Appraisal Report

Lower Republican River Basin

Nebraska and Kansas

January 2005

Table of Contents

Appendices

Figures

Tables

Acronyms and Abbreviations

ac-ft	acre-feet
the Basin	Lower Republican River Basin
BCU	Beneficial Consumptive Use
BOC	Bottom of conservation pool
CFR	Comprehensive Facility Review
cfs	cubic feet per second
the Compact	Republican River Compact
Corps	U.S. Army Corp of Engineers
the Court	U.S. Supreme Court
DPR	Definite Plan Report
EOM	end of month
ERS	Economic Research Service
fps	feet per second
FSS	Final Settlement Stipulation
FWCA	Fish and Wildlife Coordination Act of 1958
HP	horsepower
Irr.	Irrigation
LRNRD	Lower Republican Natural Resource District
KAR	Kansas Administrative Regulation
KBID	Kansas Bostwick Irrigation District No. 2
KAF	1,000 ac-ft
kV	kilovolts
KSA	Kansas Storage Act
KWO	Kansas Water Office
MDS	Minimum Desirable Streamflow
MP	mile post

msl	mean sea level
NA	not appropriate
NED	National Economic Development
NEPA	National Environmental Policy Act
NAGPRA	Native American Graves Protection and Repatriation Act
NPDES	National Pollutant Discharge Elimination System
NRD	Natural Resources District
O&M	Operation and Maintenance
OM&R	Operation, Maintenance and Replacement
P.L.	Public Law
PMF	Probable Maximum Flood
POS	plan of study
P-SMBP	Pick-Sloan Missouri Basin Program
Reclamation	Bureau of Reclamation
RMA	Resource Management Assessment
ROW	Right-of-Way
RRCA	Republican River Compact Administration
RTU	Remote Terminal Unit
Service	U.S. Fish and Wildlife Service
SHPO	State Historic Preservation Office
the States	Colorado, Kansas, and Nebraska
TATS	Technical Assistance to States
Affiliated Tribes	Pawnee, Wichita, and Arikara
TOC	Top of conservation pool
USDA, ERS	U.S. Department of Agriculture Economic Research Service
USGS	U.S. Geological Survey

Executive Summary

General

The objectives of this Appraisal Study (Study) of the Lower Republican River Basin (Basin) are to review existing data and information, qualitatively identify some system improvement needs of the area, identify possible constraints and opportunities to make more efficient use of the water that is available, and identify potential solutions to determine the advisability of proceeding to a feasibility study.

This Study meets the States (Colorado, Kansas, and Nebraska) responsibilities of the 1942 Republican River Compact (Compact) "… to provide for the most efficient use of the water of the Republican River Basin for multiple purposes…" This Study and future study efforts indicate a willingness to continue to work with the States to achieve the efficient use of the waters in the Basin.

This Study is based on available data and information with no additional field investigations.

The appraisal study area lies in the Basin below Harlan County Dam in south-central Nebraska to Clay Center, Kansas, just upstream of Milford Lake in north-central Kansas (Figure 1). Included in this area is the Bostwick Division of the Pick-Sloan Missouri River Program (P-SMBP), a Reclamation project.

There are two irrigation districts that operate and maintain the irrigation system: the Bostwick Irrigation District in Nebraska and the Kansas Bostwick Irrigation District No. 2 (KBID). Project water is supplied to 22,935 acres in Nebraska and 42,500 acres in Kansas from the Corp of Engineer's (Corps) Harlan County Lake and Bureau of Reclamation's (Reclamation) Lovewell Reservoir.

Kansas versus Nebraska and Colorado – Lawsuit and Settlement Negotiations

In May, 1998, the State of Kansas filed a Motion for Leave to file a Bill of Complaint before the U.S. Supreme Court (Court) alleging the States of Nebraska and Colorado were violating the Compact. The Court referred the matter to a Special Master in November 1999 and the States entered into negotiations for settlement. On May 19, 2003, the Court approved the Final Settlement Stipulation (FSS) entered into by the States. On October 20, 2003, the Court, based on the final report of the Special Master, took notice of this action, bringing to a formal end to the litigation between the States.

On August 22, 2003, the Republican River Compact Administration (RRCA) formally adopted the Settlement's accounting procedures, including the groundwater model. The purpose of this Study, supported by Kansas and Nebraska, is to meet the requirements as stated in the Final Settlement Stipulation (FSS), December 15, 2002:

> IV. Compact Accounting E. *"The States agree to pursue in good faith, and in collaboration with the United States, system improvements in the Basin, including measures to improve the ability to utilize the water supply below Hardy, Nebraska on the main stem."*
>
> V.A.4. *"Kansas and Nebraska, in collaboration with the United States agree to take actions to minimize by the bypass flows at Superior-Courtland Diversion Dam."*

Needs

There are many competing needs for the limited available water supplies in the study area. The two project irrigation districts usually receive less than the amount of water needed for a full irrigation water supply. Kansas has established Minimum Desirable Streamflow (MDS) requirements at two locations on the Republican River. The instream flow requirements for these two locations have a priority date of April 12, 1984, established by the Kansas Legislature. Water users that have a priority date after April 12, 1984 are closed when the flows are less than the established MDS levels.

Development of Alternatives

During the settlement negotiations, Reclamation published a Value Study Report, "Proposals for More Efficient Management of Lower Republican River Water Supplies," concerning management of the Lower Republican River water supplies. The report recommended that priorities be given to individual proposals, or proposal combinations, when conducting further study and analysis.

Nine alternatives (Alternatives A-I) were formulated using the recommended proposals provided by the Compact Commissioners. These nine alternatives provide irrigation benefits to the Bostwick Division or other needs, such as non-project irrigation or to meet MDS needs. Three other alternatives (Alternatives J, K, and L) were investigated for supplying water for meeting MDS related needs in Kansas, which could include providing water to private irrigators who are junior to the MDS.

Some of the alternatives involve the enhancement and rehabilitation of existing Reclamation owned facilities. It is recognized that the work on these existing

facilities may not require additional authority to implement. These alternatives were included in this Study effort to ensure that all of the possible alternatives would be considered and compared in order to determine the most economical and viable alternative.

The total estimated implementation cost for each alternative ranged from $1,650,000 to $25,000,000. Benefits do not exceed costs for all of the alternatives, but four of the alternatives do have benefits that exceed costs. The benefit-cost ratios for the alternatives range from 0.13 to 4.2.

