HYDROLOGIC DETERMINATION
1988

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

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Date

Acting Secretary of the Interior

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I. Executive Summary

Determination as to the availability of water under long-term service contracts for municipal and industrial (M&I) 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 for the Upper Basin of the Colorado River can be reasonably allowed to rise to 6 million acre-feet (MAF) annually. This determination certifies the availability of 94,500 acre-feet of water annually for marketing from Navajo Reservoir. Of this amount, 3,000 acre-feet annually has been reserved for use in perpetuity by the Jicarilla Apache Tribe, 69,000 acre-feet per year, previously identified by the 1984 hydrologic investigation, is available for marketing through the year 2039, and an additional 22,500 acre-feet per year is available for marketing from Navajo Reservoir in perpetuity. This depletion level can be achieved under the same shortage criteria upon which the allowable annual depletion level of 5.8 MAF was determined in the 1984 hydrologic investigation, without significant increase in the level of risk.

To avoid a critical compact interpretation, we assume that the Upper Basin will be obligated to deliver 75 MAF of water every 10 years at Lee Ferry, plus 750,000 acre-feet annually toward Mexican Treaty deliveries. This would require an average annual water delivery at Lee Ferry of at least 8.25 MAF. It must be noted here that the Upper Colorado River Commission, comprised of representatives of the Upper Basin States, does not agree with delivery of the 750,000 acre-feet annually toward the Mexican Treaty obligation.

The change in maximum depletion levels for the Upper Basin States under the previously mentioned assumptions, and as a result of this investigation is as follows:

	Depletion Levels (Acre-feet/year)	
State	1984 Investigation	1988 Investigation
Arizona	50,000	50,000
Colorado	2,976,000	3,079,500
New Mexico	647,000	669,500
Utah	1,322,000	1,368,000
Wyoming	805,000	833,000

The Upper Basin States have previously stated disagreement with some of the assumptions in the 1984 hydrologic investigation. Therefore, it should be stated that results from this 1988 hydrologic investigation are for Bureau planning purposes only.

II. Introduction

The Act of June 13, 1962 (76 Stat. 96, Public Law 87-483), authorizing the Navajo Indian Irrigation Project and the San Juan-Chama Project, provides in Section 11 that the Secretary of Interior shall not enter into long-term contracts for the delivery of water from Navajo Reservoir until he has made certain hydrologic determinations as to water availability, has submitted such determinations to the Congress, and the Congress has approved such contracts. The act also authorized the Secretary to market water from Navajo Reservoir for other municipal and industrial uses in New Mexico if he determines on the basis of hydrologic investigation that such water is reasonably likely to be available.

By November 1967, the first determination which made 100,000 acre-feet of water available for marketing was submitted to the Congress, and on March 22, 1968, Senate Joint Resolution 123 (Public Law 90-272) was adopted, approving three long-term contracts with a total estimated annual depletion of 51,550 acre-feet. However, by the early 1980's it became impractical to sell water to meet long-term demands from the Navajo Reservoir supply under the Secretary of the Interior's 1963 determination. Under that determination, any contracts must terminate in the year 2005, which did not allow enough time for potential contractors to develop a project and recover investments.

In December 1984, the Secretary of Interior signed an updated hydrologic determination for the Upper Colorado River Basin by the Bureau of Reclamation (Reclamation). A principal conclusion of the 1984 determination was the estimation that there was enough runoff in the Upper Basin to support a depletion level of at least 5.8 million acre-feet (MAF). This determination also certified the availability of 69,000 acre-feet per year of water for marketing from Navajo Reservoir through the year 2039. Although there was some indication, dependent upon assumptions and study conditions, that utilization of the Colorado River Simulation System (CRSS) might have resulted in somewhat greater yield estimations for the Upper

Basin, consensus on the appropriate procedure for employing the CRSS model limited further investigation into this possibility at that time.

On July 10, 1985, the Secretary of the New Mexico Interstate Stream Commission formally requested that Reclamation continue to pursue a review based on the CRSS of water availability in the Upper Colorado River Basin with the focus toward a re-determination of the water supply available for use in New Mexico. This investigation is a result of that request and will further examine the use of the CRSS data base for Upper Basin yield estimations.

III. Hydrologic Investigation

The Department of Interior's past position on water availability in the Upper Basin assumed that up to 5.8 MAF of water could be safely depleted annually in the Upper Basin. This number was derived from an annual virgin flow data base and developed with three assumptions: (1) the lowest 34-year period of natural runoff; (2) assigned tolerable shortages to irrigated agriculture; and (3) delivery of half the Mexican Treaty commitment from the Upper Basin.

Throughout the hydrologic investigation, and as demonstrated in the attached tables, present Colorado River Storage Project (CRSP) operating policy, along with required Upper Basin water deliveries, combine to form the underlying assumptions that are integral to a hydrologic determination of water availability from Navajo Reservoir and the Upper Colorado River Basin for use in New Mexico. To determine required water deliveries for the Upper Basin, the then current depletion projections were employed by the Bureau in a "demand data base" for the 1984 hydrologic investigation. This depletion schedule for the Colorado River System is periodically updated and the current version can be found in the Bureau publication, Quality of Water - Colorado River Basin Progress Report No.13 - January 1987. The report updates depletion projections for the river system through year 2010. These projections were then extended through year 2040 to serve in the demand data base for this 1988 investigation and can be found in Appendix I of the report.

The extended depletion schedule is based on the hypothesis that the Upper Basin level of depletions will reach 5.8 MAF in the year 2040. The examination of the effects of demands exceeding 5.8 MAF was accomplished by simply increasing the depletions in the year 2040, with no attempt to prorate the increased amount back over several years or decades. For relatively large increases, such as from 5.8 MAF to 6.3 MAF, the increase was distributed throughout the Upper Basin and among the States by their approximate percentage share of Colorado River water. For small increases, such as from 5.8 MAF to 5.87 MAF, the increase was lumped at one demand point near the bottom of the system.

As to water use in the Upper Basin, subsection (b) of Article III of the Upper Colorado River Basin Compact permits New Mexico or any other Upper Basin State to use waters in excess of its percentage allotment, provided such excess use does not prohibit any of the remaining States from utilizing its respective allotment. This excess of allotted use for New Mexico is demonstrated in Appendix I as projected negative values by year 2000. Thus the availability of Navajo Reservoir water for municipal and industrial purposes in New Mexico beyond the year 2005 depends upon the extent of water use in the entire Upper Basin beyond year 2005 as well as upon the physical availability of water in Navajo Reservoir.

A. Study Approach and Results

1. Hydrology

The basis for the current hydrologic determination is the hydrology data base used for the CRSS. This data base consists of computed monthly natural flows at key points throughout the Colorado River Basin and is complete from 1906-1980. The data have been extended to include the years 1981-1986. The years 1981, 1982, and 1983 were estimated utilizing recorded flows and reservoir operations in so far as possible, with estimated consumptive use. The years 1984, 1985, and 1986 were estimated using estimated consumptive use and basin runoff values in conjunction with stochastically generated flows which were disaggregated throughout the Upper Basin. The hydrology data base is currently scheduled to be updated through 1985 and the provisional data thus eliminated. Updates to the hydrology data base are planned every five years following publication of the Colorado River System Consumptive Uses and Losses Report. The report is prepared every five years pursuant to the Colorado River Basin Project Act of 1968, (P.L. 90-537).

Use of the CRSS hydrology data base with system storage results in a critical drawdown period of 25 years beginning in 1953. This is contrasted to the virgin flow data base used in previous hydrologic determinations which produced a critical period of 34 years beginning in 1931. The virgin flow data base was limited to annual flow values at Lee Ferry. The basis of computing virgin flow was changed several times during the period of record and for this reason, it is felt that the CRSS hydrology is more consistent.

2. Use of The Colorado River Simulation System (CRSS)

The CRSS model was used to determine available system storage and was not directly used to determine basin yield. However the hydrologic data from the model were used for this purpose. The model provided an 81 year sequence of hydrologic data based on historic records from 1906 to 1986. These data were then used to create 81 possible hydrologic cycles for the period from 1986 to 2066. Each of the 81 years functioned as the starting point for a sequence with the preceding years added to the end of the cycle. The same data were used in this investigation as were employed in verification runs for the 1984 hydrologic investigation. However using the data in this way generated 81 possible permutations of the projected hydrology to the year 2066 upon which current demands could be superimposed, (for a more complete explanation see Appendix II). When demands were superimposed on these series of hydrologic projections, a critical storage value of 24.762 MAF was derived for use in the mass balance analysis.

3. Mass Balance Analysis

The yield of the basin above Lee Ferry was determined from a simple mass balance procedure. Although the method was computerized, the basic equation was the following:

$$\text{Yield} = \frac{\frac{[Q + S(1+B)]}{n} - Rm}{1-s}$$

where Q = streamflow for the critical period
S = surface storage available
B = bank storage coefficient
Rm = minimum release to the Lower Basin
s = percent basin-wide shortage
n = number of years in the critical period.

The CRSS model, as explained above and in Appendix II, was used to determine the quantity S(1+B) for use in the mass balance analysis. Although the CRSS model could have been used to determine yield, it is an unwieldy tool for shortage and probability analyses and would have required considerable trial and error work at considerable expense.

The values input to the mass balance program are the annual natural flows at Lees Ferry for 1906-1986 (see Hydrology section, above), the amount of storage available, bank storage coefficient, percent shortage and minimum release. The program provides output values for yield, defines the critical period and computes the probability of meeting various demands higher than the firm yield, given the input constraints.

