

WTR-4.00 REP



TRANSMITTAL SLIP

DEPARTMENT OF THE ARMY
KANSAS CITY DISTICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896

IN REPLY REFER TO CENWK-PM-PF	DATE 7/19/2001
MAIL TO: MR. FRED ORE AREA MANAGER BUREAU OF RECLAMATION GRAND ISLAND AREA OFFICE P.O. BOX 1607 GRAND ISLAND, NE 68802-1607	
REMARKS: Enclosed is an original of the fully executed Field Working Agreement Between Department of the Army, Corps of Engineers, and Department of the Interior, Bureau of Reclamation Regarding Operation of Harlan County Dam and Lake, Republican River, Harlan County, Nebraska. Colonel Hazel executed the agreement on behalf of the Corps on July 17, 2001. If you have any questions, please contact Edward Parker at 816-983-3147 or me at 816- 983-107.	
Maria Chastain-Brand Project Manager Army Corps of Engineers	
ENCLOSURE	
INITIALS <i>MC-B</i>	

NAME	INITIAL	ACTION	DATE
<i>Fred</i>	<i>FO</i>		<i>7/23</i>
<i>Steve</i>	<i>SM</i>		<i>7/20</i>
<i>A. Dan</i>	<i>AD</i>		<i>7/23</i>
<i>Mike</i>	<i>MK</i>		<i>7-23</i>
<i>McCook</i>		<i>by cy</i>	<i>7/23</i>
<i>Gill</i>		<i>by cy</i>	<i>7/23</i>

REMARKS
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DUPLICATE ORIGINAL

FIELD WORKING AGREEMENT BETWEEN
DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, AND
DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION
REGARDING OPERATION OF
HARLAN COUNTY DAM AND LAKE
REPUBLICAN RIVER, HARLAN COUNTY, NEBRASKA

THIS AGREEMENT, is entered into between the Kansas City District Corps of Engineers ("Corps") represented by the District Engineer, and the Bureau of Reclamation ("Reclamation") represented by the Area Manager for the Nebraska-Kansas Area Office, collectively referred to as "the Parties",

WHEREAS, the Corps has constructed the Harlan County Dam and Lake on the Republican River near Alma, Nebraska, ("Project") and is responsible for the safety of the structure, for flood-control operations of the lake, and for certain other operations as defined herein; and

WHEREAS, Reclamation is responsible for irrigation operation of the comprehensive system of irrigation works in the Republican River Basin; and

WHEREAS, the irrigation storage in said dam and lake serves the comprehensive system of irrigation works; and

WHEREAS, a Consensus Plan for the operation of the authorized purposes of the Project has been agreed to by both Parties and documented in the Final Environmental Impact Statement, Republican River Basin, Nebraska and Kansas, Repayment and Long-Term Water Service Contract Renewals, June 2000 (Chapter 2.1 of the Technical Report is the Consensus Plan and is attached as Appendix A); and

WHEREAS, there is need for an agreement in order that there will be a clear understanding between the Corps and Reclamation as to reservoir operations for irrigation and related conservation uses, including details of storage allocations and possible reallocations, hydrologic data collection and reporting arrangements; and

WHEREAS, the 1957 Field Working Agreement and the 1952 Statement of Operational Objectives for Harlan County Lake are no longer valid.

NOW THEREFORE, it is mutually understood and agreed by and between the parties hereto as follows:

1. STORAGE CAPACITY ALLOCATION.--The storage capacity allocations of Harlan County Dam and Lake, exclusive of surcharge storage capacity above elevation 1973.5 feet, m.s.l., which is provided in combination with spillway capacity to insure safety of the structure,

are defined in the following subparagraphs:

a. Flood-control storage.--Flood-control storage capacity shall include 500,000 acre-feet between the top of multipurpose pool (elevation 1945.73 feet, m.s.l. based on the 2000 sediment survey) and the bottom of the surcharge pool (elevation 1973.5 feet, m.s.l.).

b. Irrigation, conservation and sediment reserve storage.--Irrigation storage capacity shall include 150,000 acre-feet between elevation 1932.5 feet, m.s.l. (2000 sediment survey) and the top of the multipurpose pool. The remainder of the storage below the top of multipurpose is reserved for sediment reserve storage. Until such time as sediment fully occupies the reserve storage, it will be used for irrigation and various conservation purposes including recreation, and fish and wildlife preservation in accordance with the Consensus Plan for Harlan County Lake. In accordance with the same Consensus Plan releases for irrigation shall not be made below elevation 1927.0 feet, m.s.l. Minimum releases during the months of December, January and February will follow the criteria as established and outlined in Table 3 of the Environmental Assessment for Harlan County Lake, dated December 16, 1983. This schedule is attached as Appendix B.

