authority for Report

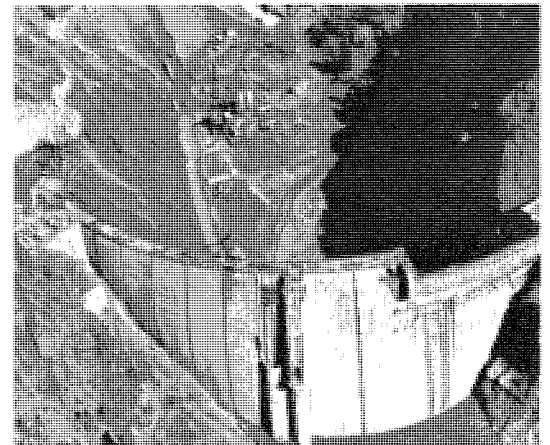
Pursuant to the Colorado River Basin Project Act (Public Law 90-537) of 1968, I am pleased to present to the Congress, and to the Governors of the Colorado River Basin States, the sixth Annual Report on the Operation of the Colorado River Basin.

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 1976 and the projected operation of these reservoirs during water year 1977 under the "Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs," published in the *Federal Register* June 10, 1970.

Thomas S. Kleppe, Secretary  
U.S. Department of the Interior



Winter sailing on Lake Mead,  
Boulder Canyon Project,  
Arizona-Nevada.

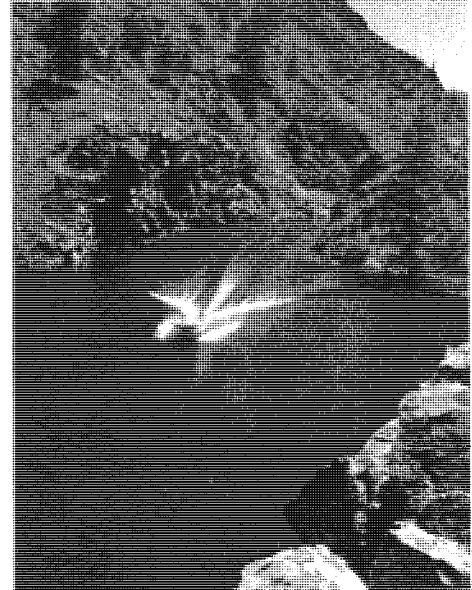


Crystal Dam, Curecanti Unit, Colorado.

# Actual Operations under Criteria—Water Year 1976

Operation of the Colorado River during 1976 was based on a forecast of runoff. Starting January 1, the snowmelt runoff was forecast and the required release of stored water to meet demands was scheduled for each reservoir through September. 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.

A description of the actual operation of each of the reservoirs in the Colorado River Basin follows. Charts 1 through 9 show hydrographs of monthly outflow from the reservoirs and water surface elevation and active storage in the reservoirs for water year 1976.



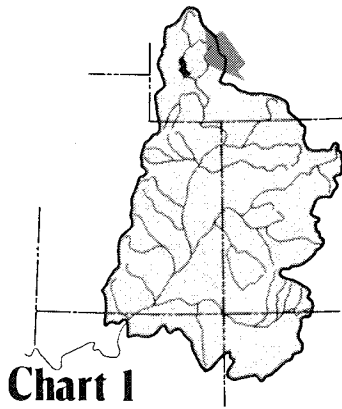
**Water skiers, Blue Mesa Reservoir, Curecanti Unit, Colorado.**



**Looking south from Imperial Dam, left to right, the California Sluiceway, All-American Canal, and the Desilting Basins, California.**

# Upper Basin Reservoirs

## Fontenelle Reservoir



**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	

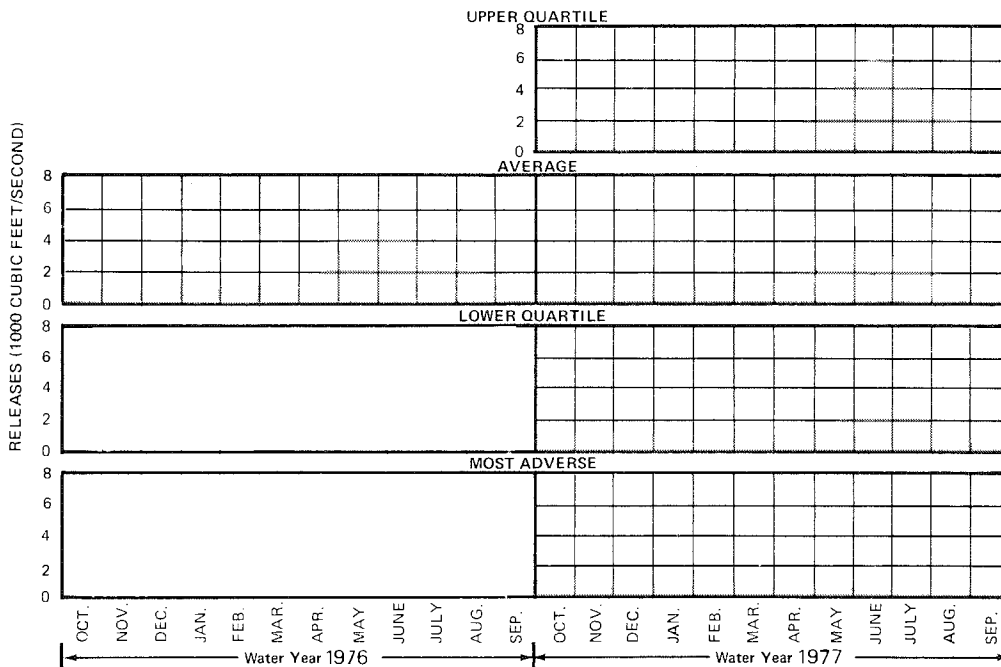
**POWER PLANT**

NUMBER OF UNITS	1
TOTAL CAPACITY	10,000 KILOWATTS

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

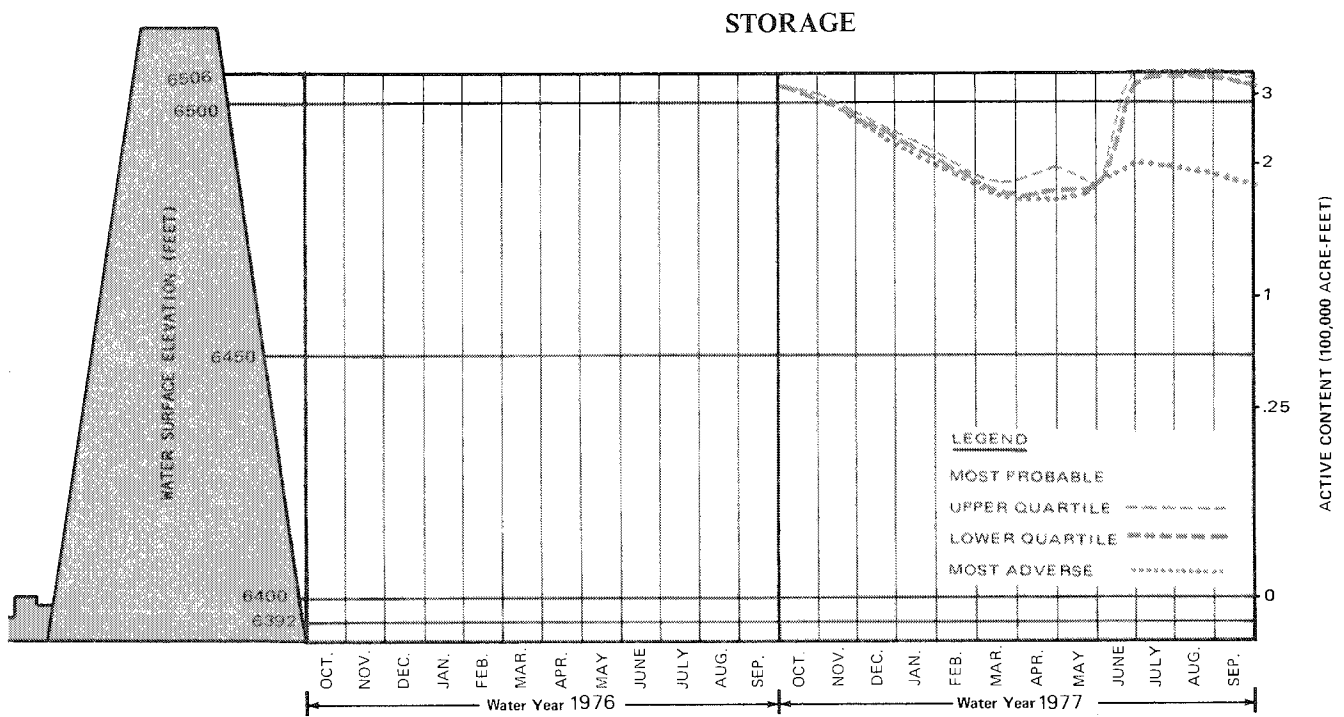
During the past year, Fontenelle Reservoir was operated for hydroelectric generation, flood control, fish and wildlife enhancement, and recreation. During the fall and winter of 1975-76, the reservoir water surface elevation was reduced slowly from elevation 6,504 feet at the beginning of the water year to a low elevation of 6,480 feet prior to spring runoff in April. The minimum release during the fall and winter was 700 cubic feet per second (ft<sup>3</sup>/s) to generate power and maintain fish flows. Springtime releases were controlled to allow the reservoir to fill early in August. Maximum releases of 7,500 ft<sup>3</sup>/s from the reservoir occurred late in June. On September 30, 1976, the reservoir had 335,000 acre-feet of water in active storage at elevation 6,505 feet. (Chart 1.)

### OUTFLOW





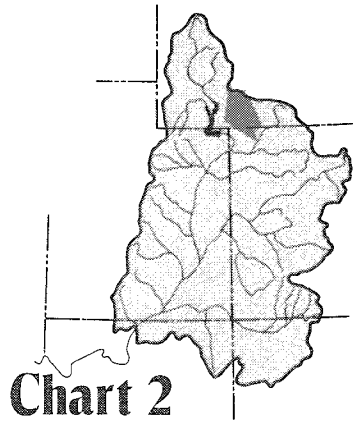
Fontenelle Dam and Reservoir, Seedskaadee Project, Wyoming.



# 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, optimum power production, recreation opportunities, and fish and wildlife benefits.

On September 30, 1975, the water surface was at elevation 6,038 feet. The active storage was 3,650,000 acre-feet. Release for power production caused the reservoir to recede 9 feet during the fall and winter to elevation 6,029 feet. The April-July 1976 runoff above Flaming Gorge was 1,329,000 acre-feet, or 116 percent of the long-time average. With this runoff, a seasonal high was reached at elevation 6,037 feet with an active storage of 3,615,000 acre-feet of water. (Chart 2.)



**Chart 2**

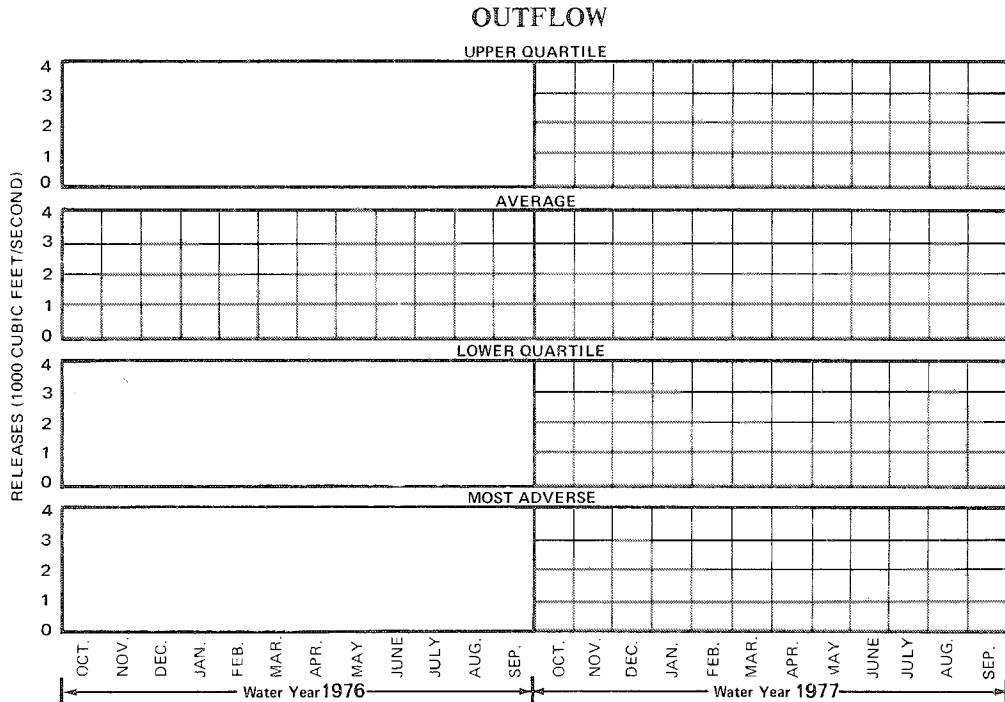
**STATISTICS  
ACTIVE STORAGE\***

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

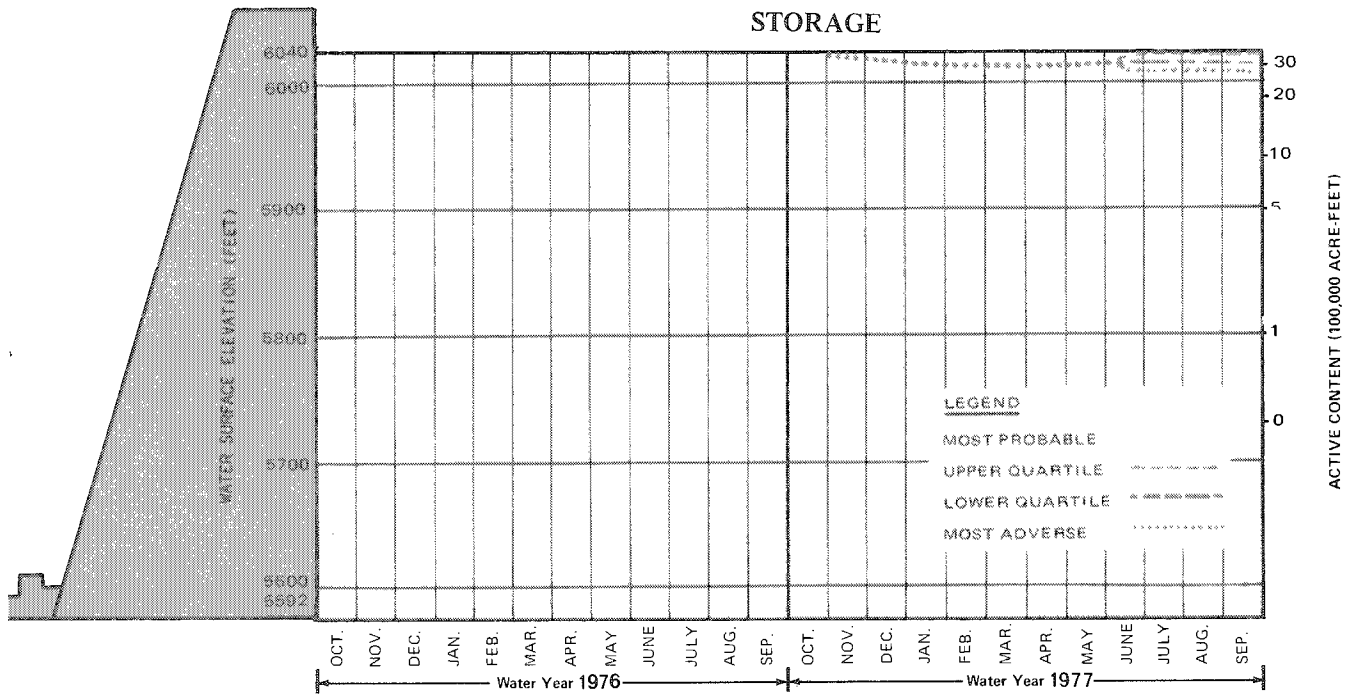
\*does not include 40,000 acre feet of dead storage below 5740 feet