The critical period is determined by examining all possible average flows and their associated period up to 50 years, over the period of record, in conjunction with the input storage value.

The storage value of 24.762 MAF determined from the CRSS data was based on a monthly operation. Since the mass balance procedure uses only annual data, it was necessary to make an adjustment to the storage value for use with the mass balance program. Adjustments were made for both the differences in the amount of streamflow over 25 years and seven months compared to 25 years of annual streamflow as well as the difference in the amount of storage used in the monthly study as opposed to that which would be used in just 25 years. Both of these adjustments were then applied to the storage value used in the mass balance program. The adjustments were as follows:

Storage Adjustment

a) 25 year 7 month storage = 24.762 MAF

b) Adjusted amount for 25 years = 24.762 x 25/25.5833 = 24.197 MAF

Streamflow Adjustment

a) 25 year critical period average streamflow = 12.97 MAF

b) 25 year 7 month critical period average streamflow = 12.81 MAF

difference = 0.16

for 25 years: 0.16 x 25 = 4.00

Total Adjustment

24.197 - 4.00 = 20.197 MAF of "adjusted" storage.

The adjusted storage includes the effects of sedimentation and bank storage. Use of this value along with the annual natural flow record at Lees Ferry and a minimum delivery to the Lower Basin from Lake Powell of 8.25 MAF produced a firm yield for the Upper Basin of 5.55 MAF. The yield varied from 5.55 MAF with no shortages to the Upper Basin to 6.03 MAF with an eight percent overall shortage as shown in Table 1.

The liklihood and magnitude of other shortages or "calls on the river" are discussed in Section 5.

4. Probability Analysis

In addition to calculating the firm yield of the Upper Basin, the mass balance model also calculated the probabilities of various higher yields for given levels of shortages. These probabilities are simple plotting positions or percent frequency and were determined by dividing the number of times an interval of critical period length produced at least the specified yield, divided by the total number of times an interval of critical period length could occur in the total record (from 1906 to 1986). The results are tabulated in Table 1 which also indicates the length of the critical period associated with each probability. These data were used to prepare the curves of Figure 1 which indicate the yield available from the system for a desired probability and a given shortage. Since the data are limited it should be understood that these curves are only approximate and give only an indication as to the probabilities involved.

TABLE 1

Relationships Between
Yield - Probability - Shortage

Shortage (Percent)	Firm Yield (MAF)	Percent Probability of Greater Yield					
		5.8	5.9	6.0	6.1	6.2	6.3
0	5.55 (25)1/	93.94 (49)	87.50 (50)	80.85 (35)	73.81 (40)	65.85 (41)	55.26 (44)
2	5.66 (25)	98.08 (30)	93.94 (49)	87.50 (50)	80.85 (35)	73.91 (36)	65.85 (41)
4	5.78 (25)	98.25 (25)	98.11 (29)	96.23 (29)	90.63 (50)	84.38 (50)	76.09 (36)
6	5.90 (25)			98.11 (29)	96.49 (25)	90.91 (49)	84.85 (49)
8	6.03 (25)				98.11 (29)	96.49 (25)	93.94 (49)

1/ Figures in parentheses indicate the associated critical period length in years.

5. Calls on the River - Site Specific Shortage Analysis

A "call on the river" occurs when the Upper Division is unable to make the required delivery to the Lower Division from Upper Basin storage and must curtail its own uses to meet the delivery from river flows. An analysis of calls was made using the CRSS model. A nominal demand level of 6.1 MAF was used with the 81 hydrologic sequences to analyze the effects and frequency of calls. The hydrologic record was wrapped around so that each sequence was extended to the year 2040 when Upper Basin demands are expected to reach maximum. The CRSS model does not model the call situation but rathe it indicates the quantity of the call by the amount it shorts the Lower Basin delivery. Appendix III shows the results of the analysis. Using these data, a frequency analysis was made which demonstrates both severity and frequency of a call on the river at a demand level of 6.1 MAF.

The results indicate that the frequency of a call of 100,000 acre feet or less is about 0.75 percent while that of a call over 2 MAF is less than 0. percent. This is shown on an incremental basis in Figure 2 and on a cumulative basis in Figure 3. A general conclusion of this analysis is that calls on the river are likely to occur only very rarely even at a 6.1 MAF demand level, but their effects could have significant impact to the Upper Basin and their magnitude could range to over 100 percent of Upper Basin depletion. Cursory examination of demands less than 6.1 MAF indicates that both frequency and magnitude of calls on the river diminish rapidly below this demand level.

6. Other Considerations - Changes in Assumptions

To obtain a wider range of yield analysis results, various changes in basi assumptions were made and the corresponding results arrayed with previous work. In particular, the use of inactive storage pools and a change in minimum delivery to the Lower Basin were examined in regards to the effects on Upper Basin yield. In the mass balance analysis discussed above, the total amount of system storage used during the drawdown period as determined from the use of CRSS was 24.762 MAF. There remained in inactive storage and minimum power pools another 3.012 MAF. If it is assumed that this entire amount is available for use and that the length of the drawdown period would be the same as previously determined, the amount of storage adjusted for use in a mass balance analysis using annual data would be:

$$[(24.762 + 3.012)\text{x}25/25.5833] - 4.00 = 23.141 \text{ MAF.}$$

Utilizing this value in the mass balance procedure along with a minimum release of 8.23 MAF at Glen Canyon produces a firm yield (no shortages) of 5.67 MAF for the Upper Basin. The results of additional analysis which relate yield to basin wide shortages and the probability of meeting a yield given a particular shortage are shown in Figure 4. Because the data are somewhat limited, it should be understood that these curves are only approximate and only give an indication as to the probabilities involved.

Additional analyses were made at the request of the Upper Basin States with minimum releases set at 7.5 MAF annually. The difference between releases can be translated directly into increased yield to the Upper Basin. Mass balance analyses similar to those described above were made using both 20.197 MAF of storage ("empty" at top of inactive pools) and 23.141 MAF ("empty" at bottom of inactive pools). The firm yields for the basin (no shortages) were calculated at 6.28 MAF and 6.40 MAF respectively. Figures 5 and 6 show the relationships between yield, shortages and probabilities. As indicated in the earlier examples, these should be considered approximate relationships.

B. Conclusions and Recommendations

Table 2 shows a summary of the results of this investigation.

TABLE 2

Summary Results

Study	Hydrology	Storage (MAF)	Min. Release (MAF)	Yield: Without Shortages (MAF)	Yield: With Tolerable Shortages 1/ (MAF)
1967 Study	Virgin Flow	26.232	8.25	5.45	5.80
Current Studies					
Maintain					
Min. Pools	CRSS Nat'l	20.197	8.23	5.55	6.00
	CRSS Nat'l	20.197	7.5	6.28	6.77
Use					
Min. Pools	CRSS Nat'l	23.141	8.23	5.67	6.09
	CRSS Nat'l	23.141	7.50	6.40	6.88

1/ Yield has approximately a 98.5% probability of being sustained with about a 6% shortage.

Use of the CRSS hydrology data base and system storage availability as determined from the use of CRSS indicate that the Upper Basin firm yield, without acceptable shortages, is about 100,000 acre-feet greater than was previously thought, based on other similar assumptions. At the previous estimate of firm yield at 5.45 MAF, the application of risk and shortage criteria resulted in a reasonable depletion level of 5.8 MAF. Applying similar risk and shortage criteria to the present hydrologic determination as those applied to earlier determinations, the increase of Upper Basin firm yield to 5.55 MAF will result in a reasonable depletion level of 6.0 MAF. This has been discussed with the Basin States and the magnitude and consequences of such risk and shortages are understood. Therefore, based on an allowable over-all basin shortage of six percent and a probability of meeting the demands about 98.5 percent of the time (see Figure 1), it is recommended that the Secretary certify that 6.0 million acre feet is reasonably available in the Upper Basin for beneficial consumptive use. This figure takes into account the above risk and shortage criteria as well as provides for a minimum operational release of 8.23 MAF at Lees Ferry.