Results from Study

The Study results indicate additional water can be made available for storage in Lovewell Reservoir. The storage of this additional water could also be considered in other possible downstream facilities such as the Beaver Creek site or Jamestown Wildlife Management Area site. Due to the limitations of the operations model, the hydrology analyses modeled the operation of the system for each alternative with the intent to maximize irrigation benefits of the Bostwick Division. Restrictions of the operations model prevented analyzing the economic impacts related to the MDS and/or the non-project irrigators. Additional hydrological analyses to model system operation which emphasized other potential resource needs, such as MDS, were not performed at this time. As a result, only irrigation benefits of the Bostwick Division have been quantitatively estimated. Allocation of water to provide MDS and/or non-project irrigation benefits would reduce the water available to provide irrigation benefits to the Bostwick Division.

Chapter 1 – Introduction

1.1 Authority

This Appraisal Study (Study) of the Lower Republican River Basin (Basin) was authorized under Federal Reclamation Laws (Act of June 17, 1902, 32 Stat. 388, and acts amendatory thereof and supplementary thereto).

1.2 Purpose and Scope of this Appraisal Study

The purpose of this Study, supported by Kansas and Nebraska, is to meet the requirements as stated in the Final Settlement Stipulation (FSS), December 15, 2002:

> IV. Compact Accounting E. *"The States agree to pursue in good faith, and in collaboration with the United States, system improvements in the Basin, including measures to improve the ability to utilize the water supply below Hardy, Nebraska on the main stem."*
>
> V.A.4. "*Kansas and Nebraska, in collaboration with the United States agree to take actions to minimize the bypass flows at Superior-Courtland Diversion Dam."*

This Study also meets the States (Colorado, Kansas, and Nebraska) responsibilities of the 1942 Republican River Compact (Compact) "… to provide for the most efficient use of the water of the Republican River Basin for multiple purposes…"

This Study is based on available data and information with no field investigations.

1.3 Objectives

There are three main objectives for this Study in accordance with the FSS:

1. Review existing data and information
2. Qualitatively identify system improvement needs of the area
3. Identify possible constraints, opportunities, and potential solutions to determine the advisability of proceeding to a feasibility study.

1.4 Project Area and Description

The appraisal study area lies in the lower portion of the Basin from Harlan County Dam in south-central Nebraska to Clay Center, Kansas just above the upper reaches of Milford Lake in north-central Kansas (Figure 1). Included in this area is the Bostwick Division of the Pick-Sloan Missouri River Program (P-SMBP), a Reclamation project. There are two irrigation districts that operate and maintain the irrigation system: the Bostwick Irrigation District in Nebraska and the Kansas Bostwick Irrigation District No. 2 (KBID). These two districts began delivering water in the early 1950's. Current service is available to 22,935 acres in Nebraska and 42,500 acres in Kansas. Storage water is provided to the Bostwick Division from the Corps of Engineer's (Corps) Harlan County Lake and Reclamation's Lovewell Reservoir. The water supply for Harlan County Lake comes from the Republican River and Lovewell's water supply comes from diversions from the Republican River at the Superior-Courtland Diversion Dam with some inflow from White Rock Creek. Irrigation water for the Bostwick Division is diverted directly from Harlan County Lake and Lovewell Reservoir, from the Republican River at the Superior-Courtland Diversion Dam, and a small amount pumped from the Republican River below Harlan County Dam.

There are about 3,722 square miles of surface drainage area in the Basin between Harlan County Dam and the river gaging station at Clay Center, Kansas. The Republican River is the predominant natural feature. Throughout its length, the river has eroded a valley mantled by alluvial sand and gravel deposits ranging to 60 feet in depth. The valley, averaging less than 2 miles wide, is now entrenched 100 to 200 feet below the adjacent uplands. The bordering loess-mantled prairie plains have been eroded into long tongues of rolling uplands. There are several small, entrenched tributaries, flowing nearly at right angles to the river that drain the upland areas.

This study area is considered subhumid. Precipitation in the area is normally poorly distributed and insufficient for optimum plant growth. The Bostwick Division depends primarily upon the storage water from Harlan County Lake and Lovewell Reservoir. Harlan County Lake inflows have been generally declining with an occasional year or two of excess inflows that help to replenish some of the storage water. Harlan County Lake usually has a limited amount of carryover storage. Lovewell Reservoir carryover storage is supplemented by fall diversions from the Republican River through Courtland Canal. There are competing needs for the limited available water so there is an urgent need to use the available water supplies as prudently and efficiently as possible. Chapter 2 discusses these competing needs further.