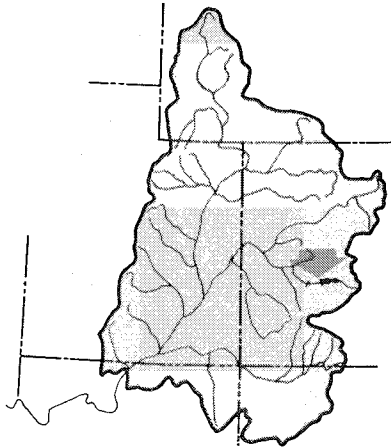




Flaming Gorge Dam and Reservoir, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming.



**Curecanti Unit—Blue Mesa Reservoir**



**Chart 3/ Blue Mesa Reservoir**

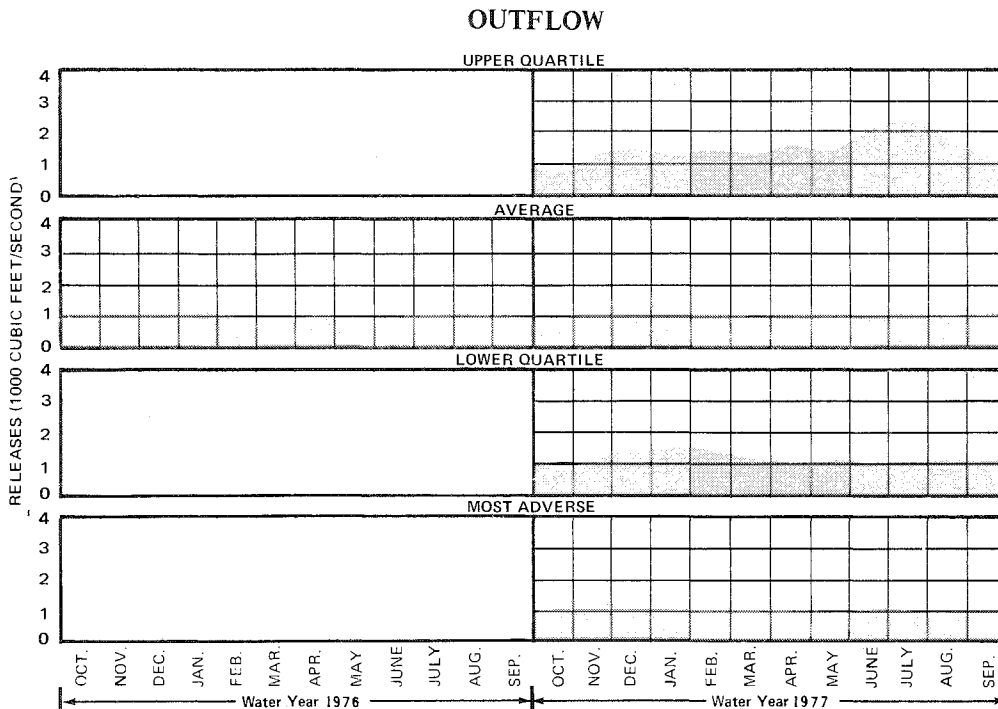
STATISTICS		
ACTIVE STORAGE*		
RESERVOIR	(ACRE- FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	829,523	7519
RATED HEAD	249,395	7438
MINIMUM POWER	81,070	7393
SURFACE AREA (FULL)	9180 ACRES	
RESERVOIR LENGTH (FULL)	24 MILES	
POWER PLANT		
NUMBER OF UNITS	2	
TOTAL CAPACITY OF UNITS	60,000 KILOWATTS	

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

At the end of September 1975, Blue Mesa Reservoir had 695,000 acre-feet of active water storage, with a water surface elevation of 7,504 feet. The reservoir was drawn down to elevation 7,468 feet, 60 percent of the long-time average. During April-July 1976, inflow to Blue Mesa was 477,000 acre-feet, with a 1976 water year total of 729,000 acre-feet. The seasonal high water level for the reservoir was elevation 7,498 feet and an active storage of 645,000 acre-feet. During water year 1976, a minimum flow of 200 ft<sup>3</sup>/s was maintained below Gunnison Tunnel to protect the fishery.

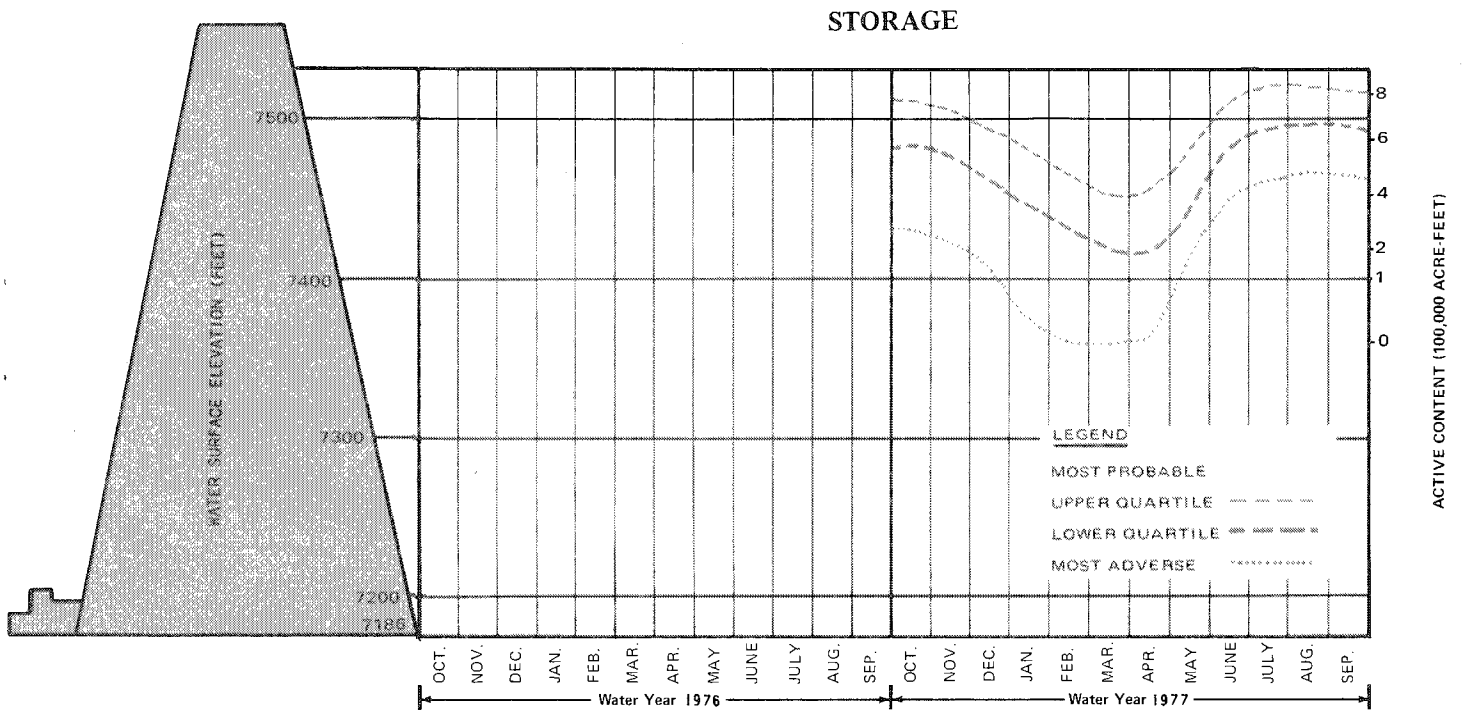
The March 1, 1976, forecast of the April-July 1976 inflow to Blue Mesa was 610,000 acre-feet. The flood control regulations did not require evacuation of space during the snowmelt season; consequently, the operation of Blue Mesa did not include releases for flood control. (Chart 3.)

From May 1 through September 30, 1976, controlled releases from Blue Mesa provided downstream flows that were compatible with construction activities at the Crystal Dam site.





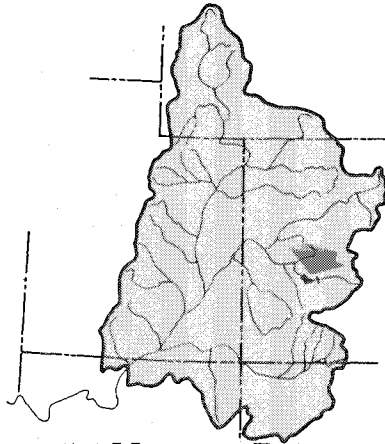
Blue Mesa Dam, Curecanti Unit, Colorado River Storage Project, Colorado.



## Curecanti Unit—Morrow Point Reservoir

Morrow Point Reservoir was essentially full during water year 1976. On September 30, 1975, the reservoir contained 116,000 acre-feet of active storage at a water-surface elevation of 7,158 feet. Its inflow is extensively controlled by the operation of Blue Mesa Reservoir, which is upstream.

Usually, Morrow Point Reservoir will 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

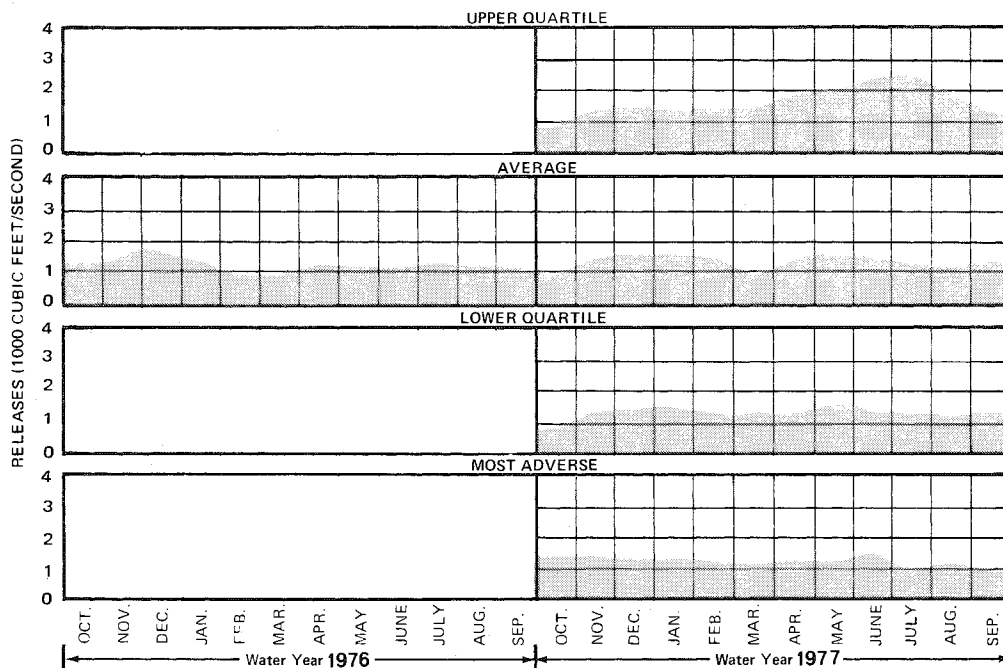
	(ACRE- FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	117,025	7160
RATED HEAD	79,805	7108
MINIMUM POWER	74,905	7100
SURFACE AREA (FULL)	817 ACRES	
RESERVOIR LENGTH (FULL)	11 MILES	