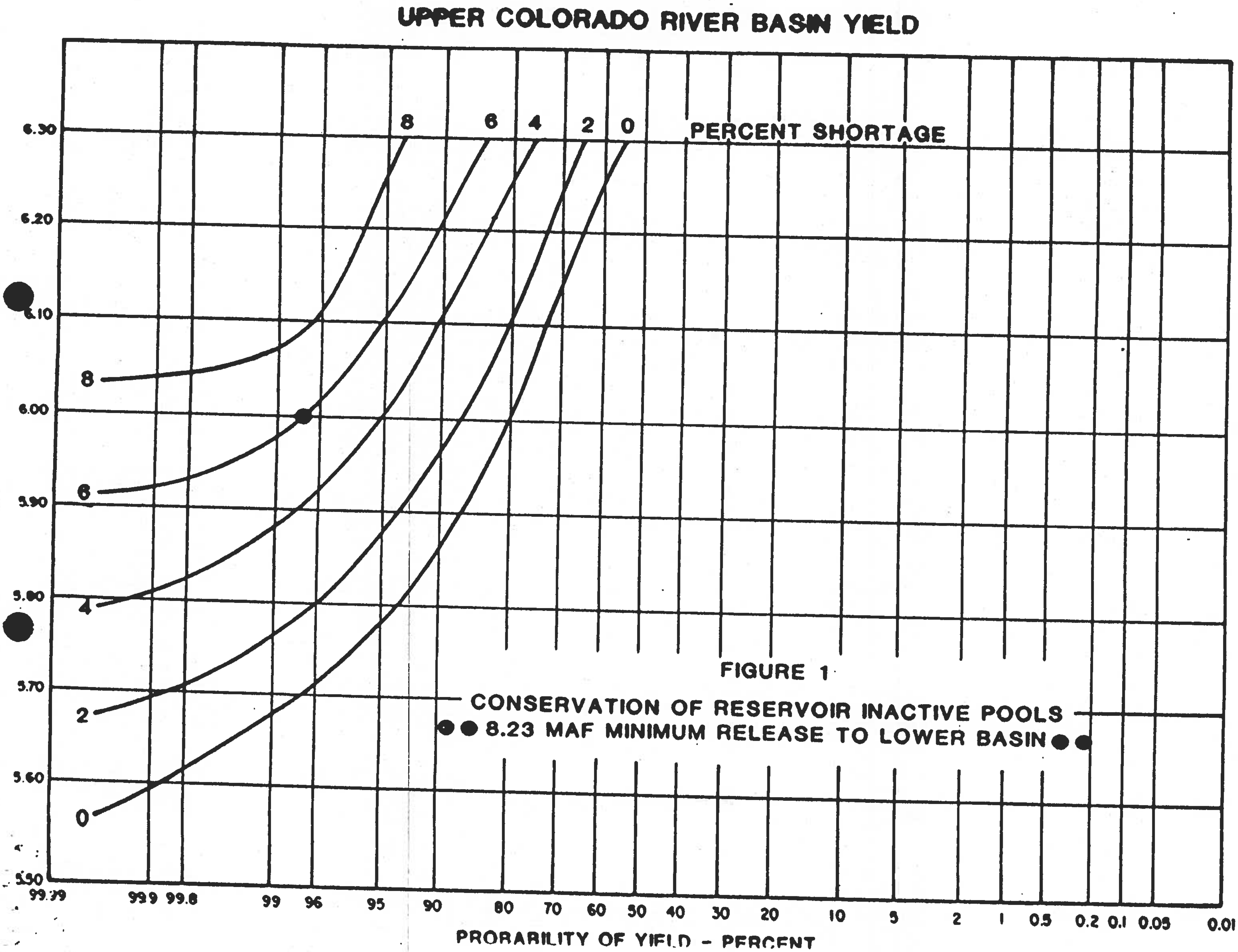


FIGURE 1
CONSERVATION OF RESERVOIR INACTIVE POOLS
8.23 MAF MINIMUM RELEASE TO LOWER BASIN

Figure 2

FREQUENCY OF CALLS – COLORADO RIVER
Call Range in 1000 AF

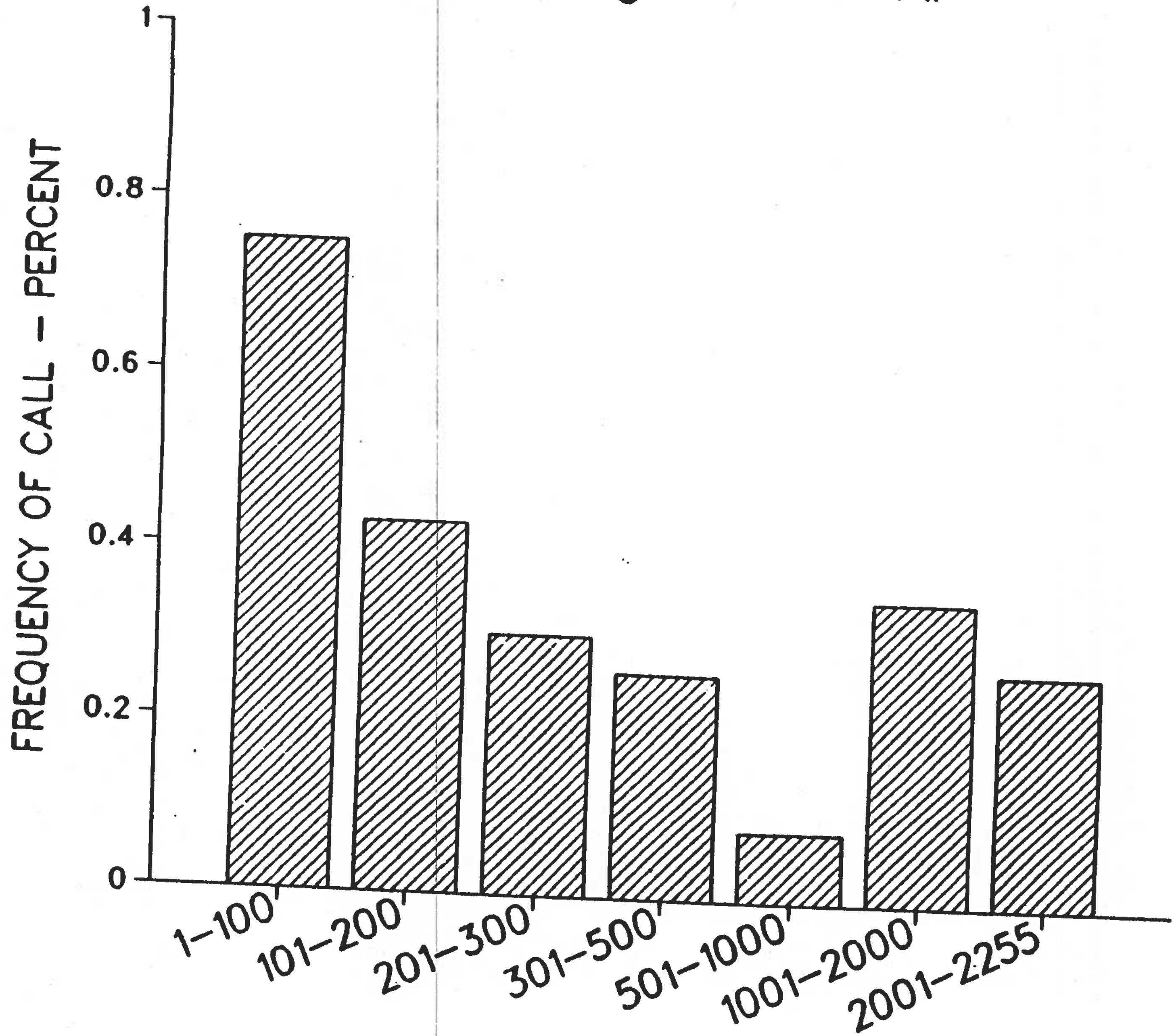
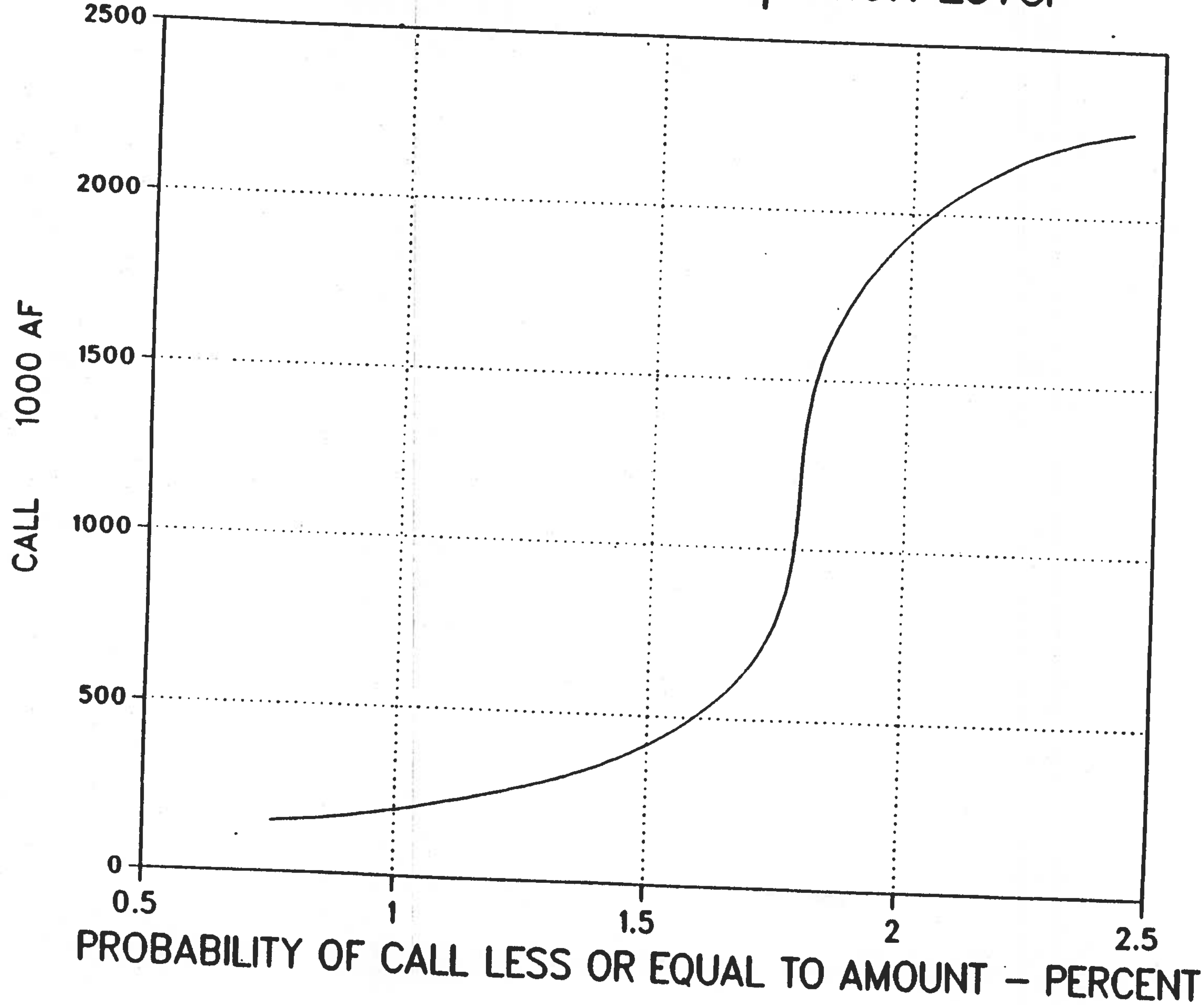