2. STORAGE REALLOCATIONS.--The Corps shall at reasonable intervals make necessary field surveys and office studies to prepare estimates of the volume and location of sediment deposits in the reservoir. The storage capacity allocations will be changed to reflect the revised area capacity data.

3. PLAN OF OPERATION.

a. The Corps will operate the storage capacity in the Harlan County Lake referenced in paragraph 1b, above, through appropriate instruction to the Operations Project Manager of Harlan County Lake to supply the water requirements for the Bostwick Irrigation Project as prescribed by Reclamation, and to fulfill the other authorized purposes in accordance with the Consensus Plan for Harlan County Lake.

b. Prior to January 10 of each year, the Corps and Reclamation will establish the minimum irrigation forecast and proposed shutoff elevation as determined by the method described in Appendix A. Prior to June 10 of each year, the Corps and Reclamation will establish the shutoff elevation for Harlan County Lake for the current year by using the methodology described in Appendix A. If the shutoff elevation is within the sediment pool, Reclamation will keep a tabulation of the releases so that it can be determined whether releases will be discontinued after 119,000 acre-feet of water has been released.

c. When the reservoir level is in the flood-control pool, the Corps will make such minimum releases as Reclamation may prescribe as necessary to meet irrigation requirements. This in no way restricts the evacuation of excess water from the flood-control pool in accordance with the Harlan County Water Control Manual and the discretion of the Corps.

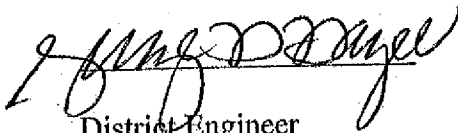
4. OPERATION AND HYDROLOGIC REPORTING ARRANGEMENTS.--Proposed schedules of flood-control releases and flood-control storage changes, if available, and current

operating data shall be provided to Reclamation by the Corps. The current reservoir operating data shall be tabulated daily and furnished periodically as required, and shall include such items as: reservoir elevation, storage, inflow, and outflow. All available reports from meteorological and stream-flow stations pertinent to the operation of the reservoir obtained by either the Corps or Reclamation shall be exchanged as required. These data shall be furnished or exchanged by the most expeditious method of communication under detailed arrangements as may be made from time to time.

IN WITNESS WHEREOF, the parties hereto have caused this memorandum of agreement to be executed as of 17 July 2001, 2001.

CORPS OF ENGINEERS:

BUREAU OF RECLAMATION:



District Engineer
Kansas City District



Area Manager
Nebraska-Kansas Area Office

17 Jul 2001
Date

July 6, 2001
Date

APPENDIX A

Technical Report

For the
Final Environmental Impact Statement
Republican River Basin
Nebraska and Kansas

Repayment and Long-Term Water Service Contract Renewals

May 2000

(Section 2.1)

2.1 Description of the Consensus Plan for Harlan County Lake

The Consensus Plan for operating Harlan County Lake was conceived after extended discussions and negotiations between Reclamation and the Corps. The agreement shaped at these meetings provides for sharing the decreasing water supply into Harlan County Lake. The agreement provides a consistent procedure for: updating the reservoir elevation/storage relationship, sharing the reduced inflow and summer evaporation, and providing a January forecast of irrigation water available for the following summer.

During the interagency discussions the two agencies found agreement in the following areas:

- The operating plan would be based on current sediment accumulation in the irrigation pool and other zones of the project.
- Evaporation from the lake affects all the various lake uses in proportion to the amount of water in storage for each use.
- During drought conditions, some water for irrigation could be withdrawn from the sediment pool.
- Water shortage would be shared between the different beneficial uses of the project, including fish, wildlife, recreation and irrigation.

To incorporate these areas of agreement into an operation plan for Harlan County Lake, a mutually acceptable procedure addressing each of these items was negotiated and accepted by both agencies.