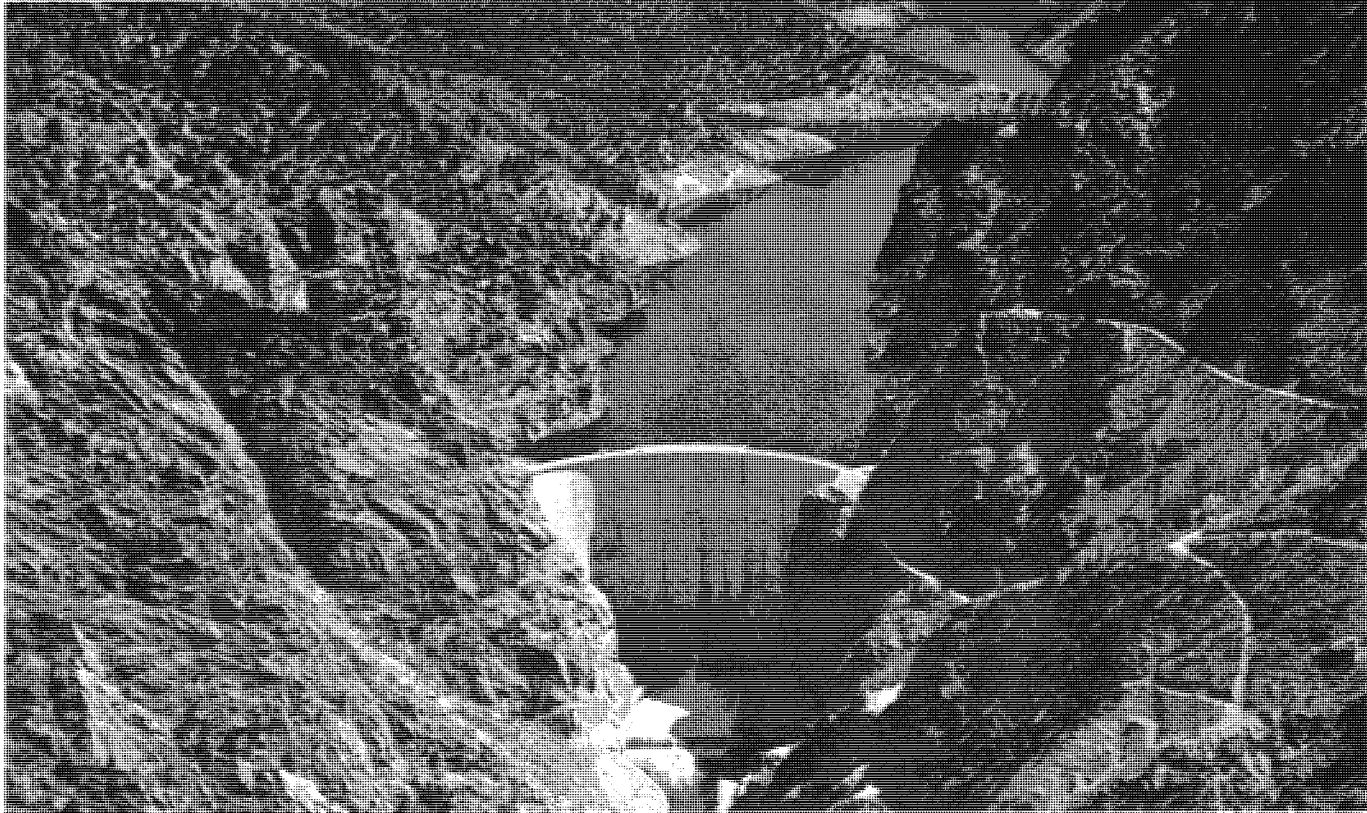
#### POWER PLANT

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

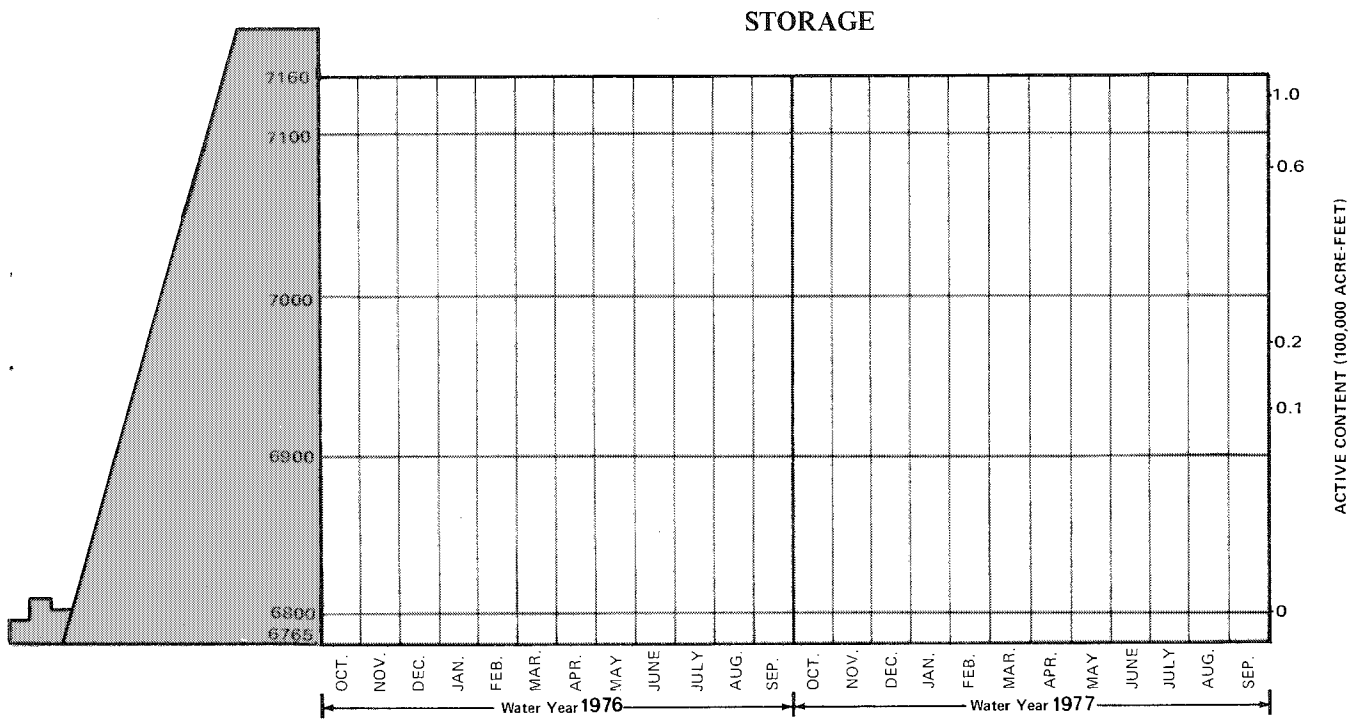
\*does not include the 165 acre feet of dead storage below 6808 feet

### OUTFLOW

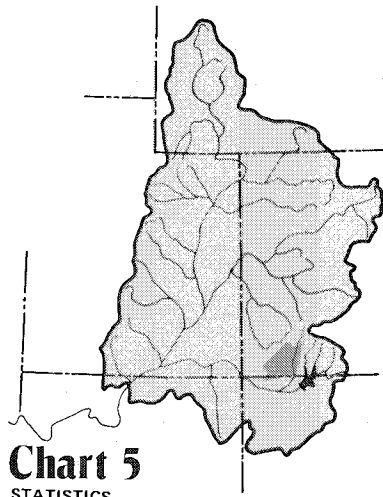




Morrow Point Dam and Reservoir, Curecanti Unit, Colorado River Storage Project, Colorado.



# Navajo Reservoir



**Chart 5**

STATISTICS  
ACTIVE STORAGE\*

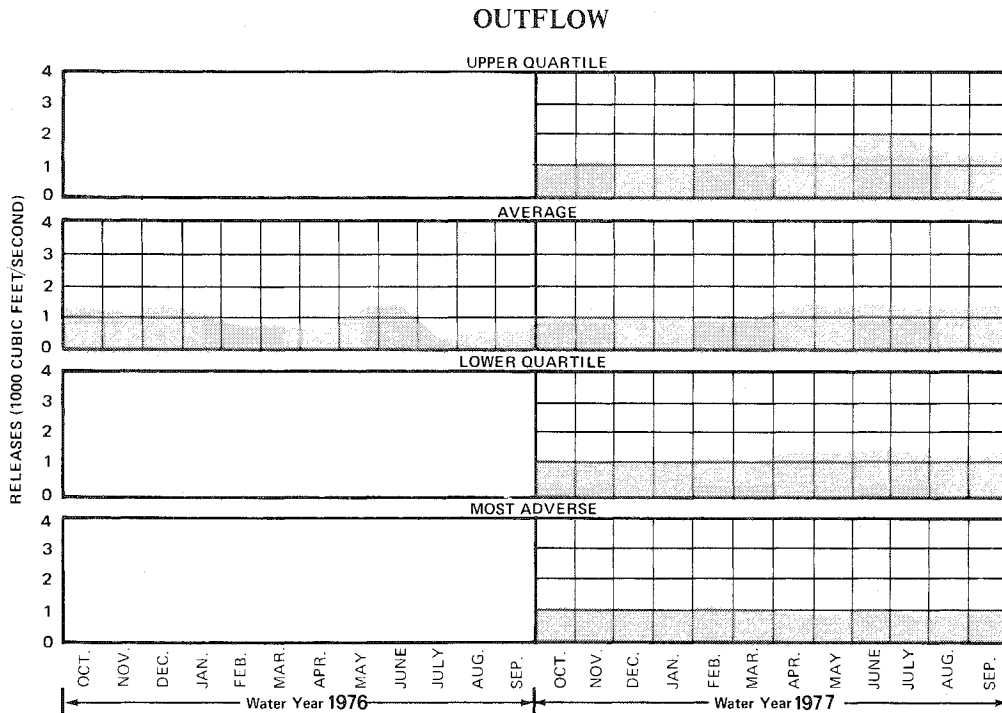
RESERVOIR	(ACRE- FEET)	ELEVATION (FEET)
MAXIMUM STORAGE	1,696,400	6085
INACTIVE STORAGE	660,500	5990
SURFACE AREA (FULL)	15,610 ACRES	
RESERVOIR LENGTH (FULL)	33 MILES	

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

During water year 1976, 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 6,038 feet during the winter of 1975 and spring of 1976. The actual April-July inflow to Navajo Reservoir was 496,000 acre-feet, or 67 percent of the long-time April-July runoff average above Navajo. The seasonal high occurred in July with the water surface reaching elevation 6,056 feet and a live storage of 1,292,000 acre-feet.

Navajo Reservoir is operated under a formal flood control plan. On March 1, 1976, Navajo Reservoir had 1,091,000 acre-feet of water in storage. The April-July inflow forecast on March 1 was 600,000 acre-feet. Based on the March 1 forecast, the current flood control diagram allowed the reservoir to be full, and the scheduled operation of the reservoir did not include any releases specifically required for flood control. (Chart 5.)

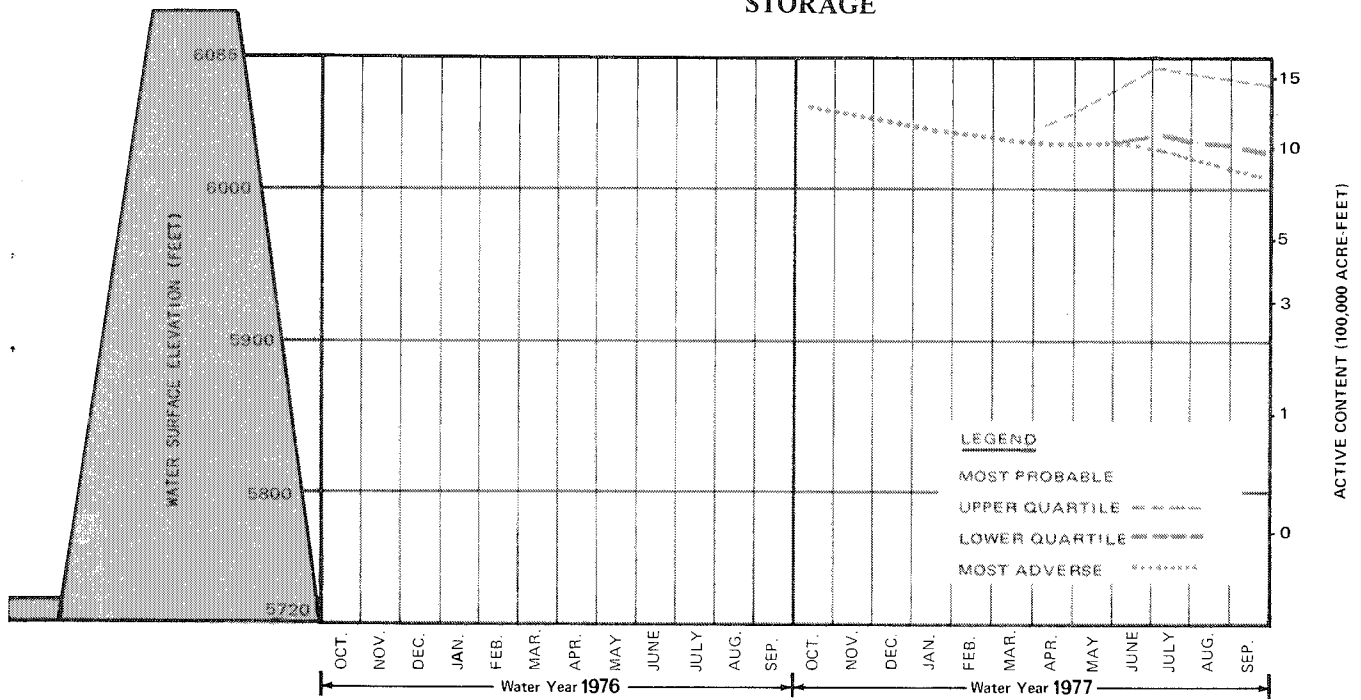
Releases were scheduled to control downstream flows to the minimum level practicable in order to minimize bank erosion.





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

### STORAGE

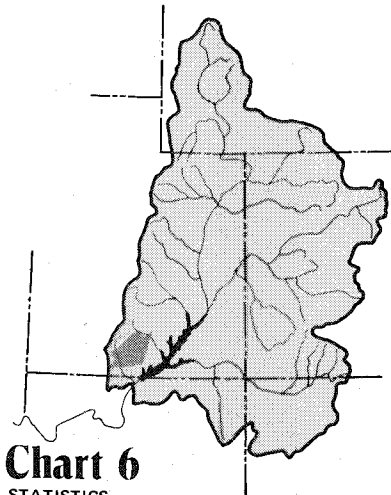




# Glen Canyon Dam, Lake Powell

During water year 1976, 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, 1975, Lake Powell water-surface elevation was at 3,668 feet with an active storage of 20,202,000 acre-feet. During the fall and winter months, the reservoir water level dropped about 4 feet to elevation 3,664 feet. Releases of water for hydropower generation were scheduled in the early spring to integrate hydroelectric power from the Northwest and the Missouri River Basin with CRSP power production. The April-July 1976 runoff above the gage at Lees Ferry, Ariz., was 5.3 million acre-feet, or 67 percent of the 1906-68 average. A seasonal high-water elevation occurred on July 5, 1976, when the reservoir contained 20,796,000 acre-feet of active storage, with the water surface at elevation 3,672 feet. (Chart 6.)