Figure 3

CALL ANALYSIS – COLORADO RIVER
6.1 MAF Nominal Depletion Level



81 YEAR, 81–TRACE ANALYSIS

UPPER COLORADO RIVER BASIN YIELD

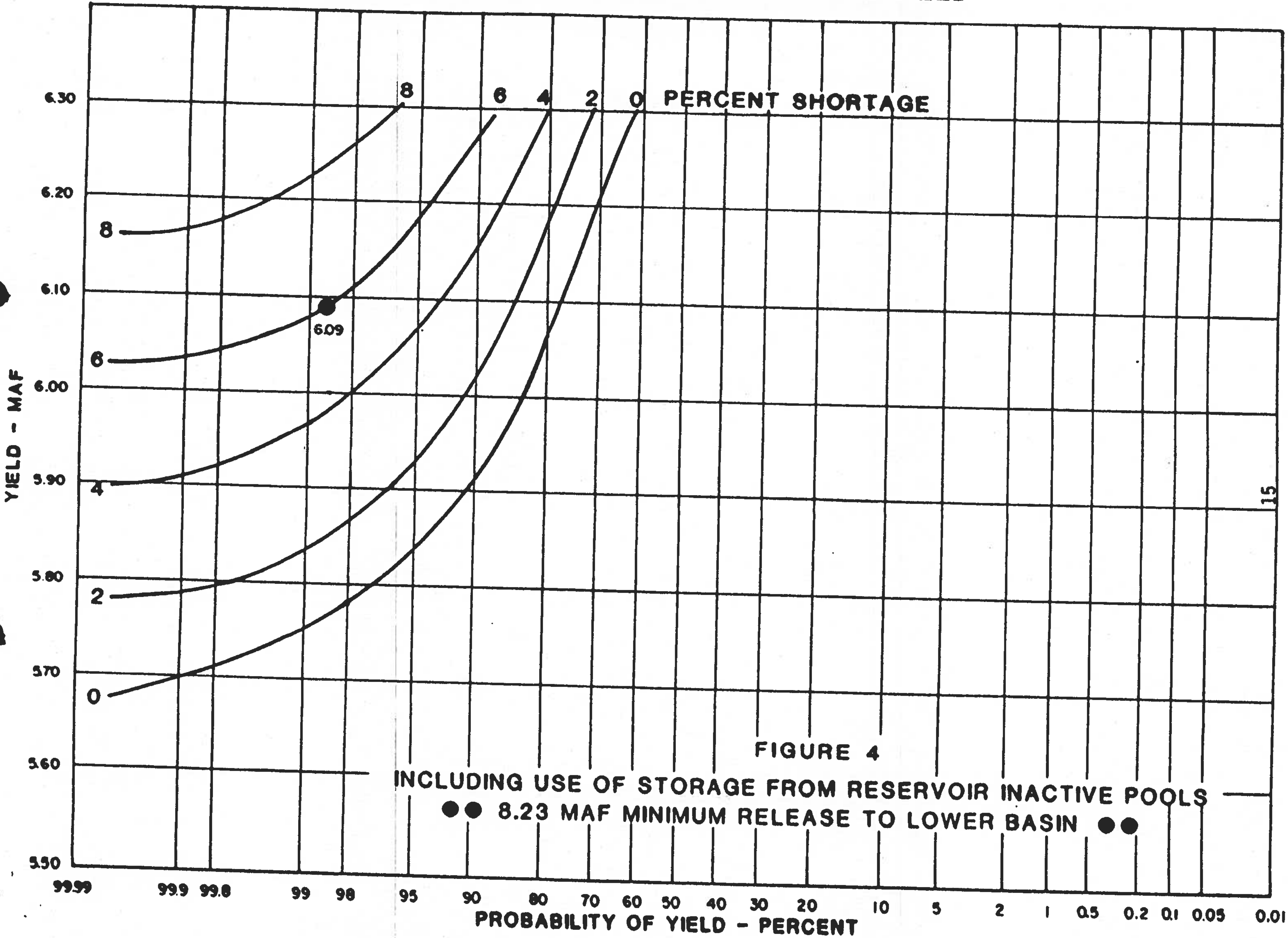


FIGURE 4

INCLUDING USE OF STORAGE FROM RESERVOIR INACTIVE POOLS

●● 8.23 MAF MINIMUM RELEASE TO LOWER BASIN ●●

UPPER COLORADO RIVER BASIN YIELD

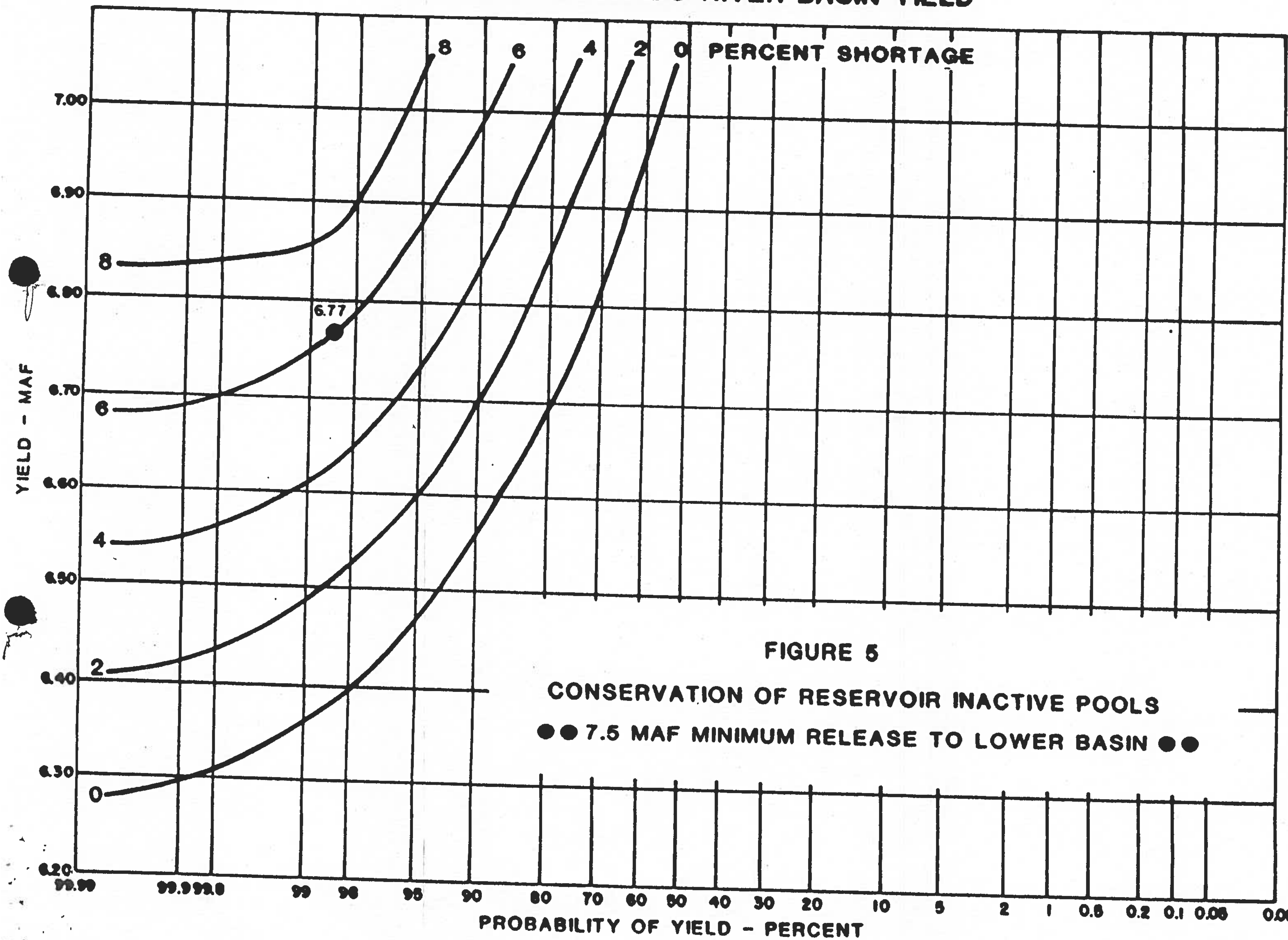


FIGURE 5

CONSERVATION OF RESERVOIR INACTIVE POOLS

●● 7.5 MAF MINIMUM RELEASE TO LOWER BASIN ●●

UPPER COLORADO RIVER BASIN YIELD

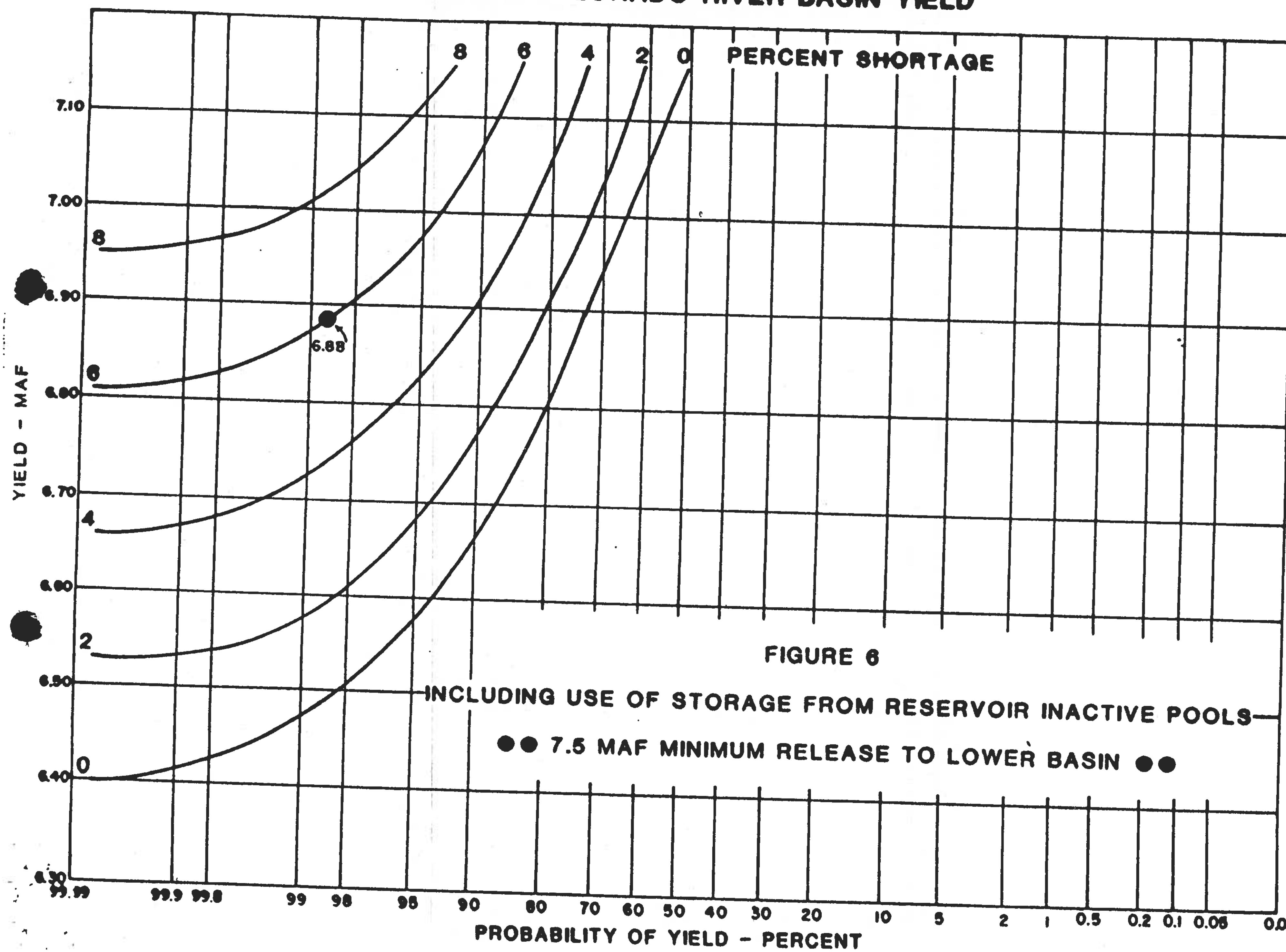


FIGURE 6

INCLUDING USE OF STORAGE FROM RESERVOIR INACTIVE POOLS

●● 7.5 MAF MINIMUM RELEASE TO LOWER BASIN ●●

IV. Current Water Service at Navajo Reservoir

The 1984 hydrologic investigation identified an annual 69,000 acre-feet of water available for water service contracts until the year 2040. Table 3 is a list of water service contracts which are currently in effect for Navajo Reservoir:

TABLE 3

Navajo Reservoir Water Service Contracts

Contractor	Expiration Date	Annual Depletion or Diversion (Acre-feet)
Public Service Co. of New Mexico	2005	16,200 depletion 20,200 diversion
Utah International Inc.	2022	35,300 depletion 44,000 diversion
Farmington Elks Lodge 1/	1989	20
Sunterra Gas Processing Co. 2/	2005	50
Long-term subtotal	=	51,570
San Juan Basin Water Haulers Association	1988	500
Bloomfield Refining Co.	1988	340
Amoco Production Co.	1990	200
Earl Hickman	1988	150
Douglas Lee	1990	80
Bloomfield Water & Sanitation	1988	40
Burnett Construction	1988	40
Meridian Oil	1990	50
Nielson Inc.	1987	9
Short-term subtotal	=	1,409

1/ Long-term contract is currently under negotiation.

2/ Formerly known as Southern Union Gas Company, an amendatory contract to extend the expiration date is currently under negotiation.

V. Additional Requests for Water from Navajo Reservoir

Long-term water service contracts for municipal and industrial uses from Navajo Reservoir involve a projection into the future of estimated water uses and water supplies. The Bureau projection of water supply and depletions from the Navajo Reservoir through the year 2039 is formulated with the consultation of the State of New Mexico. The remaining block of Navajo Reservoir water supply, as identified in the 1984 determination, will still be marketed by the United States and will still be allocated in consultation with the New Mexico Interstate Stream Commission. New individual long-term water service contracts would also need the approval of the Congress.

With an increase in the consumptive use of the Upper Basin to 6.0 MAF, the proportionate share for the State of New Mexico of that increase will be 22,500 acre-feet per year of depletion. The following is a list of additional water service requests submitted to the Bureau of Reclamation for Navajo Reservoir water when it becomes available.

TABLE 4

Additional Requests for Navajo Reservoir Water Service and/or Contract Extensions

Request	Amount (Acre-feet) 1/	Contract Length
Jicarilla Apache Tribe	40,000	perpetuity
Gallup-Navajo Project	24,000	until 2039
Paragon Resources	17,000	40 years
Public Service Company of New Mexico	16,200	until 2025
Bloomfield Refining	340	until 2025
Southern Union Refining Co.	50	40 years
Farmington Elks Lodge	20	40 years

1/ Diversion or depletion not specified.

VI. Determination

