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Hydrologic Determination, 2007

**HYDROLOGIC DETERMINATION
2007**

**Water Availability from Navajo Reservoir and
the Upper Colorado River Basin for Use in New Mexico**

April 2007

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Date


Secretary of the Interior

I. Executive Summary

Determination as to the availability of water under long-term service contracts for uses from Navajo Reservoir involves a projection into the future of estimated water uses and water supplies. On the basis of this hydrologic investigation, water depletions by the Upper Basin states from the Upper Colorado River Basin can be reasonably allowed to rise to an annual average of 5.76 million acre-feet (maf) per year, exclusive of Colorado River Storage Project (CRSP) reservoir evaporation from Lake Powell, Flaming Gorge Reservoir, and the Aspinall Unit. This depletion level can be achieved under the same shortage criteria upon which the allowable Upper Basin yield was determined in the 1988 Hydrologic Determination.

This document determines the availability through at least 2060 of water from New Mexico's Upper Basin allocation and Navajo Reservoir to service a proposed contract for the Navajo Nation's consumptive uses in New Mexico under the Navajo-Gallup Water Supply Project in the annual amount of 20,780 acre-feet (af) and the Navajo Indian Irrigation Project (NIIP) in the amount of 270,000 af per year on average over any period of ten consecutive years. It also is likely that sufficient water will be available from Navajo Reservoir to service the proposed contract after the 2060 planning horizon, depending upon future storage, hydrologic conditions, and other factors. This determination does not guarantee that the United States will be able to deliver water under the proposed contract without shortages in deliveries, and does not obligate the United States to maintain storage facilities beyond their useful lives. The proposed contract is part of a Navajo Nation water rights settlement in the Upper Basin in New Mexico, and the settlement provides that uses made pursuant to the contract will be subject to administration in accordance with the Upper Colorado River Basin Compact and New Mexico state law. Implementation of the Navajo-Gallup Water Supply Project and the NIIP is subject to compliance with federal environmental laws including the National Environmental Policy Act and the Endangered Species Act.

II. Introduction

The State of New Mexico has proposed the Navajo-Gallup Water Supply Project to provide a renewable water supply from the San Juan River for municipal and domestic uses for Indian and non-Indian communities located within New Mexico. Uses under the project by the Jicarilla Apache Nation and the City of Gallup would be supplied through the Jicarilla Apache Nation's Navajo Reservoir water supply contract approved by Congress in 1992. Uses in New Mexico under the project by the Navajo Nation would be supplied through a proposed new Navajo Reservoir water supply contract that is a component of the San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement Agreement (hereinafter referred to as the Settlement Agreement) that the State of New Mexico and the Navajo Nation executed on April 19, 2005. The new contract also would supersede the existing Navajo Reservoir water supply contract for the NIIP.

On June 19, 2003, the Upper Colorado River Commission resolved that the States of the Upper Division consent to the Navajo-Gallup Water Supply Project, provided that water diverted by the project for use in New Mexico shall be a part of the consumptive use apportionment made to the State of New Mexico by Article III(a) of the Upper Colorado River Basin Compact. The maximum amount of consumptive use through the project by the Navajo Nation in New Mexico that would be permitted in any one year under the Settlement Agreement and the proposed contract is 20,780 acre-feet.

Public Law 87-483 at section 11(a) requires that no long-term contract, except contracts for the NIIP and the San Juan-Chama Project, shall be entered into for the delivery of water stored in Navajo Reservoir, or any other waters of the San Juan River and its tributaries to which the United States is entitled, until the Secretary of the Interior has determined by hydrologic investigation that sufficient water to fulfill such contract is reasonably likely to be available for use in the State of New Mexico under the allocations made in Articles III and XIV of the Upper Colorado River Basin Compact, has submitted such determination to Congress, and Congress has approved the contract. The last such hydrologic determination was approved by the Secretary on February 2, 1989 (Hydrologic Determination, 1988, Water Availability from Navajo Reservoir and the Upper Colorado River Basin for Use in New Mexico, hereinafter referred to as the 1988 Hydrologic Determination). The 1988 Hydrologic Determination evaluated the availability of water from the Navajo Reservoir water supply for the Jicarilla Apache Nation's Navajo Reservoir water supply contract. The State of New Mexico, by letter dated May 3, 2005, requested that the 1988 Hydrologic Determination be updated to evaluate the availability of water to service the proposed Navajo-Gallup Water Supply Project.

