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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

RELEASED

OCT 3 1973

B-156966

The Honorable Wayne Owens
House of Representatives

Dear Mr. Owens:

In accordance with your request of March 15, 1973, and subsequent discussions with our representatives, we have examined the potential financial and operational effects of the U.S. district court decision not to allow the waters of Lake Powell to enter the Rainbow Bridge National Monument. We reviewed estimates from the Bureau of Reclamation, Department of the Interior, of (1) the loss of power revenues, (2) the loss of water through evaporation and bank storage, and (3) the potential loss of water to the Upper Basin States.

On December 10, 1970, Friends of the Earth, et al., filed a complaint in the U.S. District Court for the District of Columbia. The complaint was subsequently transferred to the U.S. District Court for the District of Utah. The suit was filed to compel Ellis L. Armstrong, the then Commissioner, Bureau of Reclamation, et al., to prevent the waters of Lake Powell from entering the monument's boundaries and to take adequate measures to protect the monument, in accordance with sections 1 and 3 of the Colorado River Storage Project Act (Public Law 84-485). The complaint stated that the defendants had failed to take measures to protect the monument.

On February 27, 1973, the Chief Judge, U.S. District Court for the District of Utah, directed the Commissioner of Reclamation, et al., to take whatever actions necessary to remove Lake Powell waters from the monument and to permanently prevent these waters from reentering.

As a result of two studies prepared in 1970 and 1971, the Bureau estimated that if it had to operate Lake Powell at or below the 3,600-foot elevation, instead of the 3,700-foot level for which the project was designed, the Colorado River storage project (CRSP) would lose an average of $3 million per year in revenues and the Upper Colorado River Basin Fund would lose about $375 million through the year 2059. Although our review showed that certain items in the two studies were not treated

on a consistent basis, we concluded that the technique used for projecting future water supplies and the rationale used for computing future generating capability and power sales appeared reasonable and provided us with no basis for questioning their validity.

Subsequent to our review, the Bureau conducted new rate and repayment studies for CRSP to analyze the effect of the district court order on the operations of CRSP and Lake Powell--particularly Glen Canyon Dam. These studies were made to recommend corrective measures for certain discrepancies identified during our review and to update the original studies. The new studies projected a net difference of revenue to the basin fund of about $529 million by the year 2059. The average net annual loss of power revenues to CRSP through 2059 as a result of operating Lake Powell at or below 3,604 feet would be about $2.69 million.

The two Bureau studies projected the loss of water through evaporation at 432,000 acre-feet at the 3,700-foot elevation and 245,000 acre-feet at the 3,600-foot elevation, and the average bank storage amount was 5,363,000 acre-feet and 4,932,000 acre-feet, respectively. After reviewing the Bureau's rationale and procedures for making computations of annual evaporation and cumulative bank storage at Lake Powell and our discussion with the Natural Sciences Coordinator for the Lake Powell research project, we concluded that the Bureau's computations are reasonable and that we have no basis for questioning their validity.

The Bureau studies also showed that, if the level of Lake Powell was kept at or below the 3,600-foot elevation (the elevation used in the court suit), the Upper Basin would lose an average of about 1.1 million acre-feet of consumptive use of Colorado River water per year. After reviewing the rationale and procedures the Bureau used to compute the potential effect of the court suit on Upper Basin consumptive use of Colorado River water, we concluded that we have no basis for questioning the Bureau's approach and that the approximate loss of 1 million acre-feet of water per year is reasonable.

Subsequent to our review, the Court of Appeals for the Tenth Circuit, in a decision filed August 2, 1973, stated that the trial court was in error and reversed the trial court's prior decision. The court of appeals directed that the trial court retain jurisdiction for 10 years to permit the Friends of the Earth to seek further relief if the monument is endangered from the depth of the water. As long as the monument is not endangered this decision would permit the Bureau to operate the project as originally intended.

A more detailed discussion of our review is presented in the enclosure.