Recognizing the status of water use in the Upper Colorado River Basin, the physical availability, and institutional constraints, it is determined through hydrologic investigation that sufficient water is reasonably likely to be available under the provision of Section 11(a) of Public Law 87-483, to fulfill contracts that involve additional Navajo Reservoir water depletions up to 94,500 acre-feet annually. Of this amount, 3,000 acre-feet annually has been reserved for use in perpetuity by the Jicarilla Apache Tribe, 69,000 acre-feet annually is available for marketing through the year 2039, and an additional 22,500 acre-feet of water annually is reasonably likely to be available for depletion from Navajo Reservoir in perpetuity.

Extensive hydrologic data analyses, present Colorado River Storage Project operating policies, and required and projected Upper Basin water deliveries, support the Upper Basin depletion limit of 6.0 MAF. This 6.0 MAF yield from the Upper Colorado River Basin is recognized by the Bureau and the Department as an estimate which takes into account risk and shortage criteria as well as providing for the minimum operational release of 8.23 MAF at Lees Ferry. The 6.0 MAF figure is an estimate to be used for planning purposes only and is not intended to be an interpretation of the Upper Basin entitlement according to the provisions of the Colorado River Compacts and other law of the river.

Therefore, we conclude that the projection of water uses now envisioned in the Upper Basin by year 2040 can reach a 6.0 MAF depletion level without impairment of the Upper Basin's ability to meet its water delivery obligation to the Lower Basin and the Republic of Mexico.

APPENDIX I

This appendix summarizes the extension of project depletions published by the Department of the Interior in the Quality of Water - Colorado River Basin Progress Report No. 13 - January 1987. The projections for the year 1985 through 2010 which appear in the report, represent the best estimate by the Bureau of Reclamation of how water use will be developed over the next 25 years. The projections were made after consultation with individual States within the Colorado River Basin; however, the States do not necessarily concur, but do not object, with the projections adopted by the Bureau for planning purposes. The projections after 2010 were developed in order to extend depletion levels to their previously assumed maximums at year 2040. The state shares of the Upper Basin yield and the remaining water available after use have been adjusted to reflect the revised 6.0 MAF total yield. Upon the approval of this hydrologic determination, the consumptive use projections will be updated accordingly

June 1987

Bureau of Reclamation
Upper Colorado Region
Projected Water Supply and Depletions
Upper Colorado River Basin

Present and Projected Depletions (Unit--1,000 acre-feet/year)

Upper Basin projects	1985	1990	2000	2010	2020	2030	2040
Arizona							
Comprehensive Framework Study	10	10	10	10	10	10	10
Miscellaneous additional depletions							
Irrigation	6	6	6	6	6	6	6
Municipal and domestic	6	8	10	12	12	12	12
Navajo Powerplant	22	22	22	22	22	22	22
Gallup-Navajo Indian Water Supply Project (temporary)	0	(5)	(7)	(7)	(7)	(7)	(7)
Total depletions	44	46	48	50	50	50	50
Compact Apportionment	50	50	50	50	50	50	50
Remaining Water Available	6	4	2	0	0	0	0