This hydrologic investigation is made for the purpose of contracting for water from the Navajo Reservoir water supply for the Navajo Nation's uses in New Mexico under the Navajo-Gallup Water Supply Project. The Bureau of Reclamation prepared this hydrologic investigation in consultation with the Upper Colorado River Commission because of the critical nature of this determination of the Upper Basin water supply. The Upper Colorado River Basin Compact created and defined several areas of responsibility for the Commission that directly and indirectly relate to this investigation.

III. Upper Basin Yield

A. General Upper Basin Hydrology

Based on the Bureau of Reclamation's Colorado River Simulation System (CRSS), natural flows for the period 1906-2000, the natural runoff from the Upper Colorado River Basin averages about 15.3 maf per year at Lee Ferry. Of this amount, approximately 2 maf per year originates in the San Juan River Basin above Bluff, Utah. New Mexico can only develop its Upper Basin allocation from the San Juan River and its tributaries. The Bureau of Reclamation's Colorado River System Consumptive Uses and Losses Report for 1996-2000 indicates that current consumptive uses from the San Juan River Basin

average about 382,400 af per year in New Mexico and about 192,500 af per year in Colorado. Only minor amounts of depletions are made in the San Juan River Basin in Utah and Arizona.

B. Approach

This hydrologic investigation considers and uses many of the same basic assumptions as the 1988 Hydrologic Determination. Both investigations assume use of the CRSS natural flows at Lee Ferry, minimum releases from Lake Powell of between 7.48 maf and 8.23 maf annually, an allowable overall shortage of no more than 6 percent for a critical period, either maintenance or use of the minimum power pools at CRSP units, reduced storage capacity in Lake Powell due to sedimentation, and inclusion of bank storage. The CRSS natural flows at Lee Ferry for the period 1971-1980 were increased to reflect recalculation of historic irrigation depletions in the Upper Basin using the Soil Conservation Service (SCS) modified Blaney-Criddle method with SCS effective precipitation. The revised CRSS natural flows for 1971-1980 are consistent with the CRSS natural flows at Lee Ferry determined for the remainder of the 1906-2000 period of record. Also, sedimentation in Lake Powell was adjusted to reflect a 2060 planning horizon, and a 4 percent bank storage factor was used in this investigation consistent with Reclamation's current CRSS model.

Neither the Lower Division states nor the Upper Colorado River Commission agree with the modeling assumption for the objective minimum release used in this report. At the request of the Commission, this hydrologic investigation considers for planning purposes both the objective minimum release of 8.23 maf and a minimum release from Lake Powell of 7.48 maf annually. However, this hydrologic determination does not quantify the Colorado River Compact Article III(c) requirement or make or rely on a critical compact interpretation regarding Article III(c). The 1988 Hydrologic Determination also showed the Upper Basin yields under these minimum release scenarios.