2.1.1 Sediment Accumulation.

The most recent sedimentation survey for Harlan County project was conducted in 1988, 37 years after lake began operation. Surveys were also performed in 1962 and 1972; however, conclusions reached after the 1988 survey indicate that the previous calculations are unreliable. The 1988 survey indicates that, since closure of the dam in 1951, the accumulated sediment is distributed in each of the designated pools as follows:

Flood Pool	2,387 acre-feet
Irrigation Pool	4,853 acre-feet
Sedimentation Pool	33,527 acre-feet

To insure that the irrigation pool retained 150,000 acre-feet of storage, the bottom of the irrigation pool was lowered to 1,932.4 feet, msl, after the 1988 survey.

To estimate sediment accumulation in the lake since 1988, we assumed similar conditions have occurred at the project during the past 11 years. Assuming a consistent rate of deposition since 1988, the irrigation pool has trapped an additional 1,430 acre-feet.

A similar calculation of the flood control pool indicates that the flood control pool has captured an additional 704 acre-feet for a total of 3,090 acre-feet since construction.

The lake elevations separating the different pools must be adjusted to maintain a 150,000-acre-foot irrigation pool and a 500,000-acre-foot flood control pool. Adjusting these elevations results in the following new elevations for the respective pools (using the 1988 capacity tables).

Top of Irrigation Pool	1,945.70 feet, msl
Top of Sediment Pool	1,931.75 feet, msl

Due to the variability of sediment deposition, we have determined that the elevation capacity relationship should be updated to reflect current conditions. We will complete a new sedimentation survey of Harlan County Lake this summer, and new area capacity tables should be available by early next year. The new tables may alter the pool elevations achieved in the Consensus Plan for Harlan County Lake.

2.1.2 Summer Evaporation.

Evaporation from a lake is affected by many factors including vapor pressure, wind, solar radiation, and salinity of the water. Total water loss from the lake through evaporation is also affected by the size of the lake. When the lake is lower, the surface area is smaller and less water loss occurs. Evaporation at Harlan County Lake has been estimated since the lake's construction using a Weather Service Class A pan which is 4 feet in diameter and 10 inches deep. We and Reclamation have jointly reviewed this information and assumed future conditions to determine an equitable method of distributing the evaporation loss from the project between irrigation and the other purposes.

During those years when the irrigation purpose expected a summer water yield of 119,000 acre-feet or more, it was determined that an adequate water supply existed and no sharing of evaporation was necessary. Therefore, evaporation evaluation focused on the lower pool elevations when water was scarce. Times of water shortage would also generally be times of higher evaporation rates from the lake.

Reclamation and we agreed that evaporation from the lake during the summer (June through September) would be distributed between the irrigation and sediment pools based on their relative percentage of the total storage at the time of evaporation. If the sediment pool held 75 percent of the total storage, it would be charged 75 percent of the evaporation. If the sediment pool held 50 percent of the total storage, it would be charged 50 percent of the evaporation. At the bottom of the irrigation pool (1,931.75 feet, msl) all of the evaporation would be charged to the sediment pool.

Due to downstream water rights for summer inflow, neither the irrigation nor the sediment pool is credited with summer inflow to the lake. The summer inflows would be assumed passed through the lake to satisfy the water right holders. Therefore, Reclamation and we did not distribute the summer inflow between the project purposes.

As a result of numerous lake operation model computer runs by Reclamation, it became apparent that total evaporation from the project during the summer averaged about 25,000 acre-feet during times of lower lake elevations. These same models showed that about 20 percent of the evaporation should be charged to the irrigation pool, based on percentage in storage during the summer months. About 20 percent of the total lake storage is in the irrigation pool when the lake is at elevation 1,935.0 feet, msl. As a result of the joint study, Reclamation and we agreed that the irrigation pool would be credited with 20,000 acre-feet of water during times of drought to share the summer evaporation loss.

Reclamation and we further agreed that the sediment pool would be assumed full each year. In essence, if the actual pool elevation were below 1,931.75 feet, msl, in January, the irrigation pool would contain a negative storage for the purpose of calculating available water for irrigation, regardless of the prior year's summer evaporation from sediment storage.

2.1.3 Irrigation withdrawal from sediment storage.

During drought conditions, occasional withdrawal of water from the sediment pool for irrigation is necessary. Such action is contemplated in the Field Working Agreement and the Harlan County Lake Regulation Manual: "Until such time as sediment fully occupies the allocated reserve capacity, it will be used for irrigation and various conservation purposes, including public health, recreation, and fish and wildlife preservation."

To implement this concept into an operation plan for Harlan County Lake, Reclamation and we agreed to estimate the net spring inflow to Harlan County Lake. The estimated inflow would be used by the Reclamation to provide a firm projection of water available for irrigation during the next season.