**Chart 6**

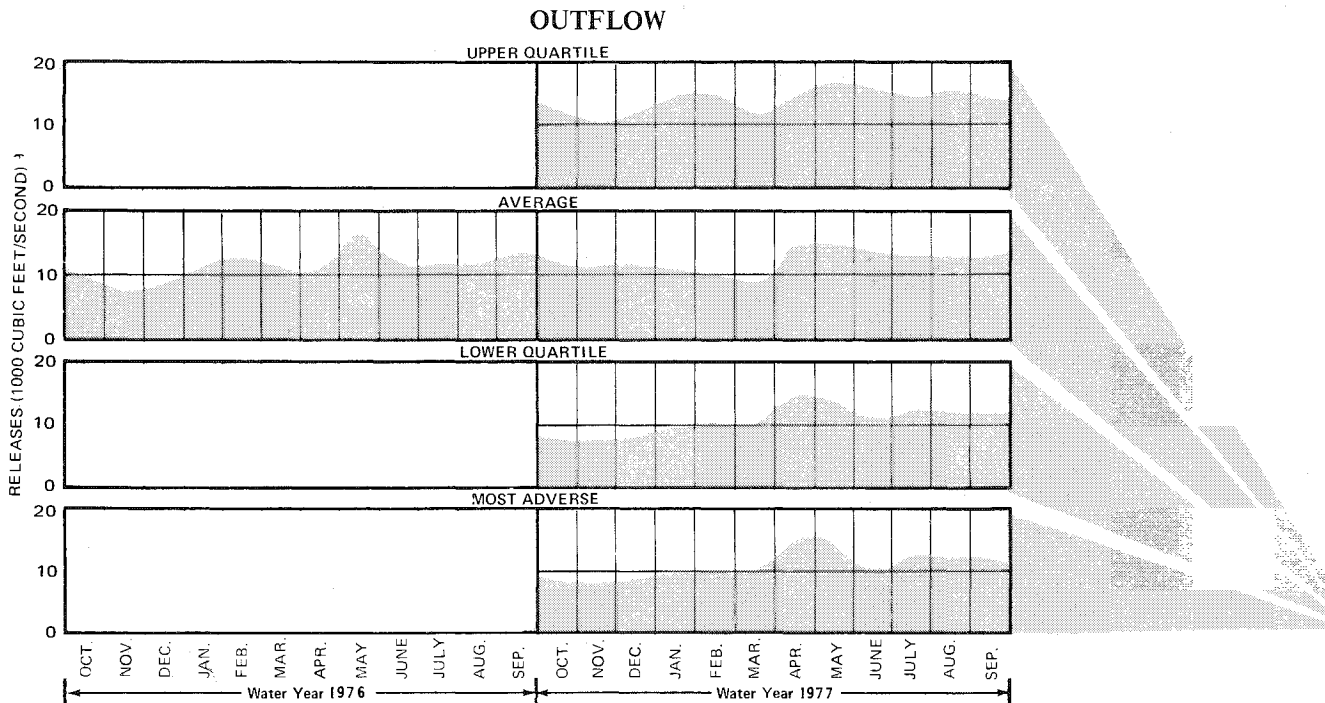
**STATISTICS  
ACTIVE STORAGE\***

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	

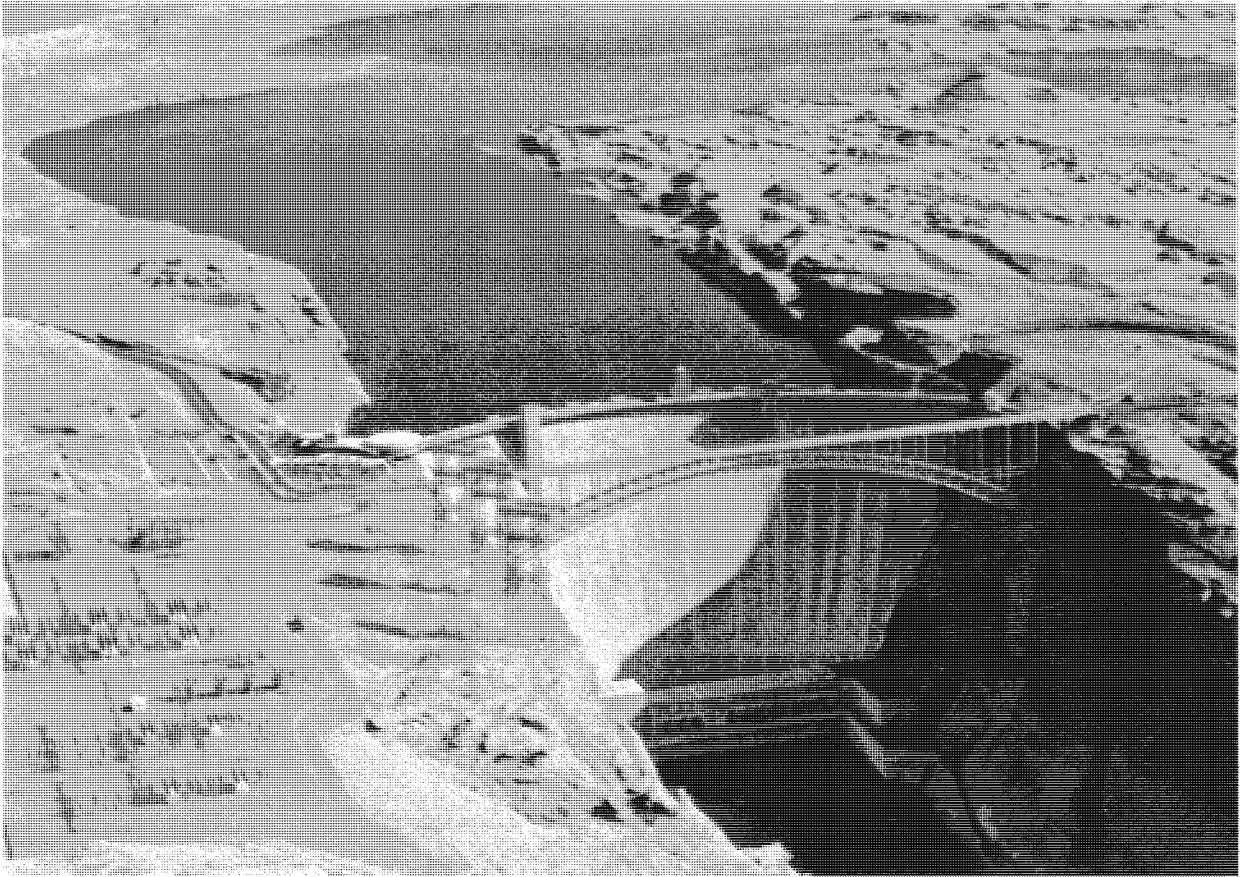
**POWER PLANT**

NUMBER OF UNITS	8
TOTAL CAPACITY OF UNITS	900,000 KILOWATTS

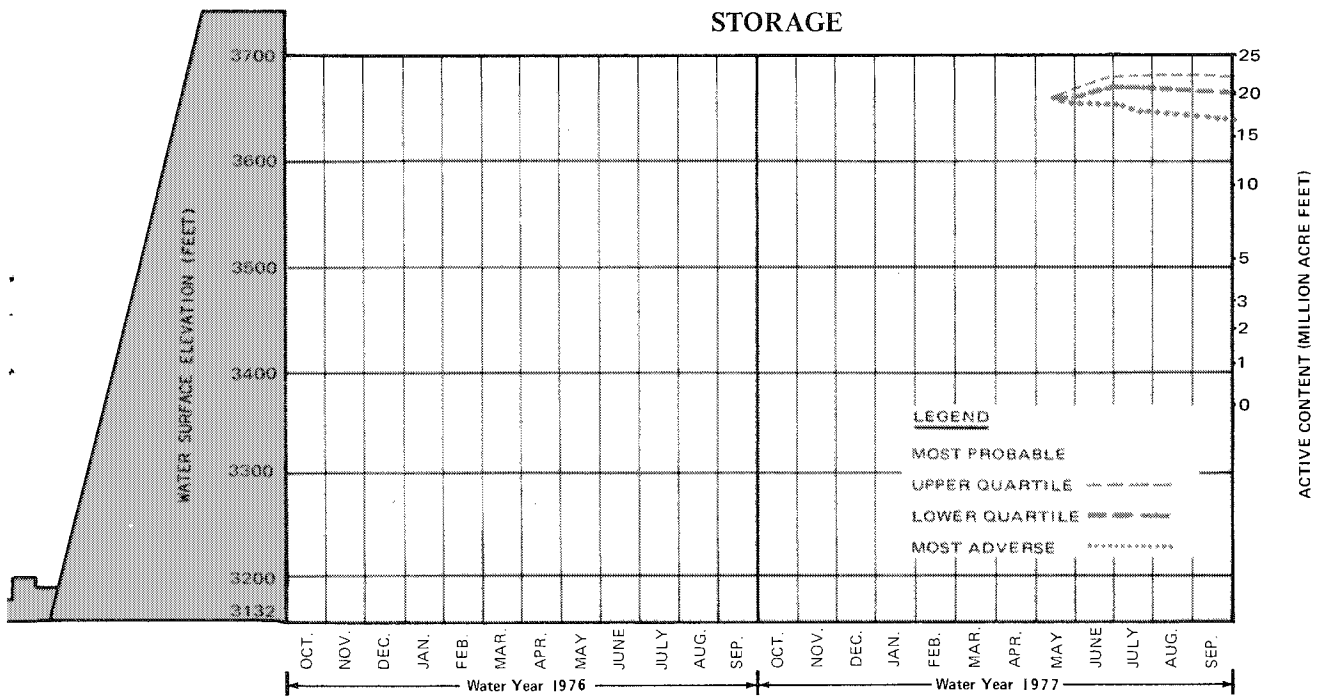
\*does not include 1,998,000 acre feet of dead storage below 3370 feet





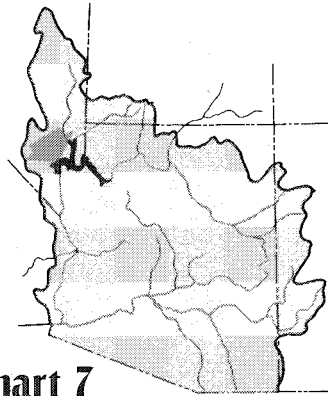


Glen Canyon Dam and Lake Powell, Glen Canyon Unit, Colorado River Storage Project, Arizona-Utah.



# Lower Basin Reservoirs

## Hoover Dam, Lake Mead



**Chart 7**

**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**

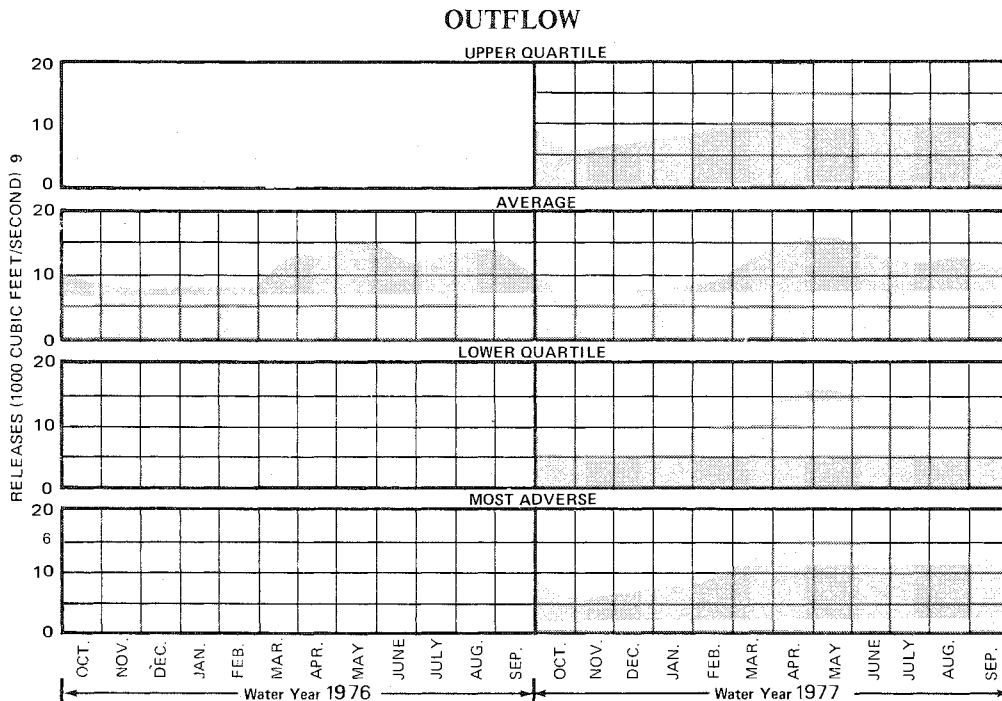
NUMBER OF UNITS	17
TOTAL CAPACITY OF UNITS	1,344,800 KILOWATTS

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

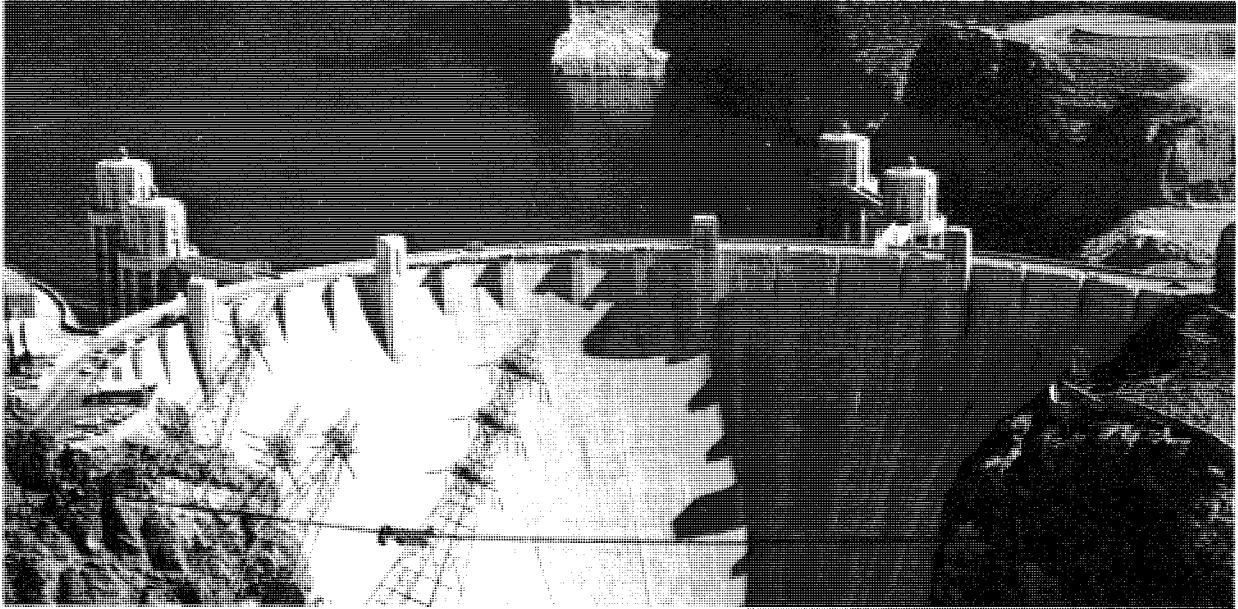
At the beginning of water year 1976, Lake Mead had a water-surface elevation of 1,180 feet and an active storage of 20,196,000 acre-feet. During the water year, releases were made to meet downstream water use requirements in the United States and Mexico, programed levels of Lakes Mohave and Havasu, and 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 was 8,319,000 acre-feet. At the end of the water year, Lake Mead had a water-surface elevation of 1,179 feet and an active storage of 20,062,000 acre-feet, which reflect a decrease in storage during the water year of 134,000 acre-feet.