The matters presented in this report have been discussed with Bureau officials. As agreed with your office, a copy of the report will be sent to Senator Frank E. Moss. We do not plan to distribute this report further unless you agree or publicly announce its contents.

Sincerely yours,

R. F. Keller

Comptroller General
of the United States

Enclosure

INTRODUCTION

On December 10, 1970, Friends of the Earth, et al., filed a complaint in the U.S. District Court for the District of Columbia. The suit was filed to compel Ellis L. Armstrong, the then Commissioner, Bureau of Reclamation, et al., to prevent the waters of Lake Powell from entering the boundaries of Rainbow Bridge National Monument and to take adequate measures to protect the monument, in accordance with sections 1 and 3 of the Colorado River Storage Project Act (Public Law 84-485). This act authorized the creation of the initial units of the Colorado River storage project (CRSP) including Glen Canyon Dam and Lake Powell. Section 1 of the act states that the Secretary of the Interior shall take protective measures to preclude the impairment of the monument, and section 3 states that no dam or reservoir constructed under the provisions of this act shall be within any park or national monument.

The complaint stated that the defendants had failed to take protective measures to preclude impairment of the monument and, unless relief was granted to the plaintiffs, the defendants would also be in violation of section 3 of the act by allowing the waters of Lake Powell to enter the monument. The defendants replied that the Congress had refused to appropriate funds for the erection of protective works for the monument.

The suit was transferred to the U.S. District Court for the District of Utah. On May 19, 1971, before a decision was made on the merits of this case, the waters of Lake Powell rose to an elevation of 3,606.17 feet and flowed through the monument's entrance, which is at 3,606 feet. A maximum elevation of 3,622.34 feet was achieved on July 11, 1971. This elevation placed the waters about 1,400 feet from the streambed directly below Rainbow Bridge, which is at the 3,654-foot elevation.

On February 27, 1973, the Chief Judge, U.S. District Court for the District of Utah, directed the Commissioner of Reclamation, et al., to take whatever actions necessary to remove Lake Powell waters from the monument and to permanently prevent these waters from reentering. However, the Court of Appeals for the Tenth Circuit, in a decision filed August 2, 1973, stated that the trial court was in error and reversed the trial court's decision. The court of appeals directed that the trial court retain jurisdiction for 10 years to permit the Friends of the Earth to seek further relief if the monument is endangered from the depth of the water.

On February 28, 1973, Senate bill 1057 was introduced. This bill would remove the prohibition against constructing

dams or reservoirs authorized by Public Law 84-485 within national parks or monuments.

The Bureau has stated that the project beneficiaries and the project repayment capability will be harmed if the Bureau is required to operate Lake Powell at or below the 3,606-foot elevation instead of at the 3,700-foot elevation for which Glen Canyon Dam was designed.

A discussion of the matters included in the request follows. It should be recognized that the recent decision of the court of appeals would presumably permit the Bureau to operate the project as originally intended.

LOSS OF POWER REVENUES TO BASIN FUND

Although authorized only as a secondary function, the hydroelectric power operations of CRSP are the primary source of revenues for the project. These and the revenues from the other authorized functions are deposited in the Treasury in the Upper Colorado River Basin Fund, which was authorized by Public Law 84-485. These revenues are then available to

- --pay the project costs for operation, maintenance, and replacements;
- --pay the interest on the unpaid investment allocated to power and municipal and industrial water; and
- --repay the project investments allocated to power, irrigation, and municipal and industrial water within 50 years after the date construction was completed.

Any revenues in excess of those required for these purposes are to be apportioned among the Upper Division States (Colorado, New Mexico, Utah, and Wyoming) for use in repaying the construction costs of participating projects in these States.

The projected annual revenues available to the basin fund and the total projected revenues to be apportioned to the Upper Division States are determined annually when the Bureau prepares its average rate and repayment study for CRSP. This study is used for determining the adequacy of rates for the sale of power and whether or not power can repay the investment assigned to it, as prescribed by law.