Upper Basin projects	1985	1990	2000	2010	2020	2030	2040
Wyoming							
Comprehensive Framework Study	282	282	282	282	282	282	282
Miscellaneous additional depletions							
Irrigation and livestock	6	8	26	32	41	45	47
Municipal	6	8	11	13	14	17	20
Reclamation projects							
Seedskadee	6	17	20	20	20	20	20
Lyman	10	10	10	10	10	10	10
Savery-Pot Hook	0	0	0	0	0	0	11
La Barge	0	0	0	0	0	0	4
Transmountain diversions	11	19	39	50	50	50	50
Industrial uses							
Thermal electric	29	41	51	71	71	71	71
Mineral	30	40	56	62	62	63	65
Coal gasification	0	0	19	50	52	70	88
Oil shale	0	0	4	10	24	40	58
Proposed reservoir evaporation	0	0	6	6	6	6	6
Total depletions	380	425	524	606	632	674	732
Evaporation, storage units	73	73	73	73	73	73	73
Total	453	498	597	679	705	747	805
State Share of 6.0 Million Acre-Foot Yield	833	833	833	833	833	833	833
Remaining Water Available	380	335	236	154	128	86	28

Upper Basin projects	1985	1990	2000	2010	2020	2030	2040
	Present and Projected Depletions (Unit--1,000 acre-feet/year)						
Colorado							
Comprehensive Framework Study	1,707	1,707	1,707	1,707	1,707	1,707	1,707
Misc. additional depletions							
Irrigation	24	24	24	24	24	24	24
Municipal and industrial	5	6	7	10	11	12	13
Fish and wildlife	1	1	1	1	1	1	1
Minerals	1	1	1	1	1	1	1
Exports							
Denver Expansion	48	70	100	130	160	180	200
Homestake Expansion	28	28	48	48	48	48	48
Independence Pass Expansion	7	7	7	7	7	7	7
Pueblo Expansion	3	3	3	3	3	3	3
Colorado Springs Expansion	0	0	5	5	5	5	5
Englewood	10	10	10	10	10	10	10
Fryingpan-Arkansas	69	69	69	69	69	69	69
Windy Gap	2	54	54	54	54	54	54
Reclamation projects							
Animas-La Plata	0	0	20	121	121	121	121
Bostwick Park	4	4	4	4	4	4	4
Dallas Creek	0	9	10	17	17	17	17
Dolores	7	36	80	81	81	81	81
Fruitland Mesa	0	0	0	0	0	0	21
San Miguel	0	0	0	0	0	0	25
Savery-Pot Hook	0	0	0	0	0	0	12
Upper Gunnison River Basin	1	5	10	15	20	25	35
West Divide	0	0	0	0	0	0	38
Municipal, Industrial, and Domestic							
Taylor Draw Reservoir	2	2	4	7	7	7	7
Stagecoach Project	0	2	4	4	4	4	4
Ruedi contracts	0	0	0	16	49	49	49
Blue Mesa contracts	0	5	10	10	10	10	10
Oil shale	0	0	2	8	25	34	43
Rock Creek	0	15	15	15	15	15	15
Bluestone	0	4	4	4	4	4	4
Green Mountain	0	2	2	2	2	2	2
Thermal-electric powerplants							
Craig-Hayden	17	18	18	18	18	18	18
Colorado Ute-Southwest Project	0	0	5	5	9	9	9
Unidentified	0	0	0	0	0	0	50
Total depletions	1,936	2,082	2,224	2,396	2,486	2,521	2,707
Evaporation, storage units	269	269	269	269	269	269	269
Total	2,205	2,351	2,493	2,665	2,755	2,790	2,976
State Share of 6.0 Million Acre-foot Yield	3,079.5	3,079.5	3,079.5	3,079.5	3,079.5	3,079.5	3,079.5
Remaining Water Available	874.5	728.5	586.5	414.5	324.5	289.5	103.5

Upper Basin projects	Present and Projected Depletions 1985	1990	2000	2010	2020	2030	2040 (Unit--1,000 acre-feet/year)
New Mexico							
Adjusted Comprehensive Framework Study 1/	89	89	89	89	89	89	78
Misc. additional depletions	12	12	12	12	12	12	12
Reclamation projects							
Navajo Reservoir evaporation	26	26	26	26	26	26	26
Animas-La Plata	0	0	10	34	34	34	34
San Juan-Chama	110	110	110	110	110	110	110
Navajo Indian irrigation 2/	132	134	267	267	267	267	267
Hammond	10	10	10	10	10	10	10
Hogback Extension	7	10	10	10	10	10	10
Jicarilla Apache 3/	0	3	3	3	3	3	3
Utah International, Inc. (private right)	27	39	39	39	39	39	39
Navajo Reservoir contracts (temporary)							
Public Service Company of New Mexico	16	16	16	0	0	0	0
Utah International, Inc.	0	35	35	35	35	35	0
Gallup-Navajo India Water Supply Project	0	10	14	18	24	24	0
Not identified	0	10	10	10	10	10	0
Total depletions	429	504	651	663	669	669	589
Evaporation, storage units	58	58	58	58	58	58	58
Total	487	562	709	721	727	727	647
State Share of 6.0 Million Acre-foot Yield	669.5	669.5	669.5	669.5	669.5	669.5	669.5
Remaining Water Available	182.5	107.5	-39.5	-51.5	-57.5	-57.5	22.5

1/ Assumes the buy-out of 11,000 acre-feet of private rights.

2/ The ultimate depletion level of 267,000 acre-feet is an estimated figure derived from a 1980 Solicitor's opinion based solely on the project's productive acreage. The 267,000 acre-foot figure is yet to be evaluated for technical accuracy.

3/ This figure may be increased subject to ongoing Indian water rights settlement.

Present and Projected Depletions (Unit--1,000 acre-feet/year)

Upper Basin projects	1985	1990	2000	2010	2020	2030	2040
Utah							
Comprehensive Framework Study	664	664	664	664	664	664	664
Miscellaneous additional depletions							
Irrigation and stock	1	1	1	1	1	1	1
Municipal	2	3	5	7	9	11	13
Minerals	1	1	1	1	1	1	1
Reclamation projects							
Central Utah Project							
Bonneville Unit	53	136	166	166	166	166	166
Upalco Unit	0	0	12	12	12	12	12
Jensen Unit	3	15	15	15	15	15	15
Uintah Unit	0	0	28	28	28	28	28
Emery County	10	10	10	10	9	9	9
Ute Indian lands	4	4	84	84	84	84	84
Division of Water Resources projects	15	16	20	24	28	32	36
Thermal electric powerplants							
Emery County	30	30	30	30	36	36	36
Conversion of irrigation to power	-9	-9	-9	-9	-10	-10	-10
Other Utah Power & Light Company plants	0	0	2	6	24	30	36
Deseret Generation Co-op	0	6	12	12	12	12	12
Municipal and industrial							
White River Dam	0	0	0	6	6	6	6
Oil shale	0	0	1	20	40	45	51
Tar sands	0	0	6	18	42	42	42
Total depletions	774	877	1,048	1,095	1,167	1,184	1,202
Evaporation, storage units	120	120	120	120	120	120	120
Total	894	997	1,168	1,215	1,287	1,304	1,322
State Share of 6.0 Million Acre-foot Yield	1,368	1,368	1,368	1,368	1,368	1,368	1,368
Remaining Water Available	474	371	200	153	81	64	46
Upper Colorado River Basin totals							
Total depletions	3,563	3,934	4,495	4,810	5,004	5,098	5,280
Evaporation, storage units	520	520	520	520	520	520	520
Total	4,083	4,454	5,015	5,330	5,524	5,618	5,800

DISCLAIMER

The Upper Colorado River Basin Compact provides that the States of Arizon Colorado, New Mexico, Utah, and Wyoming will share in the consumptive use of water available in the Upper basin in the following constant and proportions:

Arizona	50,000 acre-feet
Colorado	51.75 percent of the remainder
New Mexico	11.25 percent of the remainder
Utah	23.00 percent of the remainder
Wyoming	14.00 percent of the remainder

To be conservative in making its estimate of water supply and depletions i the Upper Basin, the Department of Interior has assumed that the riverflow will be 75 MAF every 10 years at Lee Ferry, plus 750,000 acre-feet annuall for Mexican Treaty deliveries. This would require an average annual water delivery at Lee Ferry of 8.25 MAF. Using this assumption, the Department of the Interior estimates that the long-term dependable yield of water available in the Upper Basin for consumptive use by man is 6.0 MAF per year. this assumption is not to be considered an interpretation of the obligation of the Upper Basin States for water delivery at Lee Ferry under the Colorado River Compact, nor is it in accord with the view of the Upper Basin States. It is the position of the Upper Colorado River Commission and the Upper Basin States that, with the delivery at Lee Ferry of 75 MAF of water in each period of 10 consecutive years, the water supply availabl in the Colorado River System below Lee Ferry is sufficient to meet the apportionments to the Lower Basin provided for in Article III (a) and (b) of the Colorado River Compact and the entire Mexican Treaty delivery. The Upper Basin States submit that the long-term dependable yield of water available in the Upper Basin would be at least 6.3 MAF.

The values of 'State Share' and 'Remaining Water Available' which appear ir the depletion tables are based on the Department of the Interior's assumed dependable yield of 6.0 MAF of water available for consumptive use in the

Upper Basin. The negative values of remaining water which appear in the New Mexico projections represent uses of water above that available under the Department's conservative, assumed water supply and are assumed by the Department to be permitted under the Upper Colorado River Basin Compact.