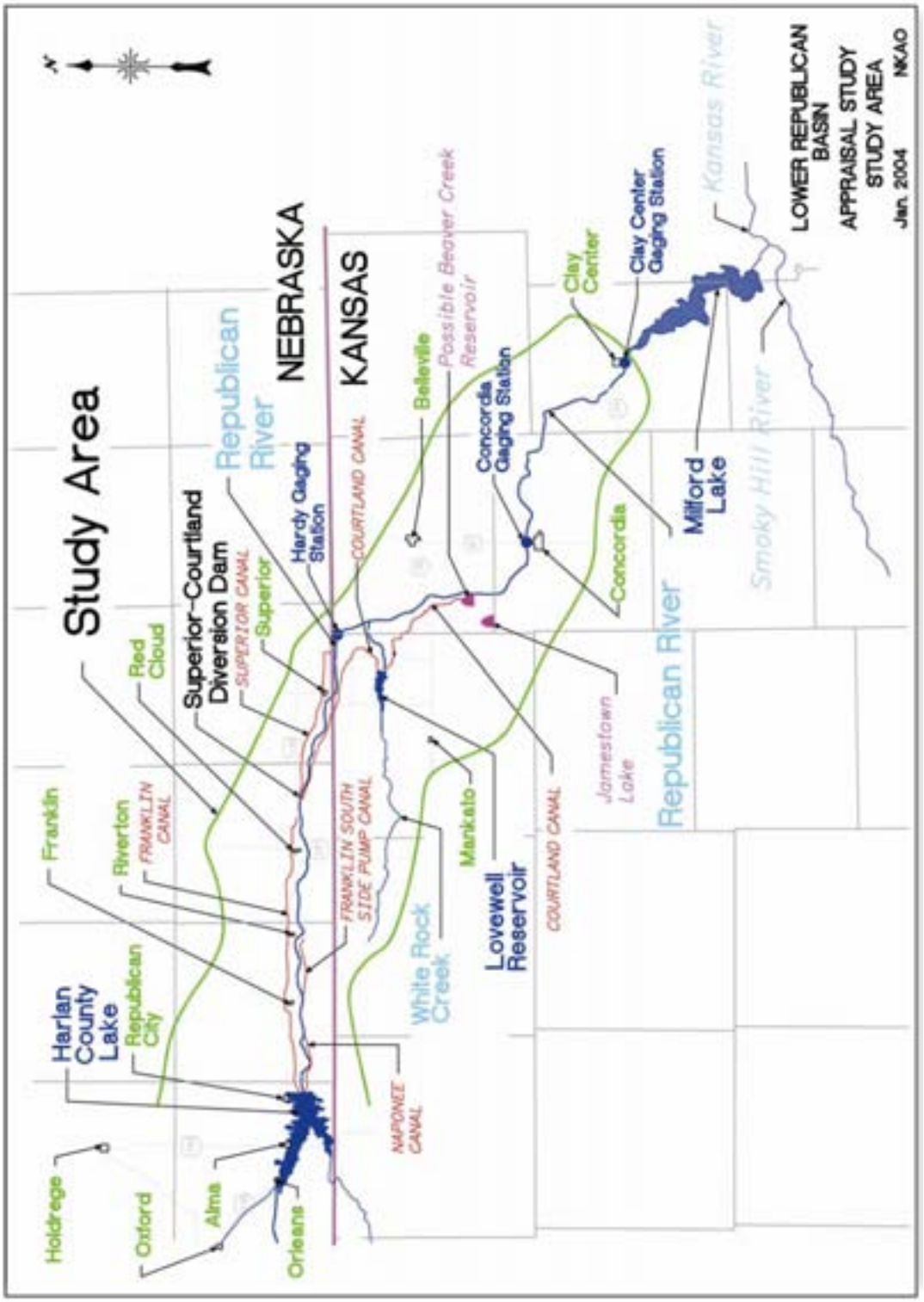


FIGURE 1. STUDY AREA.

1.5 Prior Studies, Reports, and Existing Water Projects

The Bostwick Division was authorized for construction by the Flood Control Act of 1944, Public Law (P.L.) 534, as part of the Missouri River Basin Project of the P-SMBP. The plan for the Bostwick Division was outlined in Senate Document No. 191, revised in Senate Document No. 247, as a coordinated plan of Reclamation and the Corps.

The study area has had considerable project investigations and development of water resource facilities over the last 60-plus years. Only the studies and reports that have a significant importance to the Bostwick Division and the Basin are highlighted:

- Bostwick Division, Nebraska-Kansas, Volume 1, Parts 1, 2, 3, and 4, Definite Plan Report (DPR), Bureau of Reclamation, Region 7, Denver, Colorado, June 1953.

- Bostwick Division, Nebraska-Kansas, Volume 1, Supplement, General Plan of Development, Definite Plan Report (DPR), Bureau of Reclamation, Region 7, Denver, Colorado, April 1956.

- Republican River Basin, Water Management Study, Special Report, Bureau of Reclamation, February 1985.

- Republican River Basin Flows; Flows Adjusted to 1993 Level Basin Development, prepared by Lane, Norval, and Weghorst in the Flood Hydrology Group, Bureau of Reclamation, Technical Service Center, Denver, Colorado, October 1995.

- Resource Management Assessment, Republican River Basin, Water Service Contract Renewal, Bureau of Reclamation, Great Plains Region, July 1996.

- Repayment and Long-Term Water Service Contract Renewals for the Republican River Basin, Nebraska and Kansas, July 2000.

- Technical Assistance to States (TATS) Study, Lower Republican River, Kansas, Water Augmentation Analysis, Bureau of Reclamation, May 2002.

- Final Settlement Stipulation (FSS), Supreme Court of the United States, Kansas vs. Nebraska and Colorado, December 15, 2002.

- Value Study Report, Proposals for More Efficient Management of Lower Republican River Water Supplies, Bureau of Reclamation, Technical Service Center, Denver, Colorado, December 17, 2002.

- Volume Analysis and Revised Flood Frequency Analysis for Comprehensive Facility Review, Lovewell Dam, Bureau of Reclamation, Technical Service Center, Denver, Colorado, May 2003.

- Republican River Basin Report of Preliminary Findings, Nebraska Department of Natural Resources, May 20, 2003.

- Analysis Addressing Hydrologic/Hydraulic Issues, Lovewell Dam, Bureau of Reclamation, Technical Service Center, Denver, Colorado, September 2003.

1.6 Consultation and Meetings

Reclamation and representatives from each State served on a Value Engineering Study Team that analyzed various alternatives to better utilize water supplies in the Lower Republican. During the preparation of the Value Study Report and prior to the commencement of this Study, a number of briefing meetings were conducted with the Republican River Lawsuit Settlement Negotiations Team. During the meetings, the Republican River Compact Commissioners recommended specific proposals that should be considered for further study. Chapter 2 discusses the descriptions of these proposals.

The consultation for this Study consisted of providing the States two written Status Reports and holding conference calls with the States and Reclamation representatives. State water and natural resource entities were invited and participated.

Reclamation hosted meetings in Superior and Kearney, Nebraska and Mankato, Kansas to discuss the Study. Attendees included personnel from Reclamation, both Bostwick Irrigation Districts, and state water and natural resource representatives from Kansas and Nebraska.

A brief report of Study activities was also provided to the attendees at the Annual Republican River Compact Workshop meeting held on August 21, 2003 and the Compact meeting on August 22, 2003 at Alma, Nebraska.

The State of Colorado indicated they would likely not be involved in any future feasibility study since Colorado is not directly involved with the existing features in the lower reaches of the Republican River (below Harlan County Dam). Colorado representatives did not attend the meetings held in Superior, Kearney, or Mankato, however, they were in attendance at later meetings and were a part of the Value Engineering Study Team.

Chapter 2 – Problems and Needs

There are many competing needs for the limited available water supplies in the study area. The two project irrigation districts usually receive less than the full amount of water needed for a full irrigation water supply. Kansas has established Minimum Desirable Streamflow (MDS) requirements, described later in this chapter, at two locations on the Republican River: Concordia and Clay Center. The instream flow requirements for these two locations have a priority date of April 12, 1984, established by the Kansas Legislature. (Note: Water users that have a priority date after April 12, 1984 are closed when the flows are less than the established MDS levels.)

2.1 Republican River Compact

The Compact allocates waters from the Basin, above Hardy, Nebraska to the States. The entire water supply originating below Hardy is allocated to Kansas. The Compact's Engineering Committee annually calculates the Basins water supply available for allocation and the Beneficial Consumptive Use (BCU) in the Basin. These calculations determine each States' allocation and total BCU. BCU is defined in the Compact as "That use by which the water supply of the Basin is consumed through the activities of man, and shall include water consumed by evaporation from any reservoir, canal, ditch or irrigated area." Water diverted at Superior-Courtland Diversion Dam is considered Compact water and would be included in the water supply and BCU calculations.

2.2 Republican River Compact Litigation and Settlement

In May 1998, the State of Kansas filed a Motion for Leave to file a Bill of Complaint with the U.S. Supreme Court (the Court) alleging the States of Nebraska and Colorado were violating the Compact. The Court referred the matter to a Special Master in November, 1999.