On September 30, 1976, the active storage of Lake Mead was 421,000 acre-feet more than the active storage in Lake Powell.

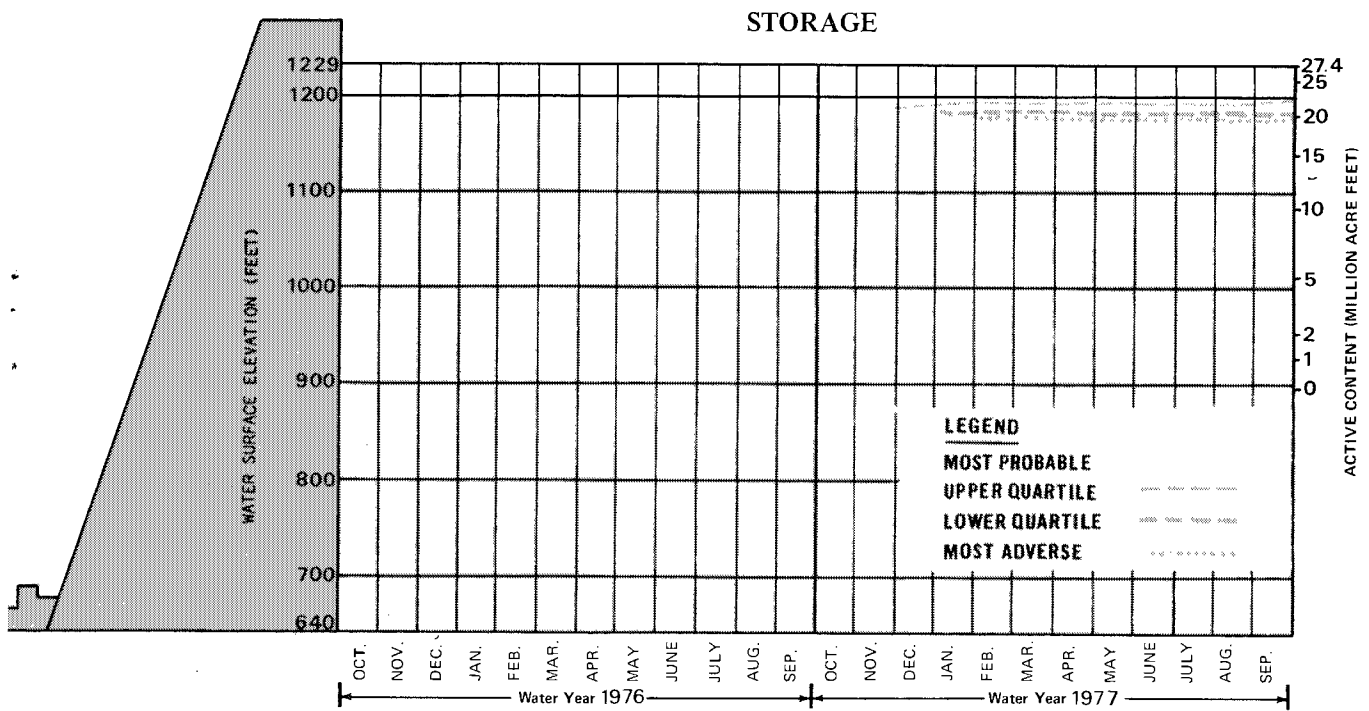
Because adequate space in Lake Mead and CRSP reservoirs was available during water year 1976, no additional releases at Hoover Dam were required pursuant to the flood control regulations. (Chart 7.)



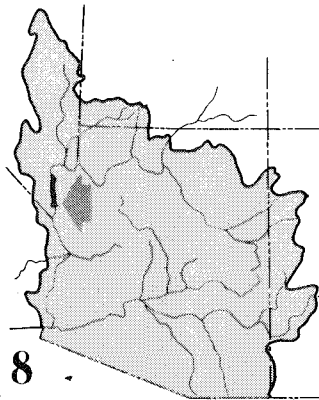
Lake Mead is the only reservoir on the Colorado River in which a specified space is exclusively allocated for mainstream flood control. Flood control regulations have been published. These regulations take into account effective space in CRSP reservoirs as well as in Lake Mead.



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



# Davis Dam, Lake Mohave



**Chart 8**  
STATISTICS  
ACTIVE STORAGE\*

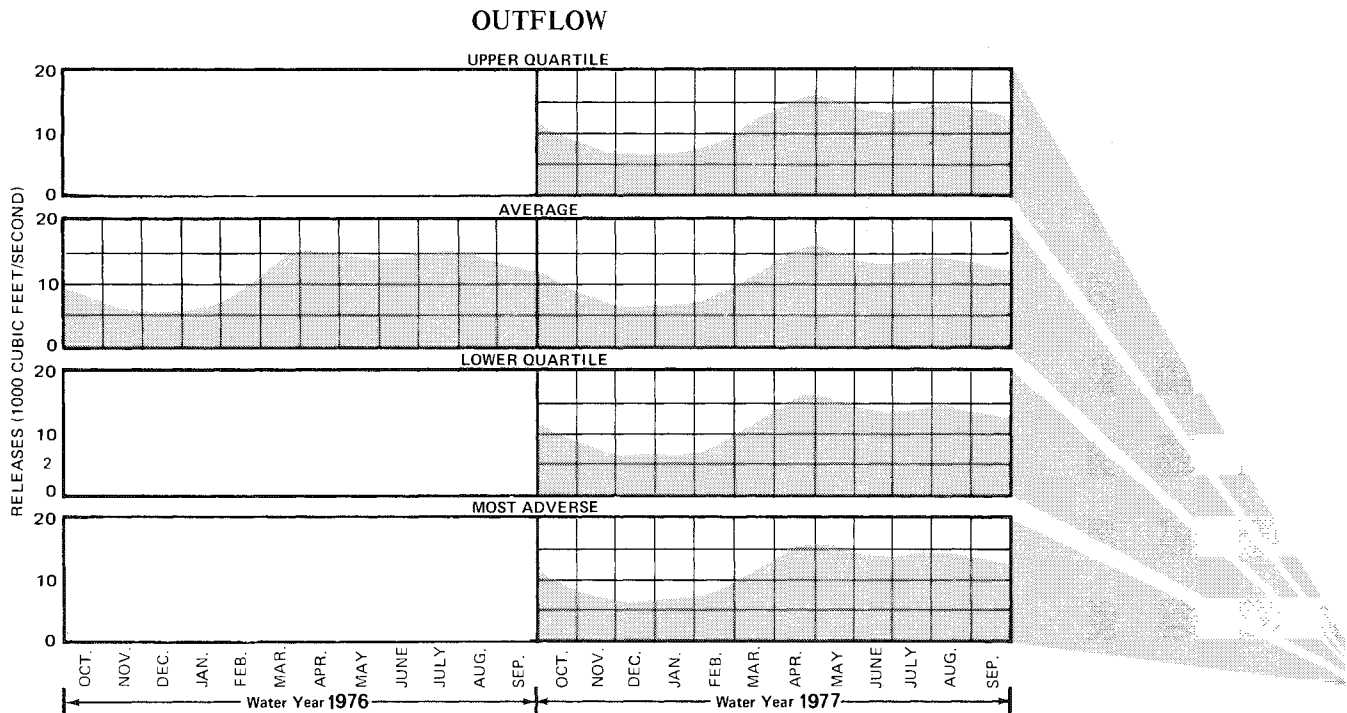
RESERVOIR	(ACRE- FEET)	ELEVATION FEET
MAXIMUM STORAGE	1,810,000	647.0
RATED HEAD	1,188,000	623.0
MINIMUM POWER	217,500	570.0
SURFACE AREA (FULL)	28,200 ACRES	
RESERVOIR LENGTH (FULL)	6.7 MILES	

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

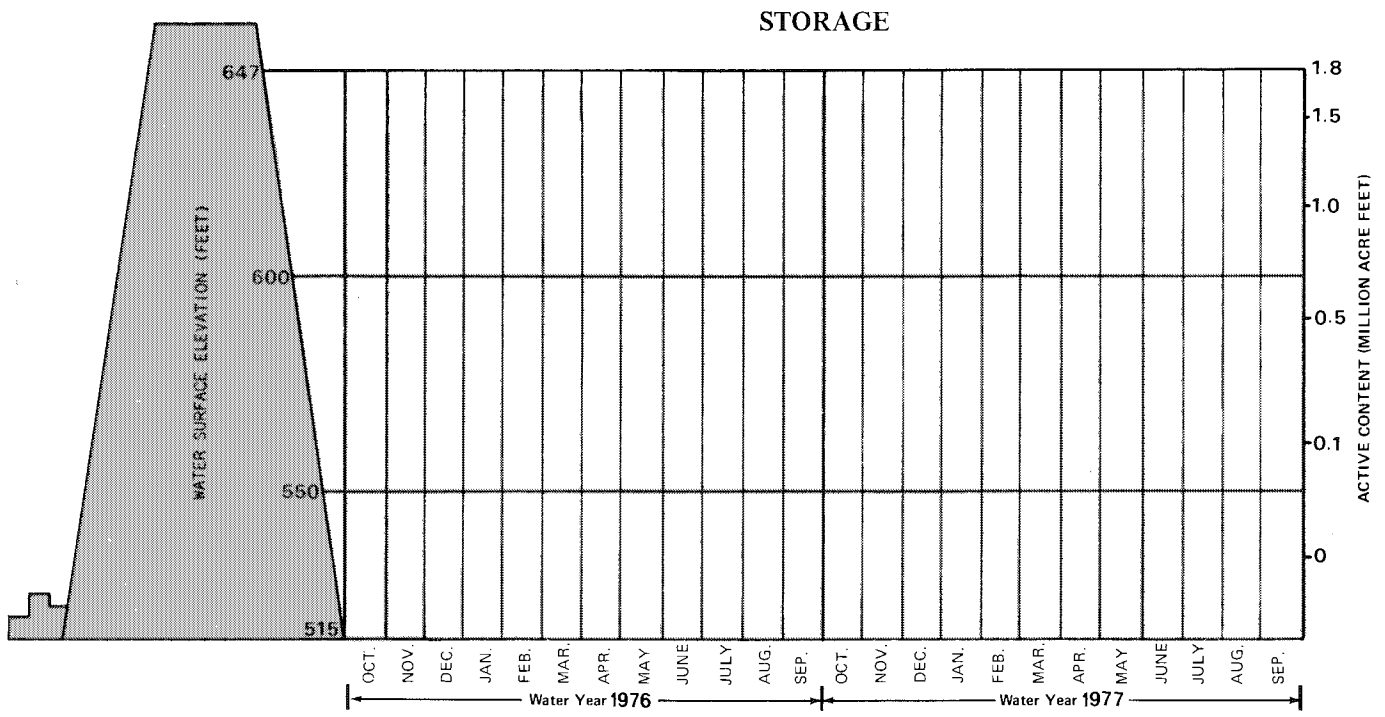
At the beginning of water year 1976, the water surface elevation of Lake Mohave was 631 feet, with an active storage of 1,385,400 acre-feet. During the spring months, the water level was raised to approximately 645 feet at the end of May and maintained between that level and 635 feet through September. The highest water level was 646 feet, with an active storage of 1,792,000 acre-feet on May 29, 1976, which is about the beginning of the heavy irrigation season. The water level was drawn down during the summer months to elevation 637 feet, with an active storage of 1,721,000 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, 8,000,000 acre-feet were released at Davis Dam, all of which was passed through the turbines for power production. (Chart 8.)

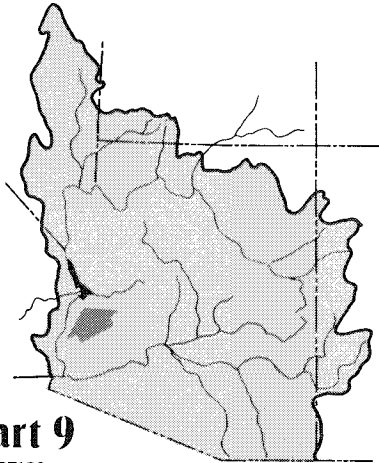




Davis Dam and Lake Mojave, Parker-Davis Project, Arizona-Nevada.