Mass balance analyses were used to analyze potential water use by the Upper Basin under 2060 conditions. The mass balance considers Upper Basin reservoir storage, natural flows at Lee Ferry, deliveries to the Lower Basin, consumptive use demands in the Upper Basin, and CRSP evaporation as a function of storage volume. All existing Upper Basin storage capacity was included in the analysis because all storage supports water use in the Upper Basin and impacts stream flows. The CRSP and non-CRSP reservoirs as groups were assumed to be the same percent full each year, and CRSP storage was assumed to be distributed between units in accordance with the average historic storage distribution. The CRSP reservoir evaporation that is used in the mass balance analyses includes evaporation from Lake Powell, Flaming Gorge Reservoir, and the Aspinall Unit that is shared among the Upper Division States, but excludes evaporation from Navajo Reservoir which is chargeable to the states based on use. Shared CRSP reservoir evaporation is modeled using a regression equation relating historic shared CRSP reservoir evaporation from Lake Powell, Flaming Gorge Reservoir, and the Aspinall Unit to the aggregate historic storage volume in these reservoirs plus Navajo Reservoir. Evaporation equations were developed for both active and live storage, and were applied

to estimate annual shared CRSP evaporation based upon yearly reservoir storage volume (surface area). The 1988 Hydrologic Determination considered variations in shared CRSP reservoir evaporation with storage for conducting statistical trace analyses to evaluate possible frequencies and magnitudes of shortages; however, it deducted a long-term average shared CRSP reservoir evaporation of 0.52 maf per year from the critical-period Upper Basin yield of at least 6.0 maf/yr to determine the amount of water available for Upper Basin uses through the critical period.

C. Results

Mass balance analyses were performed for various combinations of storage, Lower Basin deliveries, and overall shortages to evaluate the allocation of water to the Upper Basin (see mass balance analyses provided in Appendix A). The following is a summary of the results of the analyses:

<u>Storage Assumption</u>	Minimum Lower Basin Delivery (maf)	Yield without Shortages (maf)	Yield with 6% Overall Shortages (maf)
Maintain minimum power pools	8.25	5.55	5.79
	7.50	6.30	6.57
Use minimum power pools	8.25	5.72	5.98
	7.50	6.47	6.76

The yield for this analysis is defined as the amount of water available at Lee Ferry for use, on average, by the Upper Basin, exclusive of shared CRSP reservoir evaporation. Shortages in the above table are defined as 6 percent or less overall computed shortage for any period of 25 consecutive years consistent with the 1988 Hydrologic Determination. Results are shown for minimum Lower Basin deliveries of 8.25 maf and 7.50 maf as was done in the 1988 Hydrologic Determination. The analyses in this investigation should not be construed to prejudice the positions of either the Upper Colorado River Commission or the States of the Lower Division as to the interpretation or administration of Article III of the Colorado River Compact.

For those analyses that use an allowable or tolerable overall shortage of 6 percent or less of the use over any period of 25 consecutive years, the results indicate that there would be 5 years of shortage to meet all demands on the Upper Basin out of 95 years of record used in this investigation. However, the annual amounts of computed shortages for those five years would not fully materialize because Upper Basin consumptive uses will be below average under critical period hydrology due to physical water supply shortages at the sites of use in the Upper Basin. For example, the natural flow at Lee Ferry for 1977 was only 5.55 maf, and severe water supply shortages occurred throughout the Upper Basin in that year. The computations of shortage in this analysis give conservatively large estimates of annual shortages at Lee Ferry and do not fully reflect all factors,

including physical shortages in the Upper Basin that might contribute or relate to a shortage condition at any given time. The computed shortages in this investigation do not equate to administrative calls to curtail Upper Basin uses.

D. Comparison to 1988 Hydrologic Determination

The 1988 Hydrologic Determination concluded that the total Upper Basin yield, including CRSP reservoir evaporation, is at least 6.0 maf per year for the 1953-1977 critical period hydrology with a 6 percent allowable overall shortage for the period. Under the conditions assumed in the current investigation, the shared CRSP evaporation varies with CRSP storage assumptions and storage levels. Assuming an average annual Upper Basin use of 5.79 maf, an annual Lower Basin delivery of 8.25 maf, and maintenance of the power pools, the shared CRSP evaporation would range from an average of about 0.25 maf per year over the worst 25-year period of reservoir storage draw down (1953-1977) to an average of about 0.49 maf per year over the period of record used in the analysis (1906-2000). Thus, the total Upper Basin depletion, including both Upper Basin uses and CRSP reservoir evaporation, would average about 6.04 maf per year or more over any period of 25 consecutive years. The total Upper Basin depletion amount for this scenario for the 1953-1977 period is comparable to the total Upper Basin depletion of 6.0 maf per year determined to be available for the period by the 1988 Hydrologic Determination. The difference is due to the revisions made to the CRSS natural flows for 1971-1980. If the minimum power pools are used, the shared CRSP reservoir evaporation is reduced due to increased reservoir storage draw downs.