Following hearings, rulings of the Special Master, and a significant portion of discovery, the States began discussing the possibility of settlement negotiations. After several negotiation sessions the Special Master, at the request of the States, agreed to postpone the progression of the case until December 15, 2002, in order to allow the States to engage in settlement negotiations. The U.S. Department of Justice, Reclamation, and the U.S. Army Corp of Engineers (Corps) also participated. These negotiations culminated in a settlement package that was subsequently approved and entered into by the Governor and Attorney General of each State.

On April 15, 2003, the Special Master formally recommended the approval of the Final Settlement Stipulation (FSS) to the Court. On May 19, 2003, the Court approved the FSS. On October 20, 2003, the Court, based on the final report of the Special Master, took notice of this action, bringing a formal end to the litigation between the States.

On August 22, 2003, the Republican River Compact Administration (RRCA) formally adopted the Settlement's accounting procedures, including the groundwater model.

2.3 Settlement Provisions

Provisions excerpted from the FSS that pertain directly to this Study include:

> IV. Compact Accounting E. *"The States agree to pursue in good faith, and in collaboration with the United States, system improvements in the Basin, including measures to improve the ability to utilize the water supply below Hardy, Nebraska on the main stem."*
>
> V.A.4. *"Kansas and Nebraska, in collaboration with the United States, agree to take actions to minimize bypass flows at Superior-Courtland Diversion Dam."*

During the settlement negotiations, Reclamation published a Value Study Report, "Proposals for More Efficient Management of Lower Republican River Water Supplies," concerning management of the Lower Republican River water supplies. The report recommended that priorities be given to the following individual proposals, or proposal combinations, when conducting further study and analysis:

- Proposal B Courtland Canal Automation, Reshape Canal Prism, Winter Operation
- Proposal C1 Increase Lovewell Capacity – 16,000 acre-feet (ac-ft)
- Proposal C2 Increase Lovewell Capacity – 35,000 ac-ft
- Proposal G Off-stream Storage – Kansas Tributaries, Beaver Creek

Proposals B, C1, and C2 were analyzed and further developed as alternatives in the operations model. Due to budget and time constraints, potential for improved use of the water supply below Hardy on the mainstream was not analyzed. Other proposals involving tributaries to the mainstream were considered and analyzed.

Due to the limitations of the operations model, only a qualitative analysis of Proposal G was performed at this stage of the study.

2.4 Problems and Opportunities

2.4.1 Existing Conditions

The Basin reach downstream of Harlan County Dam is subject to occasional flooding, periods of excess precipitation, and occasional droughts. The existing project facilities for the Bostwick Division in Nebraska and Kansas are around 50 years old with typical ongoing maintenance and operational problems associated with aging facilities.

There are two irrigation districts that operate and maintain the irrigation system: the Bostwick Irrigation District in Nebraska and the KBID. These two districts began delivering water in the early 1950's. Current service is available to 22,935 acres in Nebraska and 42,500 acres in Kansas. Storage water is provided to the Bostwick Division from the Corps of Engineer's (Corps) Harlan County Lake and Reclamation's Lovewell Reservoir (1957). Due to changing hydrologic conditions in the entire Basin, these two districts frequently experience water supply shortages. For example, according to Reclamation's Resource Management Assessment (RMA) (Reclamation 1996) of the Basin, the mean annual historic (1931-1993) flow into Harlan County Lake was 247,000 ac-ft and the 1993 development level for the same period was 124,000 ac-ft. The 1993 development level projects what the flows would be if all of the 1993 level of development had occurred at the beginning of the study period and remained at that level throughout the study period.

In the Basin in Nebraska there are surface water rights totaling about 100 cubic feet per second (cfs) in the reach below Harlan County Dam and above the Superior-Courtland Diversion Dam. Most of these rights are junior to the Bostwick Division's rights. Below the Diversion Dam and above the Nebraska-Kansas State line there are surface water rights totaling about 25 cfs, with most of these rights also junior to the Bostwick Division rights. Nebraska has recently taken action to adjudicate water rights in this area and some rights may be cancelled in the future.

There are a considerable number of groundwater irrigation wells in Nebraska below Harlan County Dam. As of late 2003 there were 1,668 active irrigation wells in the Lower Republican Natural Resources District (LRNRD) below Harlan County Dam. There were 1,066 in Franklin County, 483 in Webster County, and 119 in Nuckolls County.

Except in certain circumstances the States adopted a prohibition on the construction of new wells in the Basin above the Superior-Courtland Diversion

Dam as part of the settlement provisions. In December 2002, in compliance with the FSS, the LRNRD approved a three year moratorium on new wells pumping more than 50-gallons-per-minute in the Nebraska part of the Basin. The LRNRD is also phasing in a well metering requirement for existing wells to track water usage.

Kansas surface water rights total about 210 cfs, including about 17 cfs vested rights, in the reach below the Nebraska-Kansas State line and above Clay Center. A vested right continues the beneficial use of water that began prior to June 28, 1945.

There are about 385 registered irrigation wells in the portion of the Basin from the stateline to Clay Center. Much of the bottom lands of the river valley are irrigated by wells pumping from the alluvial aquifer. Kansas considers the Basin to be fully appropriated. All water rights issued after 1984 are subject to administration when MDS standards are not met.

The Kansas Water Office (KWO) requests administrative action when a violation in MDS flows occurs. The Chief Engineer checks for unauthorized use, compliance with existing permits, and, if necessary, initiates administration of junior water rights. In 2000, flows dropped below the MDS resulting in the suspension of approximately 150 junior right groundwater irrigators. When they are allowed to pump, these irrigators use an estimated 10,000 ac-ft of water per year. These rights are in aquifers previously determined by the State of Kansas to be hydraulically connected to the river. This action did not impact the operations of the Bostwick Division since water rights associated with irrigation of project lands are senior to the water right priority date for MDS. Kansas has been administering MDS at Concordia and Clay Center since the summer of 2002 to the present time (August, 2004).

2.4.2 Expected Future Conditions

The conditions used for the hydrology baseline conditions, Chapter 3.3, are considered to be the expected future conditions of the Basin from Harlan County Dam to Clay Center. Actions will likely be required by the States to come into compliance with the Compact, however, there have been no understandings reached for the actions the States may take to control their consumptive uses if the Compact requirements are not met. Additionally, the new contracts between the Bostwick Irrigation Districts and Reclamation (signed in 2000) mandated distribution system and on-farm delivery system efficiency improvements. The Bostwick Irrigation Districts committed to implement improvements that would achieve on-farm efficiency improvements of 5 percent and delivery system efficiency improvements between 2 percent and 8 percent (each contract contains a specific number) in the 10-year period beginning in 2001. In the event these improvements are not obtained by any district by 2010, that district and

Reclamation will agree to additional water conservation measures to be implemented over the next 5 years (by 2015).