## Parker Dam, Lake Havasu



### Chart 9

#### STATISTICS ACTIVE STORAGE\*

RESERVOIR	(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

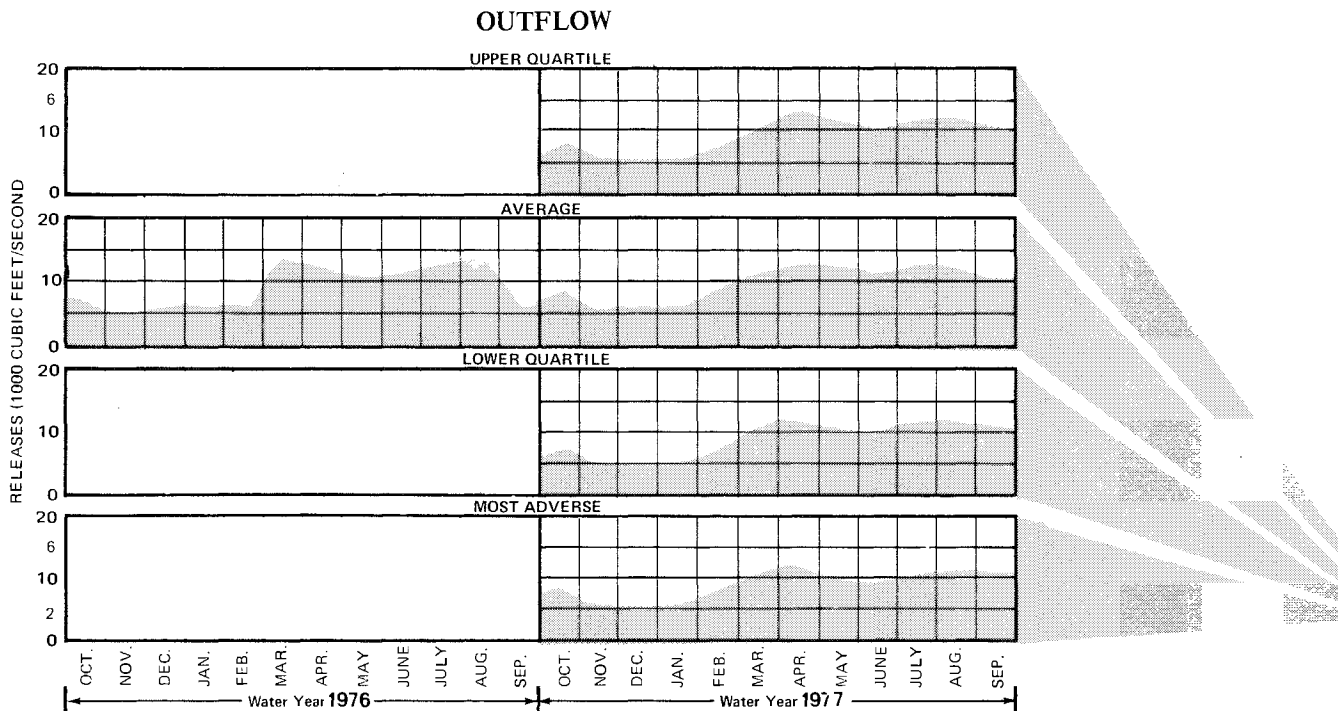
NUMBER OF UNITS	4
TOTAL CAPACITY OF UNITS	120,000 KILOWATTS

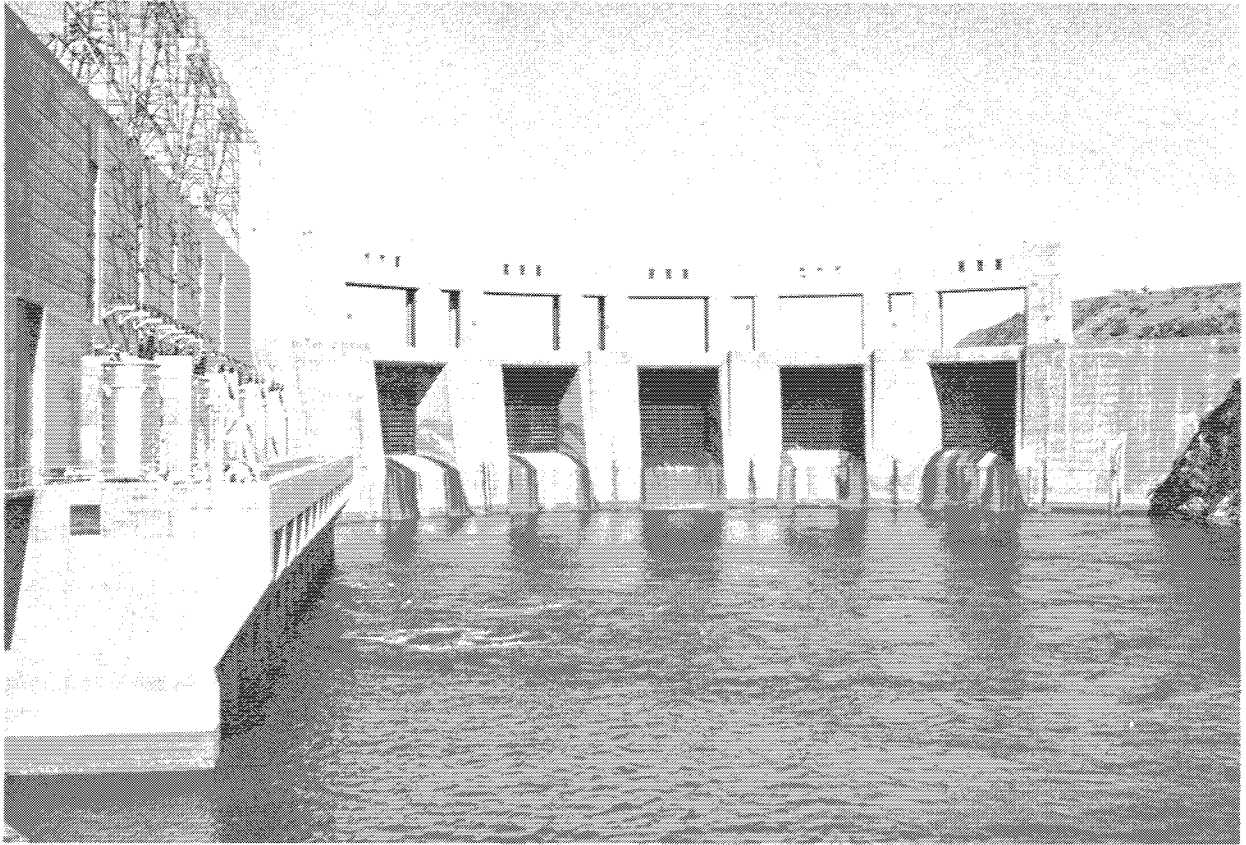
\*does not include 28,600 acre-feet of dead storage below elevation 400.0 feet

At the beginning of water year 1976, the water level of Lake Havasu was at elevation 447 feet, with an active storage of 553,000 acre-feet. The reservoir was drawn down to about elevation 446 feet with an active storage of about 537,000 acre-feet in November and remained near that level through mid-March to provide flood control space for runoff 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 then was drawn down to 448 feet with an active storage of 580,000 acre-feet by the end of the water year.

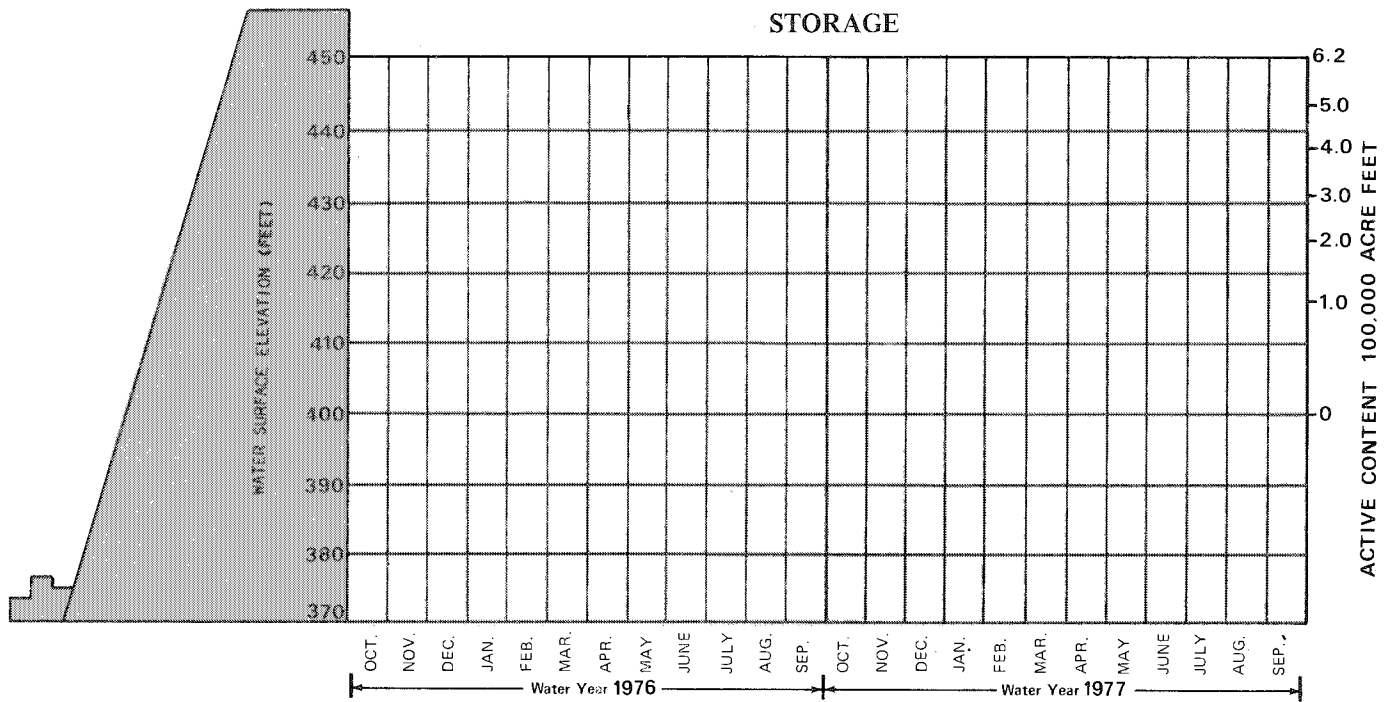
During the water year, 6,855,000 acre-feet were released at Parker Dam, all of which passed through the turbines for power production.

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, are used for this purpose now that Alamo Reservoir on the Bill Williams River is in operation. (Chart 9.)





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



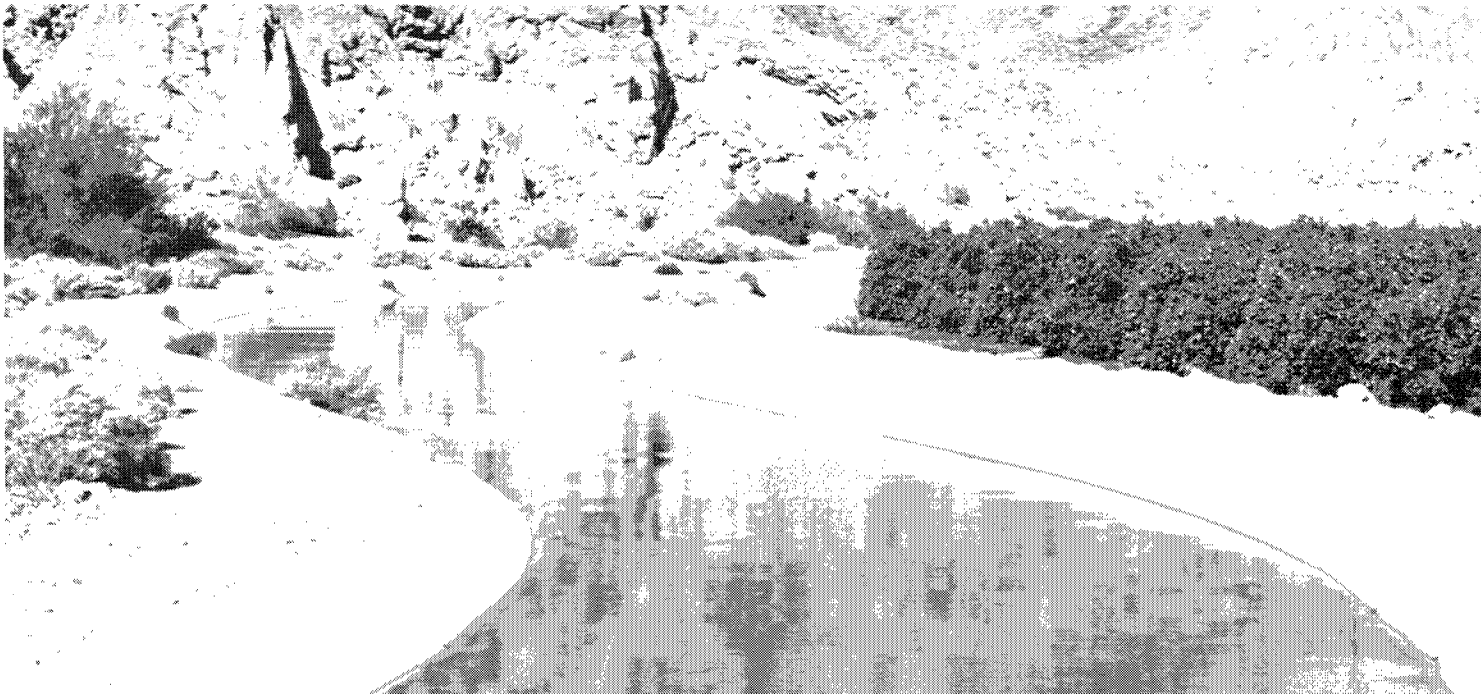
# River Regulation

During water year 1976, 8,508,000 acre-feet were released from Glen Canyon Dam as measured at the gaging station at Lees Ferry, Ariz. For the 1-year and 10-year periods ending September 30, 1976, 8,520,000 acre-feet and 87,861,000 acre-feet, respectively, passed the compact point at Lee Ferry, Ariz. The expected release of 9,245,000 acre-feet from Lake Powell scheduled for the year ending September 30, 1977, 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 89.3 million acre-feet for the 10-year period ending September 30, 1977, and would equate water storage in Lake Mead and Lake Powell.

Water releases scheduled for the Colorado River Storage Project and participating project 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 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 and all water passes through the turbines. 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 possible 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.

River regulation below Hoover Dam was accomplished in a manner which resulted in delivery to Mexico of 274,213 acre-feet in excess of minimum treaty requirements during water year 1976. Of that quantity, 205,586 acre-feet were delivered for salinity control pursuant to provisions of Minute No. 242 of the Mexican Treaty.



**Coachella Canal, Coachella Division—All-American Canal System, 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 1976, agricultural and M&I uses in the Upper Basin were estimated at 2,350,000 acre-feet. Approximately 763,000 acre-feet were diverted to adjacent drainage basins and approximately 656,000 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 3,919,000 acre-feet.

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 is based.