As a result of two such studies prepared during 1970 and 1971, the Bureau estimated that, if it had to operate Lake Powell

at or below the 3,600-foot elevation,[1] even though the entrance to the monument is at the 3,606-foot elevation, CRSP would lose an average of $3 million per year in revenues and the basin fund would lose about $375 million through the year 2059. The studies were the 1970 average rate and repayment study (ARRS-70) for CRSP, which projected operations at Lake Powell up to the 3,700-foot elevation, and the special study in response to the court suit (RBB-4), which projected operations at Lake Powell up to the 3,600-foot level. Both studies projected CRSP operations for the years 1971 through 2059.

The following table shows the differences in operations at Lake Powell if operated at the 3,700-foot elevation and at the 3,600-foot elevation.

	ARRS-70	RBB-4
Maximum storage	27 million acre-feet	14.7 million acre-feet
Maximum power generation capability	1,035 megawatts	1,028 megawatts
Average annual releases	9.7 million acre-feet	10.36 million acre-feet
Average elevation	3,650 feet	3,581 feet
Average power head	510 feet	441 feet
Average water pressure at turbine	221 pounds per square inch	191 pounds per square inch
Powerplant capability at average head	1,035 megawatts	961 megawatts
Average annual energy	4.28 billion kilowatt-hours	3.98 billion kilowatt-hours

The studies showed that, through 2059, the differences in operations at Lake Powell would affect the CRSP revenue and expense estimates in the following manner.

	Study		Increase or decrease(−) in RBB-4
	ARRS-70	RBB-4	
Revenues:			
Firm commercial sales	$3,259,897,293	$2,952,289,293	−$307,608,000
Nonfirm commercial sales	8,865,296	78,942,296	70,077,000
Other revenue	119,594,595	110,237,595	−9,357,000
Total			−246,888,000
Expenses:			
Purchased energy	239,601,263	260,357,263	20,756,000
Interest	343,531,514	450,402,671	106,871,157
Total			127,627,157
Net difference			−$374,515,157

[1]The Bureau used the 3,600-foot elevation in its study because the court suit would have required the Bureau to operate the project at that elevation.

We analyzed the Bureau's assumptions and rationale used in preparing the studies and offer the following comments regarding projected water supplies and power sales.

Water supply

Probably the most difficult aspect of projecting future river basin operations is determining the water supply to be used in these projections. The Bureau has good records of the flows of the Colorado River that occurred at Lees Ferry, Arizona, from 1906 to the present. Lees Ferry is the point on the Colorado River which separates the Upper and Lower Basins of the Colorado River system.

To project future operations from the hydrologic patterns and the runoff cycles that will determine the inflow to the CRSP reservoirs, sequences of historical runoff were assumed to reoccur as before. The Bureau equated 1971 to 1906 in its projection and routed the historical flows, less projected depletions, through the reservoir system to determine the electric power production, water releases, reservoir evaporation, etc., that would result under such circumstances. Similarly, 1971 was also equated to 1911 and 1916 and to the first year of each 5-year period thereafter and the flow sequences for these years were routed through the reservoir system. Thirteen routing studies (sequences) were prepared for the period 1971 through 2030, thus providing 13 values for power generation and each of the other parameters for each year in the future. The average of these 13 values was taken as the most probable quantity for the particular parameter that would be generated by the system's operation for each year through year 2030. The most probable values for each parameter, projected for year 2030, were also used for the years 2031 through 2059.

Power sales

Generating capability is the maximum power which a system can supply under specified conditions in a given time interval. The generating capability of the Glen Canyon powerplant is primarily a function of the power head, which is the difference between the surface elevation of the lake and the elevation of the Colorado River below the dam. This capability was estimated to be 1,028 megawatts when the reservoir elevation is at 3,600 feet and 1,035 megawatts at a 3,607 foot or higher elevation, and was the basis for projecting power sales. The Bureau's computer studies, which simulated reservoir operations under the 13 water supply sequences, computed the amount of power to be generated for sale under each sequence.