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

APPENDIX II

USE OF THE COLORADO RIVER SIMULATION SYSTEM (CRSS) TO DETERMINE AVAILABLE STORAGE

Documentation of the CRSS model is found in the following publications, all published by the Bureau of Reclamation:

- Colorado River Simulation System - An Executive Summary
- Colorado River Simulation System - System Overview
- CRSM User Manual

The model accounts for sedimentation in four reservoirs: Navajo, Flaming Gorge, Lake Powell, and Lake Mead. Sedimentation is assumed to be a constant annual amount that varies seasonally for each reservoir, but the distribution of sediment between active and dead storage pools is a function of the individual reservoir operation. The model continually updates the elevation-capacity relationships for each of the four reservoirs. Sedimentation is important in yield determination since over the 81 year period of record used in modeling, total Upper Basin system storage is decreased by over 5 MAF as a result of sediment.

Shortages are calculated locally in the model at individual demand points and summed for the entire basin. The model output indicates total annual shortages. It is recognized that inaccuracies in shortages are generated by the model. This is due to modeling limitations such as not modeling local storage facilities, as well as not recognizing water right priorities. In some instances shortages are generated due to inadequacy of hydrologic information in localized areas.

In current runs of the CRSS model, consideration of bank storage is given to two reservoirs in the Upper Basin. The change in storage of Lake Powell is modified by a bank storage factor of 0.08 and in Flaming Gorge the change in storage is modified by a factor of 0.033. No consideration for bank storage is given for any of the other Upper Basin reservoirs.

A number of different model runs were made to determine the amount of storage that would be available during a critical drawdown period of the Upper Colorado system. To get some idea of the stress placed on the system under current modeling conditions, i.e. using the current demand schedule that indicates development to 5.8 million acre-feet by the year 2040, an 81 year (1986 to 2066), 81-trace run was performed. Traces are modeling simulation runs with a fixed sequence of hydrology. The initial trace began with the initial hydrology year of 1906 set at the initial modeling year of 1986. The hydrology was then shifted one year for each trace until each of the 81 years of record had been used as the initial modeling year, (see Table 1 for an alignment of hydrology and trace years).

This run indicated that the 5.8 MAF level of demands was not great enough to completely utilize all of the system storage. Since sediment accumulation continually changes reservoir characteristics, and because all upstream reservoirs in the CRSS model are forced down as Lake Powell empties, the elevation of Lake Powell was used as an index to determine the storage state of the system. The maximum drawdown in Lake Powell occurred in trace 75 in March 2065 with Powell elevation at 3530 or some 40 feet above minimum power pool and corresponded to a total system storage remaining of about 5.6 MAF.

Another 81-trace run was performed that set the demands to a 6.3 MAF level at the year 2040. At that level of demand, the system is over stressed. This is apparent in that not only is the entire Upper Basin system storage utilized, but the system remains drawn down to minimum levels for a relatively high number of months. Of the 81 traces, there were 28 traces in which Lake Powell was empty (at minimum power pool) from 3 to 31 months. From Table 2 it can be seen that trace 75 is the critical trace in that it reflects the greatest stress on the system. It should be noted that trace 75 not only produces the greatest number of months of complete drawdown, but is also the trace in which the greatest amount of water in storage is available and used. Because of this, additional analysis was focused on trace 75.

To determine the amount of storage that could reasonably be available in a critical drawdown period, several single-trace runs of trace 75 were made until a level of demands was found that produced a drawdown in which the system just emptied, i.e. reached minimum power pools or inactive storage levels for one month. This occurred when the nominal demands reached a level of 5.87 MAF in 2040. The run produced a drawdown that started with the reservoirs full near the beginning of 2040 and just emptied in February 2065. This indicated a drawdown period of 25 years and 7 months. The sediment-modified storage amount utilized from full system to empty system was 24.762 MAF. The actual depletions for the drawdown period including evaporation and adjustment for shortages amounting to 4.45 percent, averaged 5.805 MAF.

Additional CRSS model runs were made to answer specific questions or allow further analysis of some situations. A 100-year run of trace 75 was made with the 81-year hydrologic record being "wrapped around" to verify system recovery. The run was identical to the previously discussed run through the year 2066. The additional years of operation indicated that the system would refill in June of 2072.

A trace 75 run was made with the surplus strategy turned-off. The surplus strategy provides for the release of water early in a wet (above average) year which would not normally be released until the flood runoff period. The purpose of this strategy is to make better use of water in these higher runoff years with the effect of drawing or keeping down reservoirs earlier in the year. A run made with the surplus strategy turned-off was done to answer questions regarding the effects of the surplus strategy. Although the operation during the early years of the run varied somewhat, the system filled and emptied in the same respective months as in the previous run. Because the pattern of sediment deposition was changed somewhat, the amount of water between full and empty states varied by about 15,000 acre feet. When considered over the more than 25-year drawdown period this was felt to be insignificant.

TABLE 1
CRSS TRACES AND HYDROLOGIES

Trace	Initial Year Hydrology	Ending Year Hydrology	Hydrology Year @2040 Run Year
1	1906	1986	1960
2	1907	1906	1961
3	1908	1907	1962
4	1909	1908	1963
5	1910	1909	1964
6	1911	1910	1965
7	1912	1911	1966
8	1913	1912	1967
9	1914	1913	1968
10	1915	1914	1969
11	1916	1915	1970
12	1917	1916	1971
13	1918	1917	1972
14	1919	1918	1973
15	1920	1919	1974
16	1921	1920	1975
17	1922	1921	1976
18	1923	1922	1977
19	1924	1923	1978
20	1925	1924	1979
21	1926	1925	1980
22	1927	1926	1981
23	1928	1927	1982
24	1929	1928	1983
25	1930	1929	1984
26	1931	1930	1985
27	1932	1931	1986
28	1933	1932	1906
29	1934	1933	1907
30	1935	1934	1908
31	1936	1935	1909
32	1937	1936	1910
33	1938	1937	1911
34	1939	1938	1912
35	1940	1939	1913
36	1941	1940	1914
37	1942	1941	1915
38	1943	1942	1916
39	1944	1943	1917
40	1945	1944	1918
41	1946	1945	1919
42	1947	1946	1920
43	1948	1947	1921
44	1949	1948	1922
45	1950	1949	1923
46	1951	1950	1924

TABLE 2

	TRACE	MONTHS EMPTY	UPPER BASIN STORAGE AT YEAR 2040	AVG. ANNUAL SHORTAGE FOR THE TRACE-ACRE FEET
1.	1	16	19.8	151,630
2.	2	14	18.3	151,530
3.	3	9	14.5	148,510
4.	4	8	18.2	148,218
5.	5	7	14.3	144,699
6.	6	5	11.8	141,409
7.	7	3	16.5	142,033
8.	8	0	14.9	140,383
9.	61	6	22.1	133,500
10.	62	6	20.2	134,645
11.	63	4	16.4	133,458
12.	64	9	20.6	132,660
13.	65	14	25.8	131,766
14.	66	18	25.6	131,757
15.	67	18	26.9	133,150
16.	68	18	27.0	136,135
17.	69	18	24.5	134,591
18.	70	17	26.3	137,205
19.	71	16	27.5	137,488
20.	72	16	27.7	137,466
21.	73	19	27.0	151,470
22.	74	26	25.7	152,337
23.	75	31	27.7	234,479
24.	76	27	20.3	152,835
25.	77	22	16.7	158,273
26.	78	23	13.6	155,634
27.	79	20	11.9	153,892
28.	80	18	16.6	153,600
29.	81	17	19.0	152,549

APPENDIX III

COLORADO RIVER - CALL ANALYSIS
6.1 MAF DEPLETION LEVEL
(Units--1,000 acre-feet)

Trace	Release	Year of Call	Call	EVAP	CU	Depletion	Call as Percent of Remaining Depletion
33	8,216	2097	14	276	5,503	5,779	0.24%
23	8,214	2103	16	299	5,238	5,537	0.29%
23	8,196	2117	34	299	5.271	5,570	0.61%
24	8,195	2116	35	299	5,271	5,570	0.63%
25	8,195	2115	35	298	5,272	5,570	0.63%
41	8,195	2099	35	288	5,279	5,567	0.63%
22	8,194	2104	36	299	5,238	5,537	0.65%
29	8,194	2097	36	303	5,238	5,541	0.65%
42	8,194	2098	36	287	5,279	5,566	0.65%
43	8,194	2097	36	286	5,279	5,565	0.65%
26	8,193	2114	37	298	5,273	5,571	0.67%
27	8,193	2113	37	298	5,274	5,572	0.67%
44	8,193	2096	37	285	5,279	5,564	0.67%
28	8,192	2112	38	297	5,275	5,572	0.69%
45	8,192	2095	38	286	5,279	5,565	0.69%
29	8,191	2111	39	297	5,276	5,573	0.70%
46	8,191	2094	39	285	5,279	5,564	0.71%
30	8,190	2110	40	297	5,277	5,574	0.72%
52	8,190	2088	40	284	5,281	5,565	0.72%
53	8,190	2087	40	284	5,281	5,565	0.72%
54	8,190	2086	40	284	5,281	5,565	0.72%
31	8,189	2109	41	295	5,278	5,573	0.74%
32	8,189	2108	41	295	5,279	5,574	0.74%
47	8,189	2093	41	285	5,279	5,564	0.74%
48	8,189	2092	41	285	5,279	5,564	0.74%
51	8,189	2089	41	285	5,280	5,565	0.74%
33	8,188	2107	42	295	5,279	5,574	0.76%
49	8,188	2091	42	285	5,279	5,564	0.76%
34	8,187	2106	43	295	5,279	5,574	0.78%
50	8,187	2090	43	285	5,280	5,565	0.78%
35	8,186	2105	44	294	5,279	5,573	0.80%
36	8,186	2104	44	294	5,279	5,573	0.80%
37	8,185	2103	45	294	5,279	5,573	0.81%
38	8,183	2102	47	294	5,279	5,573	0.85%
39	8,182	2101	48	293	5,279	5,572	0.87%
40	8,182	2100	48	293	5,279	5,572	0.87%
32	8,178	2098	52	276	5,503	5,779	0.91%
28	8,164	2098	66	303	5,238	5,541	1.21%
21	8,155	2105	75	298	5,238	5,536	1.37%
23	8,153	2106	77	294	5,422	5,716	1.37%
31	8,146	2099	84	276	5,503	5,779	1.47%
21	8,145	2108	85	295	5,422	5,717	1.51%
19	8,142	2110	88	297	5,422	5,719	1.56%
20	8,142	2109	88	295	5,422	5,717	1.56%
22	8,142	2107	88	295	5,422	5,717	1.56%