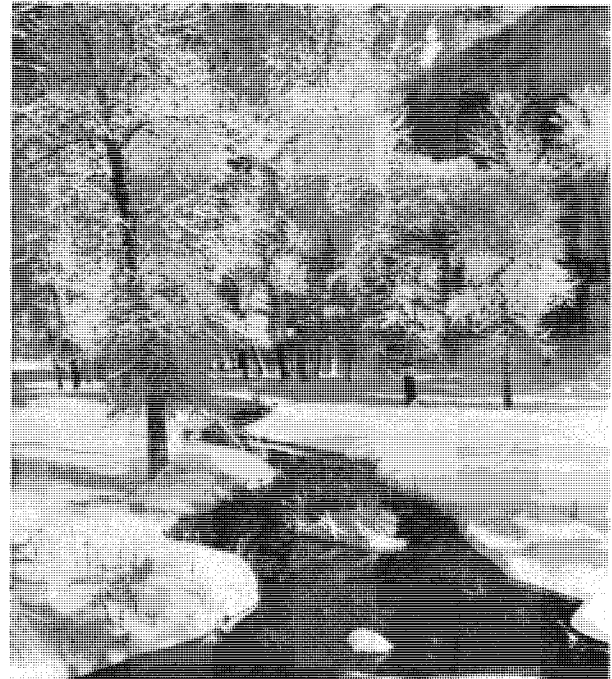
## **Lower Basin Uses and Losses**

During water year 1976, releases of 6,855,000 acre-feet 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 the regulatory waste of 68,627 acre-feet.

The major water diversion above Parker Dam was by Metropolitan Water District (MWD) of Southern California. MWD pumped 812,000 acre-feet from Lake Havasu during water year 1976, which included 9,554 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. During water year 1976, releases of

8,000,000 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 1976, releases of 8,319,000 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, 91,500 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 1976, the total releases and diversions from Lake Mead were 8,410,500 acre-feet.



**Upper Basin streams carrying runoff from snowmelt provide high quality water.**

# Water Quality Control

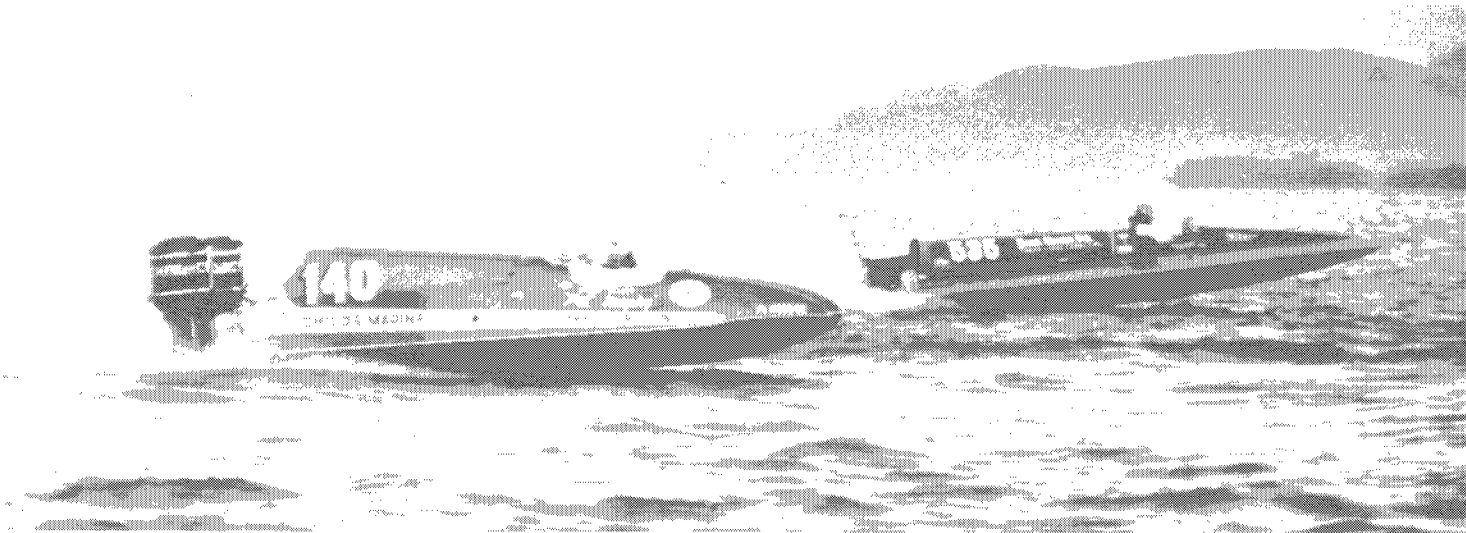
## **Water Quality Operations During Water Year 1976**

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. 8 of the biennial series will be issued in January 1977.

During water year 1976, the United States bypassed 205,586 acre-feet of drainage water to the Colorado River below Morelos Dam and replaced it with a like amount of other water, pursuant to Minute No. 242 of the Treaty with Mexico. Even though this was the only specific operation carried out for quality purposes, other incidental benefits accrue to water quality from normal procedures. Water is stored in reservoirs during the nonirrigation season and during the snowmelt runoff period when it is surplus to immediate requirements. As the streamflows diminish in late summer, storage water is released to supplement the natural streamflows, thus diluting the more saline flows

that would otherwise occur during late summer and fall. 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 enhances 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 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 of the Colorado River Basin Salinity Control Act (P.L. 93-320), June 24, 1974.



**Championship boat races at Lake Havasu.**

# 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<sup>3</sup>/s in the channel immediately below Fontenelle Dam. During water year 1976, releases for power production and other purposes provided flows in excess of 700 ft<sup>3</sup>/s.

Fishing below Flaming Gorge Dam has been enhanced by maintaining a minimum of 800 ft<sup>3</sup>/s in the river.

A release of at least 46 ft<sup>3</sup>/s throughout the winter 1975-76 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<sup>3</sup>/s to maintain fish habitat below Morrow Point Dam and below the Gunnison Tunnel.

A continuous flow of at least 400 ft<sup>3</sup>/s was maintained immediately below Navajo Dam for fish propagation.

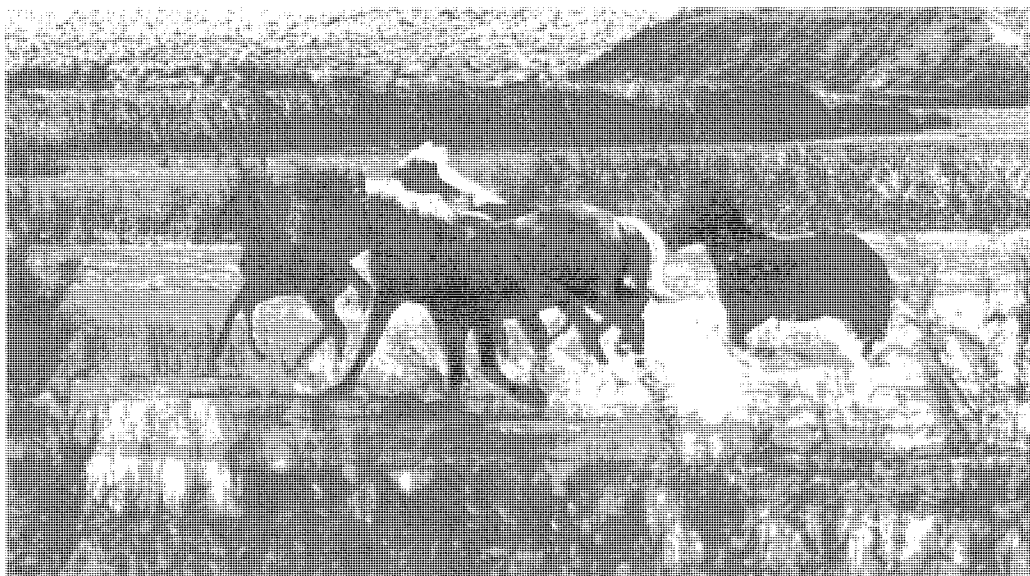
Clear water and a minimum release of 1,000 ft<sup>3</sup>/s provided good habitat for fish in the river below Glen Canyon Dam.

## Lower Basin

Lake Mead water levels were regulated to the maximum extent possible, consistent with other uses, to provide a stable or rising water surface during the bass spawning season. To provide satisfactory fish habitat along the lower river, releases from Lakes Mohave and Havasu were regulated so that minimum flows below the dams were never less than 1,880 ft<sup>3</sup>/s.



Double Crested Cormorants skimming over surface of Topock Marsh.



Feral 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 re-seeding 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 ecology of 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 and ecology 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.

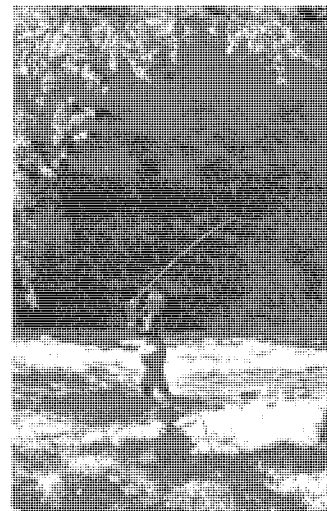
Reclamation is presently involved in a Federal-State study to evaluate, among other things, the effects of reservoir operation on the Lake Mead bass fishery. The study is scheduled for completion in 1981 and should provide valuable information to help protect and enhance Lake Mead's environment.

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

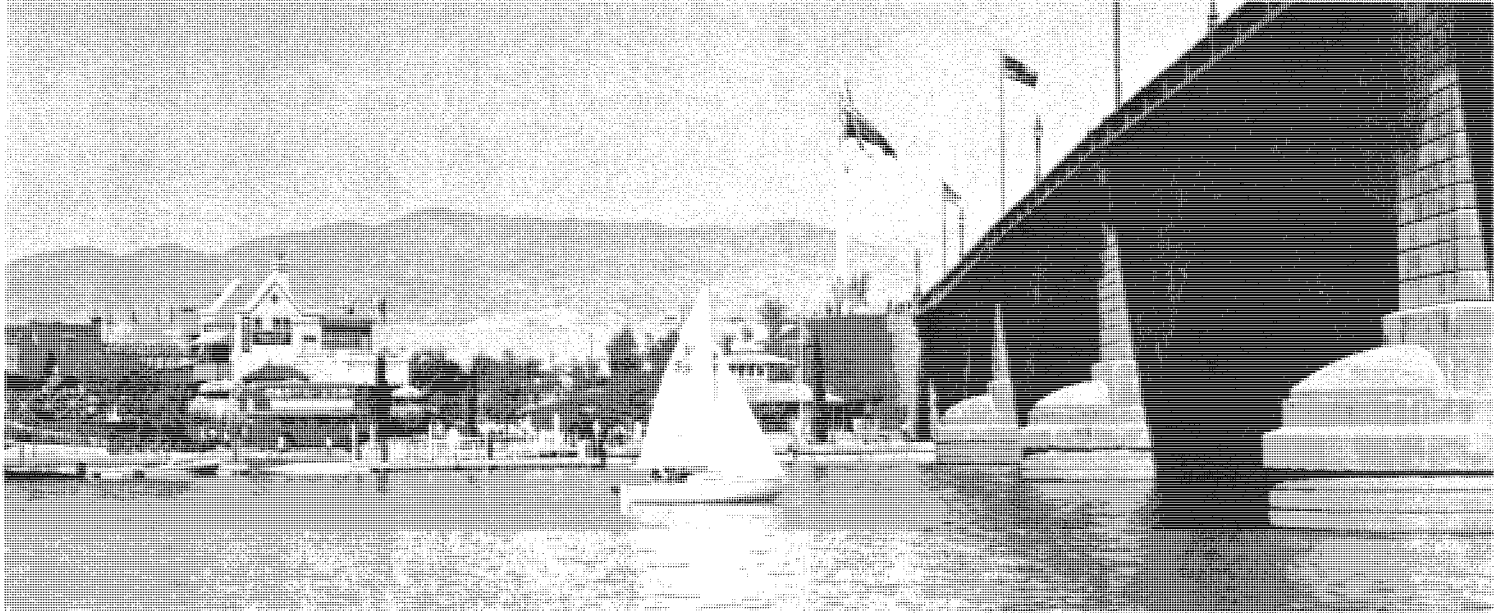
The Bureau of Reclamation is also currently involved in the preparation of the "Environmental Impact Assessment of the Operation of Lake Powell under the Long-Range Operating Criteria." The assessment will cover the historical background and project plan, a description of the present operating program, a description of the environment, and environmental impacts of present and alternative operating procedures.



Sandy Cove on Lake Mead, Hoover Dam.

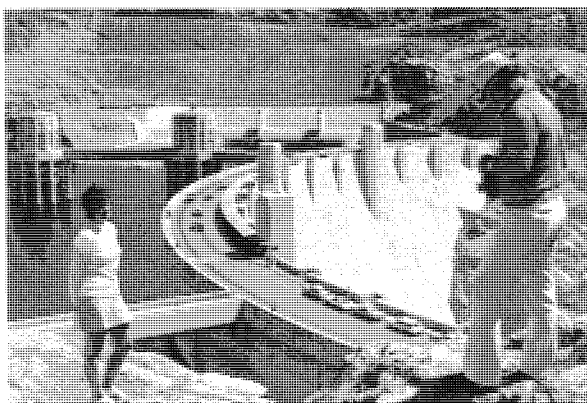


Fly fishing below Reclamation reservoir.



**English Village Park at Lake Havasu.**

# Projected Plan of Operation under Criteria for Current Year



View of Hoover Dam overlooking the roadway from Nevada side.

## 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, 1977, 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. The Lake Powell active storage forecast for September 30, 1977, is scheduled to be about equal to Lake Mead active storage forecast for that date.

The plan of operation during the current year based on average conditions is to release about 9,200,000 acre-feet of water from Lake Powell, in accordance with section 602(a)(3) of Public Law 90-537.



Whirlpool Canyon below Echo Park, Flaming Gorge.

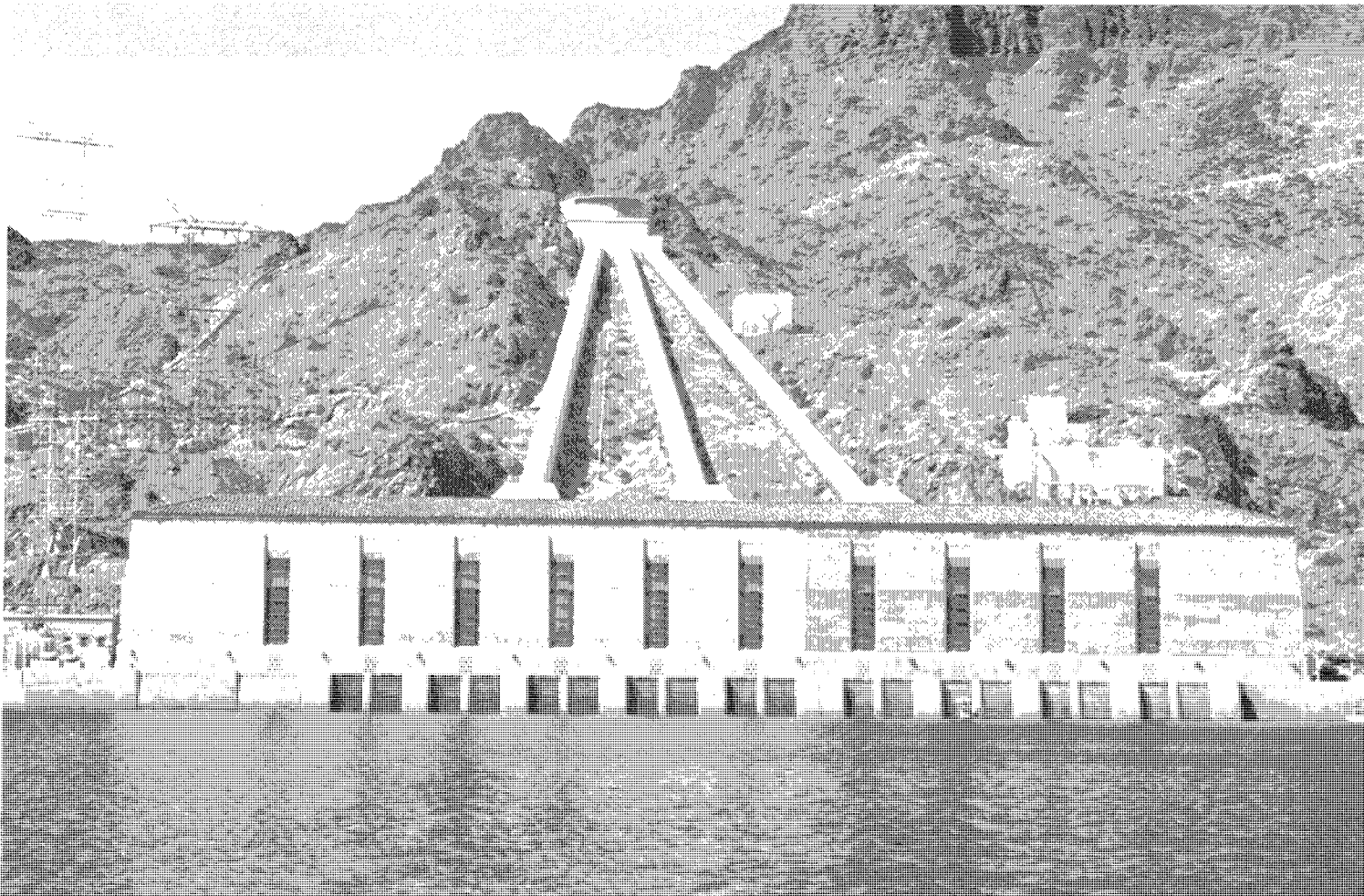
# Lower Basin Requirements

## **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.

**Metropolitan Water District intake on Lake Havasu.**







Water skiers on Flaming Gorge Reservoir.

### **Consumptive Use and Losses**

For water year 1977, a release of 7,226,000 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 1977, the Metropolitan Water District of Southern California is expected to divert 791,000 acre-feet by pumping from Lake Havasu, including a contract delivery of 9,600 acre-feet to the city of Tijuana as a part of Mexico's Treaty delivery.

Consumptive use by small users, river losses or gains, and reservoir losses between Davis Dam and Parker Dam are projected to be 385,000 acre-feet.

There are no major users between Hoover Dam and Davis Dam. During water year 1977, consumptive use by small users, river losses or gains, and

reservoir losses between Hoover Dam and Davis Dam are projected to be 60,000 acre-feet.

During water year 1976, the net diversions from Lake Mead are projected at 98,000 acre-feet. Evaporation from Lake Mead is expected to be about 884,000 acre-feet, and net gain between Glen Canyon Dam and Lake Mead is expected to be about 871,000 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 1977, 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" are in effect, but no flood control releases were anticipated for water year 1976.



# Plan of Operation— Water Year 1977

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For average runoff conditions during water year 1977, the projected operation of each of the reservoirs in the Colorado River Basin is described in the following paragraphs. Charts 1 through 9 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 1977 modified runoff from the Basin. The four assumptions are: (1) AVERAGE based on the 1906-68 record of runoff, (2) UPPER QUARTILE based on flows 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 1934.

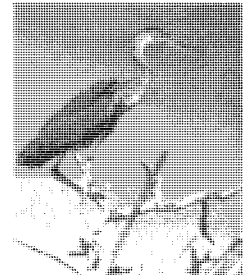
The projected releases from Lake Powell are 8.23 million acre-feet for the most adverse and lower quartile assumed runoff conditions. The average and upper quartile assumed runoff conditions would cause a splitting of storage condition between Lake Mead and Lake Powell, and releases from Lake Mead would be 9.2 and 10.4 million acre-feet, respectively.

The average and upper quartile Lake Powell release would cause Lake Mead to rise 7 feet and 15 feet higher at the end of the current year than the level reached by the most adverse condition. The projected operations of 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 "Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs" and their relation to the "Filling Criteria" (General Principles to Govern, and Operating Criteria, for Glen Canyon Reservoir and Lake Mead During the Lake Powell Filling Period). This review includes a study 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. The scheduling of additional releases would lessen the risk of future downstream flood damage and would tend to avoid the need at some future date to bypass water in excess of powerplant capacities.

Before implementing such an alternative plan for the water year 1977, the views of the seven Colorado River Basin States regarding the potential benefits versus risks related to such additional releases would be sought. The additional water releases could be scheduled for use by Mexico as part of the plan, but such releases could not be regarded as a precedent for release of water in future years. It is anticipated that such a plan might include the release of 200,000 acre-feet of water during calendar year 1977 based on the present condition of storage within the Colorado River system. If the late spring forecasts indicate an average or above average runoff for water year 1977, the views of the Colorado River Basin States will be solicited on the merits and risks of releasing even greater amounts of additional water.



Great Blue Heron make nests at Topock Marsh.

Green River immediately below Flaming Gorge Dam.



# Upper Basin Reservoirs

## Fontenelle

The reservoir water level will be lowered through the fall and winter months until a water surface elevation of about 6,480 feet is reached. 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 1977 (Chart 1.)

## Flaming Gorge

At the beginning of water year 1977, the active storage in Flaming Gorge Reservoir was 3,474,000 acre-feet, with a water surface at elevation 6,033 feet. The reservoir level will be lowered about 10 feet by March of the current year, but should remain high enough until the spring runoff so boats can be launched from all of the nine boat ramps. Average inflow would cause the reservoir to reach elevation 6,033 feet with an active storage of 3,470,000 acre-feet. Summertime flow in the river below the dam should not exceed 4,500 ft<sup>3</sup>/s and would not be less than 800 ft<sup>3</sup>/s. Releases should average about 140,000 acre-feet per month through September 1977 for a water year total of about 1,675,000 acre-feet. (Chart 2.)

## Curecanti Unit

During the current year, the water level in Blue Mesa Reservoir should reach a low in March 1977 at elevation 7,457 feet and the active storage would be 355,000 acre-feet. With average inflow during the spring of 1977, the reservoir should fill at elevation 7,519 feet with an active storage of 830,000 acre-feet. At that elevation the reservoir has a surface area of 9,180 acres and a reservoir length of 24 miles. (Charts 3 and 4.)

Morrow Point Reservoir will be operated near full during the current year. Releases of a minimum flow of 200 ft<sup>3</sup>/s will be made below the Gunnison Tunnel Diversion Dam for downstream irrigation requirements, power production, and river regulation.

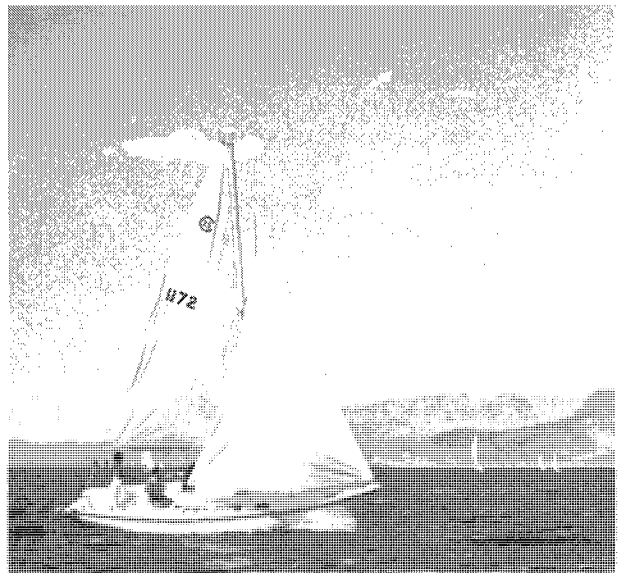
## Navajo Reservoir

On September 30, 1976, Navajo Reservoir had an active storage of 1,284,000 acre-feet with water surface elevation at 6,055 feet. During October through March, releases will be controlled to lower the reservoir elevation to 6,040 feet prior to spring runoff. At elevation 6,040 feet, Navajo Reservoir will have an extra 150,000 acre-feet of storage in anticipation of the water release for the Navajo Indian Irrigation Project. Average inflow would cause the reservoir to reach elevation 6,066 feet, with an active storage of 1,420,000 acre-feet. The reservoir will be maintained at or near this level throughout the remainder of the summer to enhance recreation use. (Chart 5.)

## Glen Canyon—Lake Powell

For the current year, the level of Lake Powell should drop about 4 feet during the fall and winter months to elevation 3,659 feet. The active storage would be 19.0 million acre-feet. Assuming an average April-July 1977 runoff, the resulting inflow of about 8.0 million acre-feet should cause the lake to reach an all-time high elevation of 3,676 feet during July, with an active storage of 21.3 million acre-feet, or approximately 85 percent of the active capacity of the reservoir. The lake would have a length of 185 miles and a water surface area of 144,810 acres. Assuming average conditions during water year 1977, a total release of 9.2 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 6.)

Sailboating on Lake Mead, backed up by Hoover Dam.



## Lower Basin Reservoirs

### **Lake Mead**

During the 1977 water year, the Lake Mead water level is scheduled to remain at about elevation 1,186 feet to enhance the bass spawn and survival conditions. At that level, the lake will have an average active storage of about 20.9 million acre-feet. During water year 1977, a total of 8.1 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 7.)

### **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 February 1977. It should remain near that yearly high elevation through May 1977. Because of the heavy irrigation use during the summer months, the water level in Lake Mohave is expected to be drawn down to elevation 630 feet by September 1977. During that time a total of 8.4 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 8.)

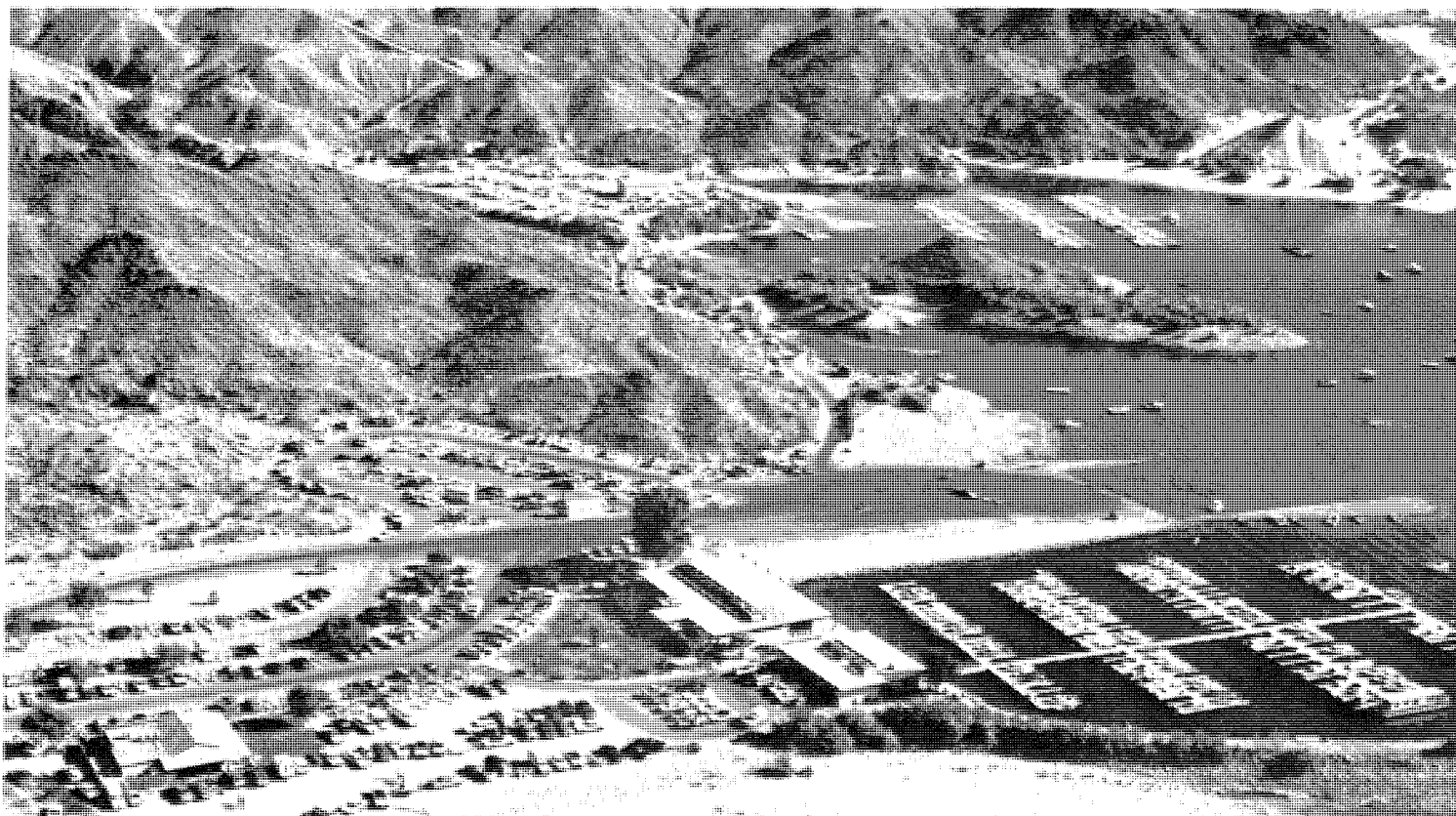


**Beach at Lake Havasu, Arizona.**

### **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 1977, a total of 7.3 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 9.)

**Katherine Landing on Lake Havasu.**





**Salt River Project Canal, Arizona.**

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.