Sales were classified in two categories--firm and nonfirm. Firm power sales, which must be guaranteed available to the

customer, were based on the capability resulting from the lower 10th percentile of the historical water supply sequences. The firm sales included the sale of capacity in kilowatts and associated energy in kilowatt-hours at the predicted future load factor of 58.2 percent, and were computed at an average rate of 6 mills per kilowatt-hour. Nonfirm sales, which represented energy generated in excess of firm energy needs, were computed at the rate of 3 mills per kilowatt-hour.

At the time of the Bureau studies firm energy sales were contracted through fiscal year 1989. Both the contracted firm sales and projected firm sales beyond the current contract period were based on the system's power capability which decreases over the years. Although the capability fluctuates due to the changes in water supplies, the Bureau used a steadily decreasing capability pattern for projecting firm sales on the assumption that it would be impractical to contract for sales of firm capacity on a fluctuating basis.

In practice the amount of energy generated during a time period depends on the power head and the amount of water released and may be more or less than the amount of firm sales for that period. When the generated energy exceeded the amount of firm sales during a particular period, the excess was sold as nonfirm energy. When the generated energy was less than the projected firm sales, energy was purchased.

In preparing the ARRS-70 study the Bureau assumed that all future energy generated would be sold as firm energy. Therefore, it did not project nonfirm sales. In preparing the RBB-4 study, however, the Bureau assumed that an average of 5 percent of the annual energy generation would be nonfirm. The reasoning for this assumption was that the elevation limitation of 3,600 feet would make it more difficult to control the releases through the Glen Canyon powerplant because the storage capacity of Lake Powell would be significantly reduced. The Bureau also assumed that it would be difficult or impossible to arrange exchange agreements with others to exchange surplus energy from certain months for energy to offset deficiencies in other months, especially since both the amount and time are unpredictable.

Our analysis of the assumptions used by the Bureau in preparing the two studies showed the following inconsistencies with regard to the computation of nonfirm power sales and energy purchases.

Nonfirm sales

The Bureau computed annual nonfirm energy sales for each of the described sequences for the ARRS-70 study. This procedure had been used for prior rate and repayment studies.

However, these computations were not used in the final ARRS-70 study due to the assumption, made only for the 1970 study, that all generated energy would be sold as firm energy. In the RBB-4 study, however, the Bureau estimated that 5 percent of the generated energy would be sold as nonfirm energy.

To determine the reasonableness of projecting nonfirm sales at 5 percent of total generation, we computed nonfirm sales for every fifth year of the historical period as they were computed in rate and repayment studies prior to ARRS-70. Our computations showed that annual nonfirm sales for the RBB-4 study would average about 3.3 percent of the average annual energy generation. The annual nonfirm sales for the ARRS-70 study, computed in the same way, would average about 2.9 percent of the average annual energy generation. Therefore, the increase in annual nonfirm sales in the RBB-4 study, above ARRS-70 nonfirm sales, would be about 0.4 percent of the annual energy generation instead of the 5 percent used.

Since the Bureau computed energy purchases by subtracting the amount of energy generation from the total of firm plus nonfirm sales, a reduction in the amount of nonfirm sales would result in a like reduction in purchased energy. Since the cost of the energy purchased was estimated at the rate of 5.35 mills per kilowatt-hour, 2.35 mills per kilowatt-hour more than the revenues from sales of nonfirm energy, a reduction in the revenues from nonfirm sales results in a larger reduction in the cost of purchases.

Bureau officials estimated that if the RBB-4 study did not contain any nonfirm energy, as was the assumption for the ARRS-70 study, the net revenue in the RBB-4 study would be increased by about $78 million. This would reduce the estimated loss of basin fund revenues from about $375 million to about $297 million by the year 2059.