Trace	Release	Year of Call	Call	EVAP	CU	Depletion	Call as Percent of Remaining Depletion
76	8,142	2063	88	354	4,081	4,435	2.02%
17	8,135	2112	95	294	5,426	5,720	1.69%
27	8,135	2099	95	301	5,238	5,539	1.75%
18	8,131	2111	99	297	5,422	5,719	1.76%
20	8,116	2106	114	298	5,238	5,536	2.10%
26	8,116	2100	114	299	5,238	5.537	2.10%
30	8,115	2100	115	276	5,503	5,779	2.03%
29	8,111	2101	119	276	5,503	5,779	2.10%
28	8,100	2102	130	281	5,503	5,784	2.30%
27	8,097	2103	133	281	5,503	5,784	2.35%
25	8,083	2103	147	400	5,213	5,613	2.69%
25	8,080	2105	150	282	5,503	5,785	2.66%
19	8,079	2107	151	298	5,238	5,536	2.80%
16	8,077	2110	153	294	5,238	5,532	2.84%
24	8,076	2106	154	282	5,503	5,785	2.75%
25	8,074	2101	156	299	5,238	5,537	2.90%
26	8,064	2117	166	381	4,988	5.369	3.19%
25	8,060	2118	170	383	4,987	5,370	3.27%
24	8,059	2119	171	384	4,987	5,371	3.29%
16	8,058	2113	172	295	5,422	5,717	3.10%
14	8,056	2115	174	295	5,422	5,717	3.14%
15	8,055	2114	175	295	5,422	5,717	3.16%
23	8,055	2120	175	384	4,986	5,370	3.37%
15	8,052	2111	178	294	5,238	5,532	3.32%
18	8,050	2108	180	297	5,238	5,535	3.36%
13	8,049	2116	181	294	5,426	5,720	3.27%
12	8,047	2117	183	294	5,426	5,720	3.31%
11	8,046	2118	184	294	5,426	5,720	3.32%
10	8,040	2119	190	295	5,426	5,721	3.44%
24	8,040	2102	190	300	5,238	5,538	3.55%
9	8,037	2120	193	295	5,426	5,721	3.49%
14	8,030	2112	200	294	5,238	5,532	3.75%
17	8,017	2109	213	297	5,238	5,535	4.00%
13	8,004	2113	226	293	5,238	5,531	4.26%
12	7,977	2114	253	293	5,238	5,531	4.79%
71	7,973	2068	257	346	4,100	4,446	6.14%
22	7,950	2108	280	282	5,503	5,785	5.09%
23	7,950	2107	280	281	5,503	5,784	5.09%
20	7,949	2110	281	282	5,503	5,785	5.11%
21	7,949	2109	281	282	5,503	5,785	5.11%
18	7,948	2112	282	283	5,503	5,786	5.12%
19	7,948	2111	282	282	5,503	5,785	5.12%
16	7,947	2114	283	283	5,503	5,786	5.14%
17	7,947	2113	283	283	5,503	5,786	5.14%
15	7,946	2115	284	283	5,503	5,786	5.16%
11	7,945	2115	285	293	5,238	5,531	5.43%
14	7,945	2116	285	284	5,503	5,787	5.18%
11	7,944	2119	286	284	5,503	5,787	5.20%
12	7,944	2118	286	284	5,503	5,787	5.20%
13	7,944	2117	286	284	5,503	5,787	5.20%
70	7,944	2069	286	346	4,100	4,446	6.88%

Trace	Release	Year of Call	Call	EVAP	CU	Depletion	Call as Percent of Remaining Depletion
10	7,943	2120	287	284	5,503	5,787	5.22%
69	7,923	2070	307	346	4,100	4,446	7.42%
75	7,914	2064	316	348	4,069	4,417	7.71%
10	7,903	2116	327	293	5,238	5,531	6.28%
68	7,893	2071	337	345	4,100	4,445	8.20%
74	7,884	2065	346	348	4,068	4,416	8.50%
9	7,867	2117	363	293	5,238	5,531	7.02%
67	7,862	2072	368	345	4,100	4,445	9.03%
73	7,860	2066	370	348	4,068	4,416	9.14%
20	7,838	2120	392	302	5,268	5,570	7.57%
21	7,836	2119	394	301	5,269	5,570	7.61%
22	7,835	2118	395	301	5,270	5,571	7.63%
72	7,832	2067	398	347	4,068	4,415	9.91%
8	7,825	2118	405	291	5,238	5,529	7.90%
66	7,814	2073	416	344	4,100	4,444	10.33%
7	7,795	2119	435	291	5,238	5,529	8.54%
65	7,758	2074	472	343	4,100	4,443	11.89%
6	7,757	2120	473	291	5,238	5,529	9.36%
64	7,709	2075	521	343	4,100	4,443	13.28%
63	7,663	2076	567	342	4,100	4,442	14.63%
62	7,628	2077	602	341	4,100	4,441	15.68%
61	7,570	2078	660	340	4,100	4,440	17.46%
60	7,342	2079	888	336	4,100	4,436	25.03%
59	7,129	2080	1,101	332	4,096	4,428	33.09%
58	7,016	2081	1,214	329	4,096	4,425	37.81%
57	6,929	2082	1,301	328	4,071	4,399	41.99%
56	6,921	2083	1,309	328	4,071	4,399	42.36%
55	6,882	2084	1,348	328	4,070	4,398	44.20%
54	6,826	2085	1,404	323	4,058	4,381	47.16%
53	6,709	2086	1,521	321	4,058	4,379	53.22%
52	6,679	2087	1,551	321	4,058	4,379	54.84%
51	6,661	2088	1,569	321	4,058	4,379	55.84%
50	6,633	2089	1,597	321	4,058	4,379	57.40%
49	6,631	2090	1,599	321	4,058	4,379	57.52%
48	6,606	2091	1,624	321	4,058	4,379	58.95%
47	6,578	2092	1,652	321	4,058	4,379	60.58%
46	6,530	2093	1,700	319	4,058	4,377	63.50%
45	6,496	2094	1,734	319	4,058	4,377	65.61%
44	6,469	2095	1,761	319	4,058	4,377	67.32%
43	6,429	2096	1,801	318	4,058	4,376	69.94%
42	6,400	2097	1,830	318	4,058	4,376	71.88%
41	6,376	2098	1,863	318	4,057	4,375	74.16%
40	6,359	2099	1,871	319	4,049	4,368	74.93%
39	6,318	2100	1,912	318	4,049	4,367	77.88%
38	6,278	2101	1,952	318	4,049	4,367	80.83%
37	6,243	2102	1,987	318	4,049	4,367	83.49%
36	6,199	2103	2,031	317	4,049	4,366	86.98%
34	6,168	2105	2,062	317	4,049	4,366	89.50%
30	6,165	2109	2,065	319	4,049	4,368	89.67%
35	6,162	2104	2,068	316	4,049	4,365	90.03%
32	6,146	2107	2,084	318	4,049	4,367	91.28%

Trace	Release	Year of Call	Call	EVAP	CU	Depletion	Call as Percent of Remaining Depletion
33	6,141	2106	2,089	317	4,049	4,366	91.74%
31	6,129	2108	2,101	318	4,049	4,367	92.72%
28	6,076	2111	2,154	318	4,049	4,367	97.33%
29	6,075	2110	2,155	318	4,049	4,367	97.42%
27	6,060	2112	2,170	318	4,049	4,367	98.77%
26	6,028	2113	2,202	318	4,049	4,367	101.71%
25	6,023	2114	2,207	318	4,048	4,366	102.22%
24	6,018	2115	2,212	318	4,048	4,366	102.69%
23	6,010	2116	2,220	318	4,049	4,367	103.40%
22	6,004	2117	2,226	318	4,049	4,367	103.97%
21	5,996	2118	2,234	318	4,049	4,367	104.74%
20	5,984	2119	2,246	319	4,049	4,368	105.84%
19	5,975	2120	2,255	319	4,048	4,367	106.77%

Average Call:
(81 years, 81 traces) 15

FREQUENCY OF CALLS

Call Range (1,000 acre-feet)	Number of Occurrences	Frequency (Percent)	Accumulative Frequency of Calls (Percent)
0	6401	97.56	
1-100	49	0.75	0.75
101-200	28	0.43	1.18
201-300	20	0.30	1.48
301-500	17	0.26	1.74
501-1000	5	0.08	1.82
1001-2000	23	0.35	2.17
2001-2255	18	0.27	2.44
81 years, 81 traces	6561	100.00	