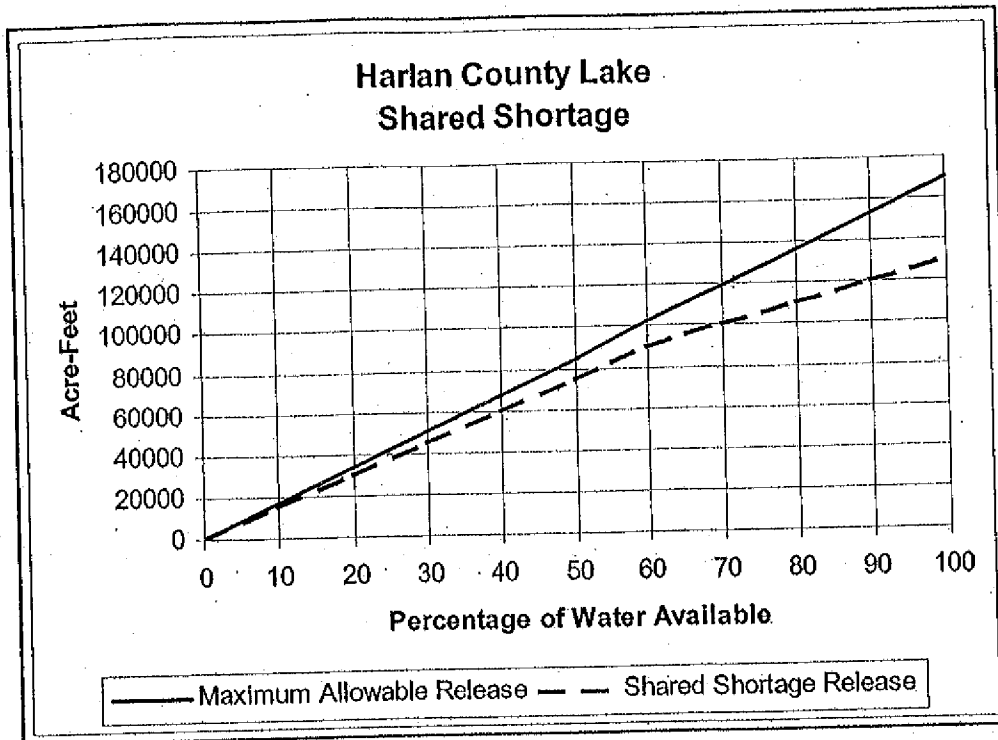
Since the construction of Harlan County Lake, inflows to the lake have been depleted by upstream irrigation wells and farming practices. Reclamation has recently completed an in-depth study of these depleted flows as a part of their contract renewal process. The study concluded that if the current conditions had existed in the basin since 1931, the average spring inflow to the project would have been 57,600 acre-feet of water. The study further concluded that the evaporation would have been 8,800 acre-feet of water during the same period. Reclamation and we agreed to use these values to calculate the net inflow to the project under the current conditions.

In addition, both agencies also recognized that the inflow to the project could continue to decrease with further upstream well development and water conservation farming. Due to these concerns, Reclamation and we determined that the previous 5-year inflow values would be averaged each year and compared to 57,600 acre-feet. The inflow estimate for Harlan County Lake would be the smaller of these two values.

The estimated inflow amount would be used in January of each year to forecast the amount of water stored in the lake at the beginning of the irrigation season. Based on this forecast, the irrigation districts would be provided a firm estimate of the amount of water available for the next season. The actual storage in the lake on May 31 would be reviewed each year. When the actual water in storage is less than the January forecast, Reclamation may draw water from sediment storage to make up the difference.

2.1.4 Water Shortage Sharing.

A final component of the agreement involves a procedure for sharing the water available during times of shortage. Under the shared shortage procedure, the irrigation purpose of the project would remove less water than otherwise allowed and alleviate some of the adverse effects to the other purposes. The procedure would also extend the water supply during times of drought by "banking" some water for the next irrigation season. The following graph illustrates the shared shortage releases.