It is anticipated the consumptive uses will stay at current levels or be reduced to attain compliance with the Compact and the FSS. The 1993 level of development for streamflow conditions was used to set the baseline condition for this Study with no significant changes in the operations of the Bostwick Division.

2.4.3 Opportunities

There are opportunities to improve the efficient use and overall management of the Basin's water resources. This can be done by increasing the water supplies available for Bostwick Division lands, providing additional flexibility for the States to comply with the FSS provisions associated with the Compact, or by supplying water for supplementing flows to meet downstream needs, particularly during times of shortage.

The Bostwick Irrigation Districts frequently experience water delivery shortages. There are opportunities to provide Bostwick Division lands with improved water deliveries to reduce the frequency and severity of the shortages.

If adequate water is available there may also be opportunities in the Basin to provide Kansas with supplemental water flows to meet the downstream needs, including supply to offset depletions of water right holders junior to MDS. Use of a storage facility at Beaver Creek, Jamestown, or other locations could provide additional fish and wildlife benefits, supplement flows to meet MDS, and improve the use of the water supply below Hardy.

2.4.4 Problems Warranting Federal Participation

Reclamation and the Corps have been involved in the Basin for over 60 years. Federal water supply contracts with the Bostwick Irrigation Districts were renewed in 2000. The Bostwick Division in Nebraska and Kansas use most of the water storage space in Harlan County Lake and Lovewell Reservoir. Both districts have experienced significant water delivery shortages and anticipate that shortages will continue. Available water supplies for the Basin have decreased over the years and the perception that Nebraska and Colorado use more than their Compact water allocation contributed to Kansas's decision to file a complaint against Nebraska and Colorado in the Court (May 26, 1998). Presently some water supplies in the Lower Basin are not being fully utilized, and with some improvements in the existing systems and possibly some additional storage, the system could be managed to alleviate some of the water shortage problems.

The Bostwick Irrigation Districts have Federal repayment obligations on their projects. The Federal government, although not a named defendant in the litigation among the States, was a participant in the negotiated FSS and agreed to collaborate with the States to pursue system improvements to make more efficient use of the water.

2.4.5 Planning Objectives and Planning Constraints

Input on planning objectives and planning constraints was sought from the involved States and interested parties such as the Bostwick Irrigation Districts, Natural Resource Districts (NRD) in the Basin, the Lower Republican Water Users, the Kansas Department of Wildlife and Parks, the Kansas Water Office (KWO), Kansas Division of Water Resources, and Nebraska Department of Natural Resources.

2.4.5.1 Planning Objectives

Input from interested parties resulted in Reclamation identifying the following planning objectives for the Study with the overriding objective to determine the Federal interest to conduct a feasibility study:

- Minimize bypass at Superior-Courtland Diversion Dam.
- Provide augmentation storage water for MDS.
- Develop cost effective solutions.
- Provide additional water supply to Bostwick Division lands (additional inches of water).
- Provide additional recreation benefits.
- Recognize possible environmental and cultural impacts.

The primary planning objective for developing alternatives is to conform to the FSS as agreed upon by the States and approved by the Court.

2.4.5.2 Planning Constraints

Constraints on the development of these plans include the following:

- Republican River Compact
- State Water Rights
- Harlan County Consensus Plan
- Physical limitations of existing facilities, including Courtland Canal, Lovewell Reservoir, and other storage facilities
- Environmental and cultural consideration

Chapter 3 – Alternative Plans

3.1 Management Methods

Several management methods were developed to enhance the use of the water supply in the section of the Basin below Harlan County Dam. Combinations of these management methods were developed into the alternatives presented in this chapter.

A number of the alternatives being considered involve the enhancement and rehabilitation of existing Reclamation-owned facilities. The work on these existing facilities may or may not require additional construction authority to implement. These alternatives were included in this Study to ensure that all of the possible methods would be considered and compared to determine the most economical and viable alternative.

3.1.1 Winterize Superior-Courtland Diversion Dam and Courtland Canal

The river flow at Superior-Courtland Diversion Dam currently cannot be diverted into Lovewell Reservoir during the winter months due to periods of icing. Winterizing[1] the Diversion Dam and Courtland Canal would allow canal diversions whenever water is needed and available. This could potentially increase the water in Lovewell Reservoir or some other storage structure near the canal. This improvement would result in Lovewell Reservoir filling earlier in the spring and would provide additional time for maintenance of the diversion dam and conveyance system.

3.1.2 Automate Superior-Courtland Diversion Dam and Courtland Canal

Fluctuations in the flows of the Republican River at the diversion dam occur because of storm runoff, weather changes, and operational changes. These flow fluctuations make it difficult to eliminate or minimize bypass flows at the Diversion Dam. Some of these fluctuations could be diverted by automating the gates at the Diversion Dam and the check structures and by placing a more reliable flow measurement structure on the canal to minimize bypass flows. This would result in a decrease in the river flow below the Diversion Dam when the capacity of Courtland Canal allows for more of the flow of the river at the Diversion Dam to be diverted. To address the stipulation detailed in the FSS to minimize the bypass flows at Diversion Dam, the implementation of an alternative involving this method would need to be addressed.

[1] "Winterizing" involves the placement of bubblers at the check stations on Courtland Canal and at the Superior–Courtland Diversion Dam to de-ice structures during the winter.

3.1.3 Renovate Courtland Canal (Restore the Courtland Canal to Design Capacity)

This measure would restore the Courtland Canal to its design capacity of 751 cfs between the Diversion Dam and Lovewell Reservoir. The current capacity is estimated to be approximately 580 cfs due to sloughing of the canal banks in some sections and the replacement of road bridges with in-line pipe structures that will not handle the canal design capacity at several points. These smaller in-line structures were installed by Jewell County as a cost savings measure when county road bridges were replaced. The pipe structures would be removed and replaced by structures which do not restrict flow. The canal would also be reshaped to provide for the additional capacity.

3.1.4 Provide for Increased Conservation Storage in Lovewell Reservoir

The existing Lovewell Reservoir has an active conservation capacity of 24,022 ac-ft (Figure 2). Proposals include raising this conservation storage by 16,000 ac-ft (Figure 3) or 35,000 ac-ft (Figure 4). Increases in conservation capacity would require raising the conservation pool from Elevation 1582.6 to Elevation 1587.3 (16,000 ac-ft) or Elevation 1592.0 (35,000 ac-ft). These proposals involve modifications to the existing dam and appurtenant structures allowing an increase in the active conservation capacity and the total reservoir capacity, while maintaining the existing flood control and surcharge capacities. Proposals that converted a

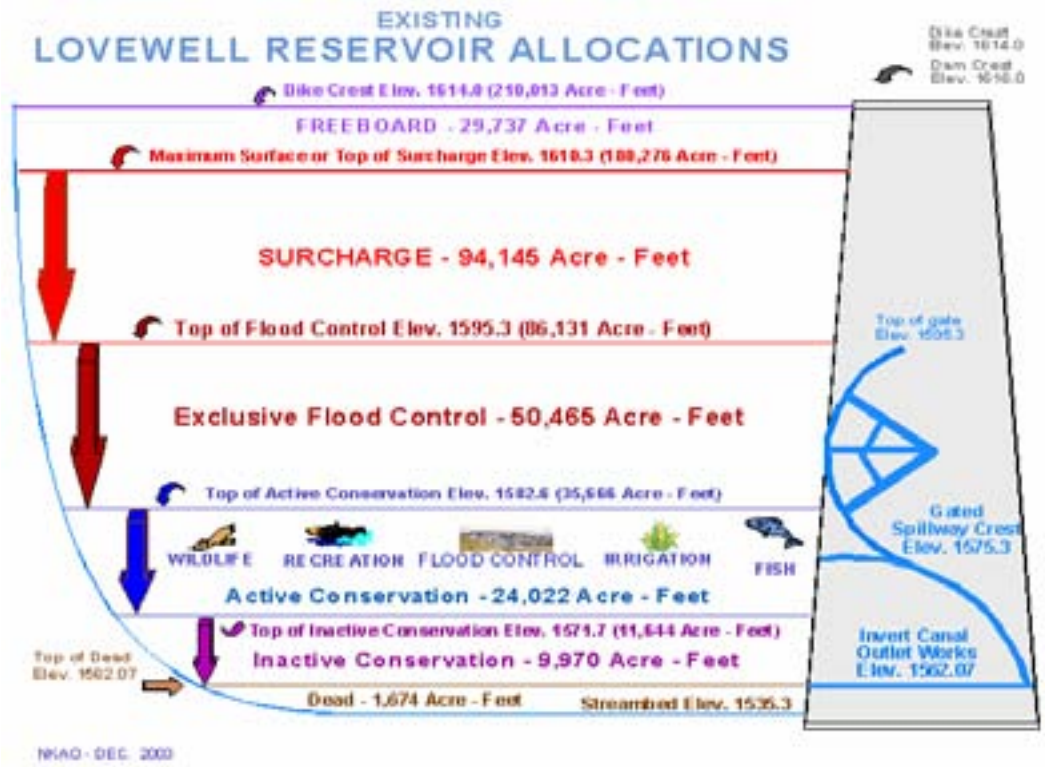


FIGURE 2. LOVEWELL RESERVOIR EXISTING ALLOCATIONS.

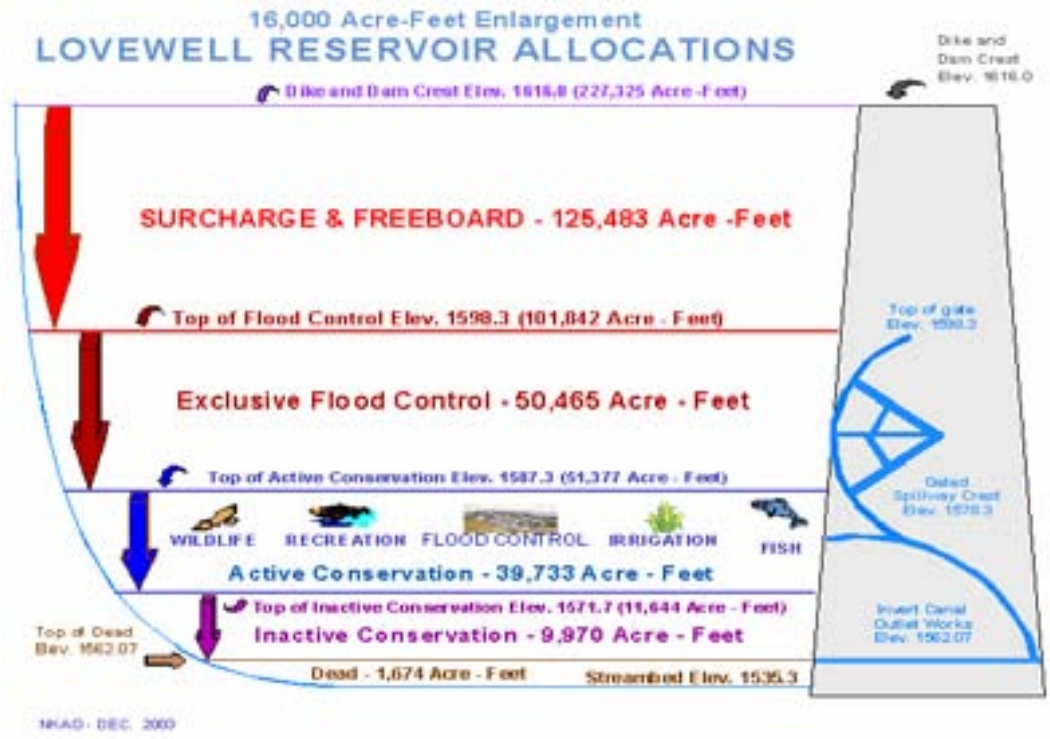


FIGURE 3. LOVEWELL RESERVOIR ALLOCATIONS FOR 16,000 AC-FT ENLARGEMENT.

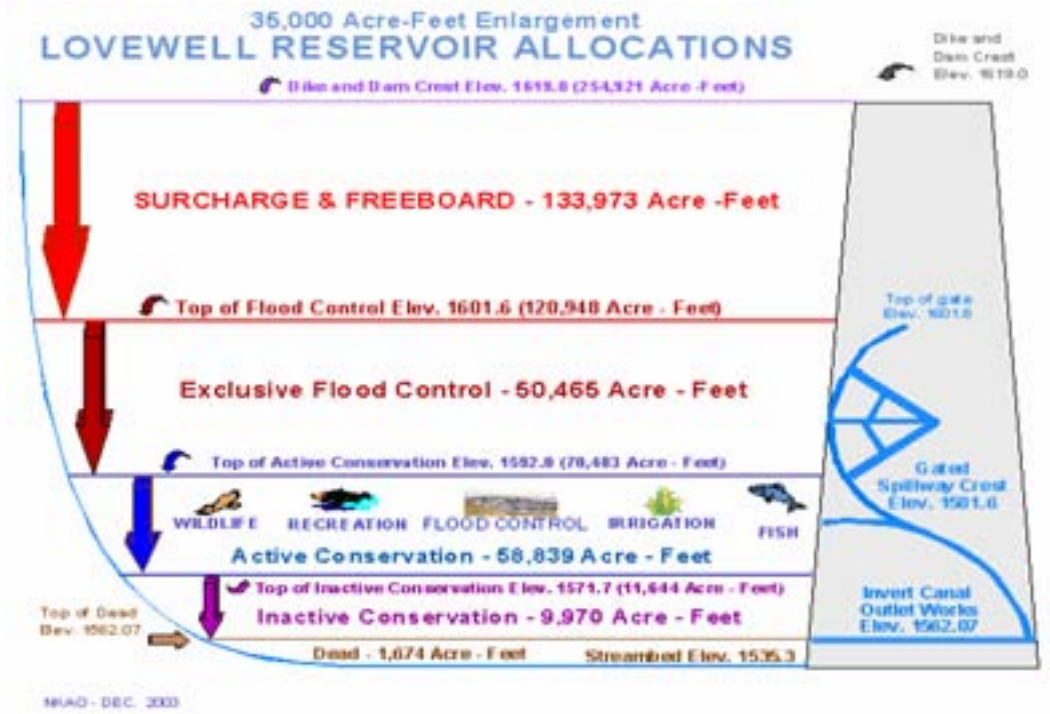


FIGURE 4. LOVEWELL RESERVOIR ALLOCATIONS FOR 35,000 AC-FT ENLARGEMENT.

portion of the flood control storage to conservation storage without modifications to the dam were considered but rejected due to the increased flood risks.

3.2 River System Operation Model

A modified version of the OPSTUDY computer model used for Reclamation's Contract Renewal Study in the Basin was used for the evaluation of the water supply for the alternatives presented in this Study. The computer model simulated the streamflow and reservoir conditions for the entire Basin. The original model used monthly hydrologic data between 1931 thru 1993. For this Study, the model was updated to include historic hydrologic data thru 2000.

Irrigation benefits for increased water supply for the Bostwick Division were determined at the appraisal level of detail. If more detailed studies to evaluate other potential benefits, such as MDS, are desired at a later date the model may need to be modified to evaluate these options for use of the water supply.

Since this Study concentrates on improving the use of the water supply below Harlan County Lake, efforts to improve the original model centered on that same area of the Basin (Figure 5). The model was modified to incorporate Harlan County Lake Consensus Plan (Consensus Plan) criteria which resulted from the contract renewal process. The details of the Consensus Plan and additional details concerning the model are included in Appendix A.

The operations model includes:

- Consensus Plan for Operation of Harlan County Lake
- Reservoir inflows and reach gain calculations
- Reservoir evaporation rates
- Monthly crop irrigation requirements.

3.3 Description of Baseline and Alternatives

The baseline condition, considered the future without or no action condition, included the simulation of the streamflows and reservoir operations of the Basin. The streamflow conditions were described above and the delivery efficiency associated with the contract renewals for the irrigation districts was included in the baseline run. The following alternatives were developed using various combinations of the management methods discussed previously. Table 1 indicates the parameters that were changed that were in the alternative model runs.

The nine alternatives are briefly described below. The evaluations of these alternatives are included in Section 3.4.

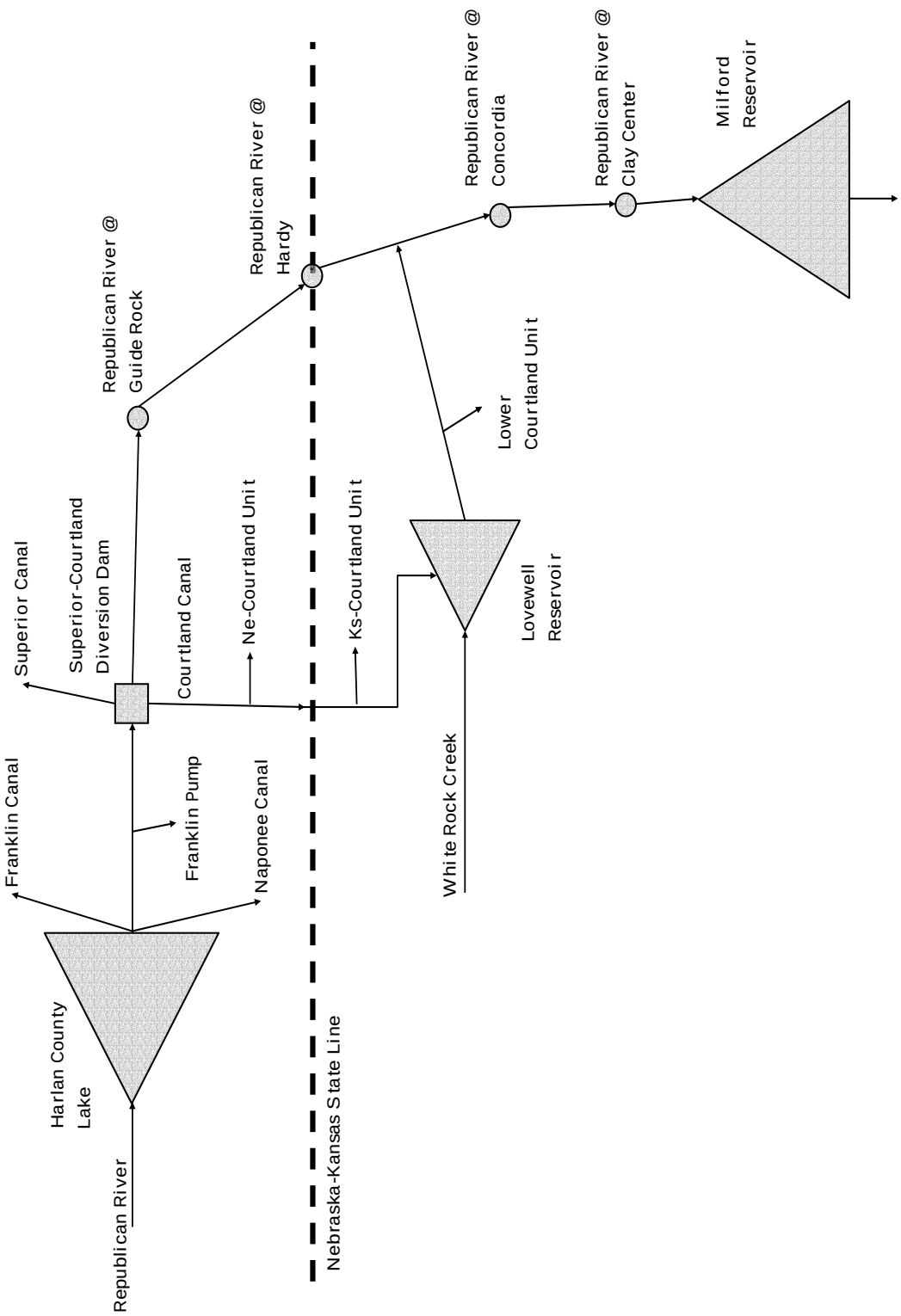


FIGURE 5. SCHEMATIC DIAGRAM OF LOWER REPUBLIC RIVER BASIN.