IV. Water Use Projections

A. Upper Basin

The Upper Colorado River Commission last approved depletions schedules for the Upper Division States for planning purposes in 1999. The depletions schedules, dated January 2000, project that the total Upper Basin use exclusive of shared CRSP reservoir evaporation will average about 5.37 maf per year under 2060 development conditions. Unless additional Upper Basin water development occurs by 2060 as compared to the January 2000 depletions schedules, the Upper Basin use may average less than about 5.40 maf per year from now through 2060. The time required to develop the Upper Basin allocation reduces risk of shortage within the 2060 planning horizon.

B. State of New Mexico

For use in this investigation, the New Mexico Interstate Stream Commission provided the Bureau of Reclamation with a preliminary revised schedule of anticipated depletions through 2060 from the Upper Basin in New Mexico dated May 2006 (see Appendix B). The revised depletions schedule includes irrigation depletions calculated using the SCS modified Blaney-Criddle method with SCS effective precipitation so that demands and supply for this hydrologic investigation are evaluated using consistent methodologies.

The irrigation depletions for the Navajo Nation's irrigation projects are water right depletion amounts provided by the Settlement Agreement. Both this hydrologic investigation and the 1988 Hydrologic Determination assume use of the full depletion amount for the NIIP. This is a conservative assumption because the total NIIP depletion right is not expected to be fully utilized under normal farm management practices. The revised depletions schedule does not include New Mexico's allocation of shared CRSP reservoir evaporation. The revised New Mexico depletions schedule shows a total anticipated depletion of 642,000 af per year, on average, for uses in New Mexico under 2060 development conditions. This represents an increase in New Mexico's total Upper Basin depletion, excluding shared CRSP reservoir evaporation, of 23,000 af per year, or about 0.02 maf per year, as compared to the January 2000 depletions schedules.

V. Probabilities of Calls to Curtail Upper Basin Uses

The 1988 Hydrologic Determination included a probabilistic risk analysis of administrative calls to curtail Upper Basin uses that indicated that: (1) such calls would occur rarely at an Upper Basin demand level of 6.1 maf per year, though their effects could have significant impact to the Upper Basin; and (2) the frequency and magnitude of such calls would diminish rapidly below this demand level. The risk analysis was made using the CRSS model. It is not necessary for this investigation to duplicate such a risk analysis.

The computations of shortage in this current investigation give conservatively large estimates of annual shortages at Lee Ferry and do not fully reflect all factors, including physical shortages in the Upper Basin that might contribute or relate to a shortage condition at any given time. While this investigation uses a 2060 reservoir storage sedimentation condition for Lake Powell, a risk analysis should vary the storage development and sedimentation conditions over time. In addition, it will take decades to develop the Upper Basin allocation. Therefore, risk of shortage is reduced within a 2060 planning horizon. Even using the CRSS model, computed shortages would not necessarily equate to administrative calls to curtail Upper Basin uses.