2.1.5 Calculation of Irrigation Water Available

Each January, the Reclamation would provide the Bostwick irrigation districts a firm estimate of the quantity of water available for the following season. The firm estimate of water available for irrigation would be calculated by using the following equation and shared shortage adjustment:

$$\text{Storage} + \text{Summer Sediment Pool Evaporation} + \text{Inflow} - \text{Spring Evaporation} = \text{Maximum Irrigation Water Available}$$

The variables in the equation are defined as:

- **Maximum Irrigation Water Available.** Maximum irrigation supply from Harlan County Lake for that irrigation season.
- **Storage.** Actual storage in the irrigation pool at the end of December. The sediment pool is assumed full. If the pool elevation is below the top of the sediment pool, a negative irrigation storage value would be used.
- **Inflow.** The inflow would be the smaller of the past 5-year average inflow to the project from January through May, or 57,600 acre-feet.
- **Spring Evaporation.** Evaporation from the project would be 8,800 acre-feet which is the average January through May evaporation.

- Summer Sediment Pool Evaporation. Summer evaporation from the sediment pool during June through September would be 20,000 acre-feet. This is an estimate based on lower pool elevations, which characterize the times when it would be critical to the computations.

2.1.6 Shared Shortage Adjustment

To ensure that an equitable distribution of the available water occurs during short-term drought conditions, and provide for a "banking" procedure to increase the water stored for subsequent years, a shared shortage plan would be implemented. The maximum water available for irrigation according to the above equation would be reduced according to the following table. Linear interpolation of values will occur between table values.

Shared Shortage Adjustment Table

Irrigation Water Available (Acre-Feet)	Irrigation Water Released (Acre-Feet)
0	0
17,000	15,000
34,000	30,000
51,000	45,000
68,000	60,000
85,000	75,000
102,000	90,000
119,000	100,000
136,000	110,000
153,000	120,000
170,000	130,000

2.1.7 Annual Shutoff Elevation for Harlan County Lake

The annual shutoff elevation for Harlan County Lake would be estimated each January and finally established each June.

The annual shutoff elevation for irrigation releases will be estimated by Reclamation each January in the following manner:

1. Estimate the May 31 Irrigation Water Storage (IWS) (Maximum 150,000 acre-feet) by taking the December 31 irrigation pool storage plus the January-May inflow estimate (57,600 acre-feet or the average inflow for the last 5-year period, whichever is less) minus the January-May evaporation estimate (8,800 acre-feet).
2. Calculate the estimated Irrigation Water Available, including all summer evaporation, by adding the Estimated Irrigation Water Storage (from item 1) to the estimated sediment pool summer evaporation (20,000 AF).

3. Use the above Shared Shortage Adjustment Table to determine the acceptable Irrigation Water Release from the Irrigation Water Available.
4. Subtract the Irrigation Water Release (from item 3) from the Estimated IWS (from item 1). The elevation of the lake corresponding to the resulting irrigation storage is the Estimated Shutoff Elevation. The shutoff elevation will not be below the bottom of the irrigation pool if over 119,000 AF of water is supplied to the districts, nor below 1,927.0 feet, msl. If the shutoff elevation is below the irrigation pool, the maximum irrigation release is 119,000 AF.

The annual shutoff elevation for irrigation releases would be finalized each June in accordance with the following procedure:

1. Compare the estimated May 31 IWS with the actual May 31 IWS.
2. If the actual end of May IWS is less than the estimated May IWS, lower the shutoff elevation to account for the reduced storage.
3. If the actual end of May IWS is equal to or greater than the estimated end of May IWS, the estimated shutoff elevation is the annual shutoff elevation.
4. The shutoff elevation will never be below elevation 1,927.0 feet, msl, and will not be below the bottom of the irrigation pool if more than 119,000 acre-feet of water is supplied to the districts.

APPENDIX B

ENVIRONMENTAL ASSESSMENT
FOR
HARLAN COUNTY LAKE

December 16, 1983

Table 3

Seasonal Variable Release Schedule (Preferred Alternative)

Month (1)	<u>Release</u> Zero	<u>Release</u> 10 cfs
	Lake Elevation (2)	Lake Elevation (3)
November	1935.7 ft.	1937.3 ft.
December	1936.2 ft.	1937.9 ft.
January	1936.6 ft.	1938.4 ft.

Note: Release is in cubic feet per second (cfs)

- ★ If, at the end of the month, the elevation is equal to or less than the elevation indicated in column 2, releases will not be made the following month.
- ★ If the end of the month elevation is equal to or greater than the value indicated in column 3, a 10 cfs maximum release will be made the following month.
- ★ If, at the end of the month, the lake elevation is between the elevations indicated in columns 2 and 3, a 5 cfs minimum release will be made the following month.