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United States Department of the Interior

BUREAU OF RECLAMATION
WASHINGTON, D.C. 20240

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Memorandum

To: Assistant Secretary for Indian Affairs

Through: Assistant Secretary - Land and Water Resources

From: ~~ACTING~~ Commissioner of Reclamation (Sgd.) D. D. Anderson

Subject: Navajo Indian Irrigation Project

A joint meeting was held at the Bureau of Reclamation's Engineering and Research Center in Denver on June 30, 1976, between representatives of the Bureau of Reclamation (BR) and the Bureau of Indian Affairs (BIA) to discuss the reports titled "Water Supply Availability in the San Juan River Basin of 1975" prepared for the Bureau of Indian Affairs by Morrison-Maierle Incorporated, and the "Navajo Indian Irrigation Project All Sprinkler Report" prepared by the Bureau of Reclamation, November 1973, revised March 1974.

The principal area of discussion at that meeting was the unit consumptive use requirement developed in the two reports. The Bureau of Reclamation used the Blaney-Criddle procedure described in technical bulletin 1275, United States Department of Agriculture, December 1962. The results as used in the 1974 BR Sprinkler Report were a consumptive use of 2.49 acre-feet per acre and a unit diversion requirement of 3.14 acre-feet per acre. The BIA used a recent Jensen-Haise procedure as described in the American Society of Civil Engineers publication "Consumptive Use of Water and Irrigation Water Requirements" dated September 1973. The results of the BIA studies showed a consumptive use requirement of 4.03 acre-feet per acre and a unit diversion requirement of 5.52 acre-feet per acre. In addition to the difference in consumptive use requirements, there are minor differences in effective precipitation as a result of a different period of study, crop distributions, and acreage for the project.

The end result of the two studies was an average annual diversion requirement of 330,000 acre-feet for the BR studies and 610,000 acre-feet in the BIA studies. Supporting documents of the authorizing legislation for the Navajo Indian Irrigation Project (NIIP) are based on diversion

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requirements of 508,000 acre-feet, and BIA agreed that diversions could not exceed that value and that project operation would be restricted. One of the primary concerns of the BIA as a result of its analysis, was the sizing of the NIP distribution system. It pointed out that higher project consumptive use requirements would result in a higher peak demand and that the project, as presently designed, may not be able to meet larger peak demands.

An additional concern was the effect that increased consumptive use would have on depletions by the project. If the project depletions increase beyond the approximately 252,000 acre-feet annually, originally estimated, it could have significant impacts on other planned water resource developments in New Mexico that would use Colorado River water.

Since that June 1976 meeting, the Bureau of Reclamation has reviewed the consumptive use estimate presented by the BIA (Jensen-Haise with elevation adjustment) as well as a number of other estimating procedures which are, or have recently been, in common use. The procedures reviewed include the Blaney-Criddle method as used in the sprinkler report (B-C), the Blaney-Criddle method using revised high-range seasonal K values (B-C with high K), Soil Conservation Service Technical Release 21 (TR-21), and the Jensen-Haise 1963 procedure (J-H 1963), 1966 procedure (J-H 1966), and 1970 procedure (J-H 1970). The 1970 Jensen-Haise procedure was used with and without the elevation adjustment (elevation = 5800 and 0).

The calculations for each procedure used comparable climatic, geographic, and cropping data. The results of those calculations are as follows:

COMPARISON OF CONSUMPTIVE USE
ESTIMATING METHODS FOR
NAVAJO INDIAN IRRIGATION PROJECT

| Method | Annual CU (feet) |
|------------------------|------------------|
| B-C (sprinkler report) | 2.49 |
| B-C with high K | 2.71 |
| TR-21 | 2.83 |
| J-H 1963 | 2.74 |
| J-H 1966 | 2.68 |
| J-H 1970, el. = 0 | 2.72 |
| J-H 1970, el. = 5800 | 4.03 |

These results indicate that five of the estimating procedures provide values of consumptive use grouped very closely around 2.75 feet per year. The other two procedures give values of about 10 percent less (sprinkler report) and 50 percent higher (Jensen-Haise with elevation adjustment).

The following tabulation indicates the range of diversion requirements, return flows, and depletions that can be expected using three of the consumptive use estimating methods listed above. It can be seen that the same significant spread in consumptive use estimates carries on through to these values as well. *(went in?)*

COMPARISON OF NIIP IRRIGATION REQUIREMENTS
(Annual Average)

| Item | USNR 1974 All-Sprinkler Report | TR-21 | BIA 1975 Study |
|---------------------------------------|--------------------------------------|---------|-------------------|
| Consumptive use (feet) | 2.49 | 2.83 | 4.03 |
| Effective precipitation (feet) | 0.61 | 0.61 | 0.72 |
| Irrigation requirements (feet) | 1.88 | 2.22 | 3.31 |
| Farm loss (25 percent) (feet) | 0.63 | 0.74 | 1.10 |
| Farm turnout requirement (feet) | 2.51 | 2.96 | 4.41 |
| Conveyance losses (20 percent) (feet) | 0.63 | 0.74 | 1.11 |
| Diversion requirement (feet) | 3.14 | 3.70 | 5.52 |
| Irrigable acres | 110,630 | 110,630 | - |
| Productive acres | 105,000 | 105,000 | 110,630 |
| Diversion requirement (acre-feet) | 330,000 | 389,000 | 610,000 |
| Beneficial (A) (acre-feet) | 198,000 | 233,000 | 366,000 |
| Losses and returns (acre-feet) | 132,000 | 156,000 | 244,000 |
| Return flow (acre-feet) | 104,000 | 123,000 | 195,000 |
| Nonbeneficial (A) (acre-feet) | 28,000 | 33,000 | 49,000 |
| Depletion (acre-feet) | 226,000 | 266,000 | 415,000 |