Purchases

When firm energy sales exceed the system's capability the Bureau must purchase additional capability (capacity). No purchases of capacity were included in the ARRS-70 study. However, the total cost of capacity purchases in the RBB-4 study was $72,279,000.

The RBB-4 study assumed that the Bureau would supply the presently contracted amounts of power to CRSP customers through fiscal year 1989, the expiration date of most of the contracts. The study also presumed that the deficit in generation, due to the lower power head at Glen Canyon, would be made up by purchasing capacity and energy as needed. We found that for several years the projected amount of capacity purchases for the

RBB-4 study would provide more salable capacity than would be available in the ARRS-70 study. Bureau officials agreed that the amounts of capacity purchases in the RBB-4 study were too high and estimated that reducing these purchases would have a net effect of increasing basin fund revenues in the RBB-4 study by about $8 million by 2059. However, rather than make new computations the officials stated that new computer studies would be made and the procedures used to compute capacity purchases would be corrected.

The decreases in the amount of nonfirm sales and purchases of power in the RBB-4 study have the approximate effect of reducing the estimated loss of revenues to the basin fund, due to the court order, to about $289 million by 2059. Also, the annual loss of revenues to CRSP would be reduced from about $3 million to about $2.36 million per year.

Conclusions

Even though certain factors were not treated on a consistent basis, the technique used in the studies to project future water supplies and the rationale used for computing future generating capability and power sales appeared reasonable and provided us with no basis for questioning their validity.

Subsequent to our review, the Bureau made new rate and repayment studies for CRSP to analyze the effect of the district court order on the operations of CRSP and Lake Powell--particularly Glen Canyon Dam. These studies were made to recommend corrective measures for certain discrepancies identified during our review and to update the original studies.

The new studies resulted in a net difference of revenues to the basin fund of about $529 million by year 2059. This difference is itemized below.

	Lake Powell elevation		Increase or decrease(-) at
	3,700 feet	3,604 feet	3,604 feet
Revenues:			
Firm commercial sales	$2,984,370,654	$2,772,486,348	-$211,884,306
Nonfirm commercial sales	170,676,932	205,449,932	34,773,000
Other revenue	107,985,389	103,908,389	-4,077,000
Total			-181,188,306
Expenses:			
Purchased energy	280,073,191	333,097,191	-53,024,000
Interest	410,126,191	705,093,588	-294,967,397
Total			-347,991,397
Net difference			-$529,179,703

CRSP's average net annual loss of power revenues through year 2059 as a result of operations at Lake Powell at or below 3,604 feet instead of at 3,700 feet is about $2.69 million.

PROJECTED LOSS OF WATER THROUGH EVAPORATION AND BANK STORAGE

Two of the three unmeasured aspects of operations at Lake Powell are losses of water through evaporation and storage of water in the reservoir banks. These, along with the unmeasured portion of inflow to Lake Powell, must be computed.

Evaporation and bank storage are affected by the quantity of water in Lake Powell since the amount of evaporation depends to a large degree on the lake's surface size and bank storage depends to a large extent on the amount of bank exposed to the lake's water. Through February 1973, Bureau operations at Lake Powell had accounted for over 101 million acre-feet of water as follows:

	Acre-feet (million)
Releases to Lower Basin	77.982
Storage:	
Reservoir	14.215
Bank	6.340
Evaporation	2.519
Total	101.056

Lake Powell, when full, will hold about 27 million acre-feet of water, will have about 1,800 miles of shoreline, and will be about 180 miles long.

Lake evaporation

The Bureau computes evaporation losses monthly. The results of extended pan evaporation method tests, water lost through evaporation from pans set out in the open air, form the basis of the computation. These results have been related to evaporation of water from Lake Powell.

To compute the monthly loss of water through evaporation, the Bureau computes the average of the lake's elevation at the beginning and end of each month and relates the average to the chart developed from the pan evaporation tests, based on the elevation-surface area relationship.