VI. Physical Availability of Water from Navajo Reservoir

The Bureau of Reclamation, using a detailed hydrologic model for the San Juan River Basin, has evaluated the physical availability of water from Navajo Reservoir and the San Juan River for the Navajo-Gallup Water Supply Project, taking into account, among other things, the habitat needs of San Juan River populations of fish species listed as endangered under the Endangered Species Act. The physical water supply analysis contained in the Biological Assessment, Navajo-Gallup Water Supply Project, dated August 16, 2005, indicates that sufficient water is likely to be available from the Navajo Reservoir water supply for the Navajo Nation's uses under the project. Although the depletions for individual uses in New Mexico that were used in the Biological Assessment differ slightly from those in New Mexico's May 2006 revised depletions

schedule, the physical water supply analysis in the Biological Assessment assumes up to about 640,500 af per year of depletion, on average, in New Mexico from the San Juan River. This amount of total average depletion in New Mexico is not significantly different than the amount of total average depletion in New Mexico shown in the May 2006 revised New Mexico depletions schedule under 2060 development conditions.

VII. Conclusions

It is concluded that based on the analysis performed by Reclamation in consultation with the Upper Colorado River Commission, the Upper Basin yield and New Mexico water allocation needed to support New Mexico's revised Upper Basin depletions schedule are reasonably likely to be available. The mass balance analyses results are sufficient to conclude that: (1) the Upper Basin yield is at least 5.76 maf per year, on average, excluding shared CRSP reservoir evaporation; (2) New Mexico's Upper Basin allocation is at least 642,400 af per year, excluding shared CRSP reservoir evaporation; and (3) the total anticipated average annual consumptive use in New Mexico from the Upper Basin, including Navajo Reservoir evaporation of 642,000 af per year as shown in the revised New Mexico depletions schedule is not likely to exceed New Mexico's Upper Basin allocation. This conclusion is reached assuming full use of the Navajo Nation's proposed depletion rights under the Settlement Agreement for both the Navajo-Gallup Water Supply Project and the NIIP.

Based upon this hydrologic investigation for a planning horizon through 2060, the May 2006 revised New Mexico depletions schedule, and the Biological Assessment for the Navajo-Gallup Water Supply Project, sufficient water is reasonably likely to be available from the Navajo Reservoir water supply through at least 2060 to fulfill the contract that is proposed by the Settlement Agreement to provide water for the Navajo Nation's uses in New Mexico under the Navajo-Gallup Water Supply Project and the NIIP. If the term of the contract extends beyond 2060, or is perpetual as proposed by the Settlement Agreement, the risk of shortages in deliveries under the contract may increase after 2060 depending upon future storage, hydrologic conditions, and other factors. Section 11(a) of Public Law 87-483 allows for contracting of water from Navajo Reservoir up to a total amount that, in the event of shortage, still results in a reasonable amount of water being available for the diversion requirements of the NIIP and the San Juan-Chama Project.

VIII. Disclaimers

A. Interstate Compacts and Federal Laws

Nothing in this report is intended to interpret the provisions of the Colorado River Compact (45 Stat. 1057), the Upper Colorado River Basin Compact (63 Stat. 31), the Water Treaty of 1944 between the United States of America and the United Mexican States (59 Stat. 1219), the decree entered by the Supreme Court of the United States in *Arizona v. California, et al.* (376 U.S. 340), the Boulder Canyon Project Act (45 Stat.

1057), the Boulder Canyon Project Adjustment Act (54 Stat. 774), the Colorado River Storage Project Act (70 Stat. 105), or the Colorado River Basin Project Act (82 Stat. 885). Implementation of the Navajo-Gallup Water Supply Project and the NIIP is subject to compliance with federal environmental laws including the National Environmental Policy Act and the Endangered Species Act.

B. Proposed Navajo Reservoir Water Contract

This determination is not to be construed as acceptance by the Department of the Interior of the terms of the Settlement Agreement, including the terms of the proposed contract. This determination also does not guarantee that the United States would be able to deliver water under the proposed contract without shortages in deliveries on account of drought or other causes outside the control of the Secretary. Nothing in this determination shall be construed to impose on the United States any obligation to maintain CRSP storage facilities, including Navajo Dam and Reservoir, or NIIP or Navajo-Gallup Water Supply Project facilities beyond their useful lives or to take extraordinary measures to keep these facilities operating.