The Bureau of Reclamation has, for planning purposes, changed its procedure for estimating consumptive use in most areas since completion of the sprinkler report. The procedure being used is the Soil Conservation Services Technical Release 21. While, that procedure provides unit consumptive use requirements for NIIP that are slightly larger than the procedure used in the sprinkler report, it is only about 2/3 as large as the value proposed by the BIA. The Bureau of Reclamation has never used a procedure in its planning program that would estimate unit consumptive use requirements at levels nearly as high as those proposed by BIA and our experience has not indicated a need to change. Furthermore, there is insufficient experience in the project area to determine that one estimating technique is superior to another. Therefore, we can not justify changing consumptive use estimates on NIIP at this time. *from what?*

We also found, during our review of the all sprinkler studies, that the estimated distribution system losses may have been over estimated. The values used were based on 3 percent seepage and 17 percent operational loss. We believe the seepage value to be reasonable, but experience on *effect on c.w.?*

similar projects indicate that the operational loss value can be reduced, particularly during peak demand periods. A reduction in operational losses counteracts increases in consumptive use with the result being less net change in peak delivery demand for the project. For example, we believe it would be reasonable to use a conveyance loss value of 13 percent (3 percent seepage and 10 percent operational loss). If the 13 percent conveyance loss were to be applied to the TR-21 values in the table on the previous page, it would result in a reduction in the diversion requirement of about 30,000 acre-feet and could result in a reduction of 10,000 acre-feet in the depletion estimates, 256006

The adequacy of lateral sizing has not been discussed in any detail, but we believe that the laterals as presently designed will be adequate, even though the larger laterals were designed using the same criteria as was the main canal. Our reason for reaching that conclusion is that the operating flexibility is somewhat greater on the laterals than on the larger and longer main canal.

We must point out that the above discussion pertains only to estimates. We have very little actual data from RIMP at this time to use in verifying either the Reclamation or BIA estimates. Based on past experience we believe that consumptive use in the 2.7 to 2.8 foot range can be reasonably expected. However, we also believe that in view of the controversy over the estimates it is important to collect operating data on RIMP to provide accurate values of consumptive use and system losses so that a determination can be made concerning expected depletions and the adequacy of the delivery system.

The Bureau of Reclamation, in cooperation with the Navajo Agricultural Products Industry, has instituted an Irrigation Management Services program on Block I of RIMP. The purpose of that program is to provide information to the project irrigators concerning the proper timing and volume of irrigation applications. In so doing, some data is available concerning the consumptive use requirements for the project.

Data collected during the first 2 years of operation of Block I does not provide positive guidance on the matter. We have, however, gained some experience on the project, and now have the necessary equipment and expertise available to assist in collecting pertinent data during the next irrigation season. However, the collection of these data will require additional personnel beyond those engaged in the Irrigation Management Services program.

RIMP as originally planned was to be a gravity system and it was thought that a reregulating reservoir would be necessary in the system to provide ability to meet peak demands. When the project was reformulated as an all sprinkler system, the delivery capacity of the main canal was considered to be adequate to meet peak demands without the reregulating reservoir. If the data collection activities on RIMP during the next few years should indicate that the capacity of the main canal is not adequate to carry the necessary water to meet the peak demands of a fully developed project, we could go ahead with the design and construction of the reregulating reservoir. Our estimates

indicate that we would need approximately 4 to 5 years lead time to collect the necessary design data, prepare designs and specifications and construct the reregulating reservoir. This would mean that it would be necessary for us to begin collecting design data in about 1981 in order to have the reservoir completed before the last two blocks of NIIP go into operation.

That schedule will allow us to collect 3 additional years of operating data on the project on which to base a decision on the adequacy of the present system. That data will also allow us to make better estimates concerning project depletions and return flow timing.

Therefore, in view of the fact that we are about 3 years away from the time that we would need to make a decision concerning the construction of a reregulating reservoir, it is our recommendation that we make a concerted effort, in cooperation with NAPI and BIA to obtain the necessary data during the next 2 or 3 years to make a firm estimate of consumptive use requirements for the NIIP. Concurrently, data on delivery system losses and farm efficiency can also be collected. With those data, we will be in a position to determine the adequacy of the distribution system capacity. If, at that time, it is determined that the system has been undersized, we would propose proceeding immediately with the necessary activities to rectify the matter through construction of a reregulating reservoir. However, we do not believe we have the necessary data on which to base such a decision at the present time.

We are available to discuss these matters with you, members of the tribe, and other interests, as you may find appropriate.

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planning with users!*

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