The ARRS-70 and RBB-4 studies used the pan evaporation method. These studies project average annual losses due to Lake Powell evaporation at 432,000 acre-feet and 245,000 acre-feet, respectively. The average lake elevation in the ARRS-70 study was projected at about 3,650 feet, while this average was reduced to about 3,580 feet in the RBB-4 study. The surface area under each condition is about 127,840 acres and 88,150 acres, respectively.

The Bureau is not satisfied with the pan evaporation method because it is not as accurate as other methods. The Bureau intends to use the mass-transfer method for computing evaporation, but this change depends on the results of a comprehensive study being financed by a National Science Foundation grant. This study, the Lake Powell research project, will include a study of Lake Powell evaporation. The research project will refine the use of the energy budget method of computing evaporation, and the Bureau intends to use those results to refine the mass-transfer method and to check computations from the mass-transfer method.

Bank storage

Bank storage is the water which enters the reservoir foundation after filling begins. Bank storage, like evaporation, is computed monthly. But unlike evaporation, Lake Powell bank storage is considered as the residual water supply, after considering inflow, surface storage, evaporation, and releases from the reservoir.

To compute Lake Powell's bank storage the Bureau begins with the U.S. Geological Survey measurements of the flows of the Colorado River near Cisco, Utah, the Green River near Green River, Utah, and the San Juan River near Bluff, Utah. These flows are adjusted (increased or decreased) by the net effect of operations from upstream reservoirs at Morrow Point, Blue Mesa, Flaming Gorge, Fontenelle, and Navajo to determine what the flows into Lake Powell would be if these reservoirs did not exist. These adjusted flow values are then correlated to historical flows at Lees Ferry, Arizona, to determine the amount of water (unmeasured) which is flowing into Lake Powell from drainage areas below the measuring locations.

Next, the Bureau adds Lake Powell's surface volume at the beginning of the month to the total inflow (measured and unmeasured) during the month. From this combination the total of the current month's ending surface storage volume, the month's evaporation, and releases from Lake Powell are subtracted. The remainder is recorded as the month's change in bank storage.

Through February 1973, the computed bank storage at Lake Powell was estimated as 6,340,000 acre-feet. During September 1972, the accumulated bank storage reached 6,699,000 acre-feet, which is the largest amount of accumulated bank storage computed to date.

When computing the change in bank storage for Lake Powell in the ARRS-70 and RBB-4 studies, the Bureau considered the monthly change as 10 percent of the change in surface volume until Lake Powell was filled and 5 percent thereafter. Bureau officials explained that they had no basis for predicting what bank storage would be in the distant future, but by using Lake Mead as a basis they assumed that the percentage of annual change in bank storage will decrease over time. The percentage of bank storage to total storage at Lake Mead, since 1935, had decreased from about 20 percent to about 6 percent. The ARRS-70 and RBB-4 studies showed average bank storage for Lake Powell as 5,363,000 acre-feet and 4,932,000 acre-feet, respectively.

We discussed the reasonableness of the Bureau's assumptions on bank storage and the computed amounts of bank storage with the Natural Sciences Coordinator for the Lake Powell research project, since he is participating in the bank storage portion of the study.

The coordinator said that it was impossible to definitely predict the ultimate amount of bank storage at Lake Powell or to precisely calculate how much bank storage is now in the banks without a great deal more information. He said, however, that it was reasonable to assume that as reservoir operations stabilize the annual changes in bank storage would decrease.

He also said that his organization had found no evidence that water was escaping from the banks of Lake Powell and exiting the Colorado River basin or that bank storage was reentering the Colorado River below Glen Canyon Dam. He explained that the "Chinle formation," which is effectively impervious, underlies most of the reservoir. He further stated that the natural ground water table appears to be normal, which additionally indicates that water is not escaping from the basin.

The Natural Sciences Coordinator felt that better information would be available about the water's speed and direction as it moves through the banks after additional wells are dug in the Lake Powell area. The Bureau is to finance these wells.

Bureau officials have said that they intended to use the research project's results to refine their computations of bank storage.

Conclusion

After reviewing the Bureau's rationale and procedures for making its computations of annual evaporation and cumulative bank storage at Lake Powell and our discussion with the Natural Sciences Coordinator for the Lake Powell research project, we concluded that the Bureau's computations are reasonable and that we have no basis for questioning their validity.

POTENTIAL LOSS OF ABOUT ONE MILLION ACRE-FEET OF WATER BY UPPER BASIN STATES

The Colorado River Compact of 1922 apportioned the exclusive use of 7.5 million acre-feet of water per year to the Upper Basin. The Upper Colorado River Basin Compact, approved April 6, 1949, then apportioned this water to the States of the Upper Basin. Public Law 84-485 was then approved to make it possible for the Upper Basin States to make full beneficial consumptive use of the water apportioned to them.

However, the Bureau found that the total developable consumptive-use water in the Upper Basin is considerably less than 7.5 million acre-feet and projected total average consumptive use at about 5.8 million acre-feet annually.

To determine the annual amount of consumptive use available to the Upper Basin the Bureau made an analysis of the expected future operations of Upper Basin reservoirs when applied to the most critical water conditions experienced in the past. To make the analysis the Bureau first operated the Upper Basin reservoirs, by computer, using historical annual water supplies and projected depletions for consumptive use to determine the amount of sediment accumulation in each reservoir by the year 2030.

This sediment accumulation information was then fed into the computer along with (1) annual requirements for releases of 8.25 million acre-feet per year to the Lower Basin and to Mexico, as prescribed by the Colorado River Compact, (2) scheduled annual Upper Basin depletions at various levels, and (3) historical water supplies from 1906 to 1968.

The projected water supplies for the future years included in the study, 1970 to 2030, were equated in sequence to the water supplies actually experienced from 1930 to 1968, then 1906 to 1929. 1970 was equated to 1930 since the Bureau wanted its study to reflect the low water years experienced from 1931 to 1964. It was then assumed that the Upper Basin reservoirs were full, since the water years which preceded 1930 were very wet years and the reservoirs would probably have been filled through normal operations had they existed at that time.

All of this information was processed within the constraints of a maximum surface elevation of 3,700 feet for Lake Powell and a minimum surface elevation for all Upper Basin reservoirs which would not be below the minimum power pool of these reservoirs. The Bureau determined that annual depletions could not be allowed to draw down the reservoirs below the minimum power pool, since the powerplants would then have to be shut down.

By computing scheduled Upper Basin depletions on a "trial and error" basis it was found that the maximum annual beneficial consumptive use for the Upper Basin was about 5.8 million acre-feet of water.

After the flooding of the monument became a court issue, the Bureau ran a parallel study to determine what the maximum beneficial consumptive use would be for the Upper Basin if the Bureau had to operate Lake Powell at or below the 3,600-foot elevation. Comparison of these two studies showed that if the Bureau were required to keep the level of Lake Powell at or below the 3,600-foot elevation, the Upper Basin would lose an average of about 1.1 million acre-feet of consumptive use of Colorado River water per year. Later these studies were rerun with historical flows updated to 1972 and the maximum Lake Powell elevation limited to 3,606 feet. The comparison of the maximum consumptive use for these updated studies for all years and only the critical water years follows:

Water supply	Maximum acre-feet of consumptive use at 3,700 feet	Maximum acre-feet of consumptive use at 3,606 feet	Difference
	(000 omitted)		
All years (1906 to 1972)	5,712	4,745	967
Critical water years (1931 to 1964)	5,329	4,403	926

CONCLUSION

After reviewing the Bureau's rationale and procedures used to compute the potential effect of the court suit on Upper Basin consumptive use of Colorado River water, we concluded that we have no basis for questioning the Bureau's approach and that the approximate loss of 1 million acre-feet of water per year appears reasonable.