TABLE 1. SUMMARY OF MODEL RUNS

Courtland Canal Capacity (cfs)	580	751	580	751	580	751	580	751	580	751
Bypass at Div. Dam (cfs)										
Irrigation Season	40	40	0	0	0	0	0	0	40	40
Rest of Year	10	10	0	0	0	0	0	0	10	10
Lovewell TOC[1] (1000 ac-ft)	35.7	35.7	35.7	35.7	51.7	51.7	70.7	70.7	51.7	51.7
Lovewell BOC[2] (1000 ac-ft	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Winter Diversions (Ice)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Increased Storage Use	NA	NA	NA	NA	Irr.[3]	Irr.	Irr.	Irr.	Irr.	Irr.

A. Courtland Canal to Design Capacity, Winterize

B. Automate, Winterize

C. Automate, Winterize, Courtland Canal to Design Capacity

D. Automate, Winterize, Raise Lovewell 16,000 ac-ft

E. Automate, Winterize, Raise Lovewell 16,000 ac-ft, Courtland Canal to Design Capacity

F. Automate, Winterize, Raise Lovewell 35,000 ac-ft

G. Automate, Winterize, Raise Lovewell 35,000 ac-ft, Courtland Canal to Design Capacity

H. Raise Lovewell 16,000 ac-ft

I. Raise Lovewell 16,000 ac-ft, Courtland Canal to Design capacity

[1] TOC = Top of conservation pool (Enlargement values vary some from values in Figures 3 and 4.

[2] BOC = Bottom of conservation pool.

[3] Irr. = Irrigation.

3.3.1 Alternative A – Courtland Canal to Design Capacity, Winterize

Alternative A would provide for winterizing Superior-Courtland Diversion Dam and Courtland Canal to allow for operations whenever water is available and needed for irrigation or storage in Lovewell Reservoir. This alternative would also return Courtland Canal to design capacity, allowing the capture of higher peak runoff events and increasing operational flexibility of Lovewell Reservoir storage.

3.3.2 Alternative B – Automate, Winterize Courtland Canal

Alternative B provides for automating and winterizing the Superior-Courtland Diversion Dam and Courtland Canal. Implementing this alternative would allow the capturing of the smaller bypass flows from the Diversion Dam that are within current reduced canal capacity, thereby minimizing the bypass at the Diversion Dam. It also provides for the diversion of water whenever water is available and needed for irrigation or storage in Lovewell Reservoir.

3.3.3 Alternative C – Automate, Winterize, Courtland Canal to Design Capacity

Alternative C is a combination of Alternatives A and B, including all the provisions of these alternatives.

3.3.4 Alternative D – Automate, Winterize Courtland Canal; Raise Lovewell 16,000 ac-ft

Alternative D includes the provisions of Alternative B and adds additional conservation storage of 16,000 ac-ft in Lovewell Reservoir for storage of available flows.

3.3.5 Alternative E – Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft

Alternative E includes all of the provisions of Alternative C and adds the additional conservation storage of 16,000 ac-ft in Lovewell Reservoir for storage of available flows.

3.3.6 Alternative F – Automate, Winterize Courtland Canal; Raise Lovewell 35,000 AF

Alternative F includes the provisions of Alternative B and adds additional conservation storage of 35,000 ac-ft in Lovewell Reservoir for storage of available flows.

3.3.7 Alternative G – Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 ac-ft

Alternative G includes the provisions of Alternative C and adds additional conservation storage of 35,000 ac-ft in Lovewell Reservoir for storage of available flows.

3.3.8 Alternative H – Raise Lovewell 16,000 ac-ft

Alternative H continues the current operations and provides additional conservation storage of 16,000 ac-ft in Lovewell Reservoir for storage of available flows.

3.3.9 Alternative I – Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft

Alternative I would return Courtland Canal to design capacity and provides additional conservation storage of 16,000 ac-ft in Lovewell Reservoir for storage of available flows.

3.3.10 Other Storage Alternatives

Additional storage facilities that would need to be supplied by water delivered through the Courtland Canal system include a reservoir on Beaver Creek and the Jamestown Wildlife Management Area. Extension of the existing canal system would be required in order to deliver water to these storage facilities. Delivery of water to these facilities was not analyzed in this appraisal study because significant

revisions to the OPSTUDY model would be required. These alternatives could be examined further if a feasibility study is undertaken. Alternatives that include delivering additional water to Lovewell Reservoir could be modified to deliver the additional water to other storage facilities if other benefits such as supplementing flows to meet MDS were desired. Use of a storage facility such as Beaver Creek or Jamestown could also provide additional fish and wildlife benefits and could improve the utilization of the water supply below Hardy.

3.4 Evaluation of Alternatives

3.4.1 Hydrologic Evaluations

3.4.1.1 Changes of Water Supply into Lovewell Reservoir

Table 2 shows the flows into Lovewell Reservoir for each model run:

TABLE 2. AVERAGE DISCHARGE FROM COURTLAND CANAL INTO LOVEWELL (KAF – 1,000 AC-FT)

		Alternatives								
	Baseline	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Annual	25.2	32.8	30.3	35.5	35.1	39.1	39.7	42.5	29.4	32.9
Non-Irrigation Season	11.2	13.8	15.6	15.0	21.6	20.6	26.7	25.1	16.1	15.3
Irrigation Season	14.0	19.0	14.8	20.5	13.4	18.6	12.9	17.5	13.3	17.6
Dec thru Feb	0.0	4.8	5.4	5.2	7.2	7.0	7.5	7.4	0.0	0.0

Additional water available for storage in Lovewell Reservoir can be calculated by comparing the value for each alternative to the baseline value. As shown in Table 2 the increase in average water supply for the non-irrigation season varies from 2,600 ac-ft to 15,500 ac-ft and the annual variance is 4,200 ac-ft to 17,300 ac-ft, (e.g., 17,300 = 42,500 – 25,200). The December through February row indicates the additional water available by changes that provide for operations during times that icing is likely to occur.

3.4.1.2 Minimum Desirable Streamflows Analysis

As stated in Chapter 2, Kansas has established MDS requirements in the Basin. The MDS specifies the minimum streamflows to meet water quality and quantity needs of aquatic life and senior water rights downstream. Water users who received a water right after the effective date of MDS requirements have water rights subject to administration during periods when MDS flows are not met. When the water supply is insufficient for all users, water right holders with junior rights may be restricted or shut off. The present irrigation rights associated with the Bostwick Division are senior to the MDS priority date of April 12, 1984. Using the flow data

from the alternative analyses, the Republican River at Clay Center flows were examined to determine the effects of the alternative on the MDS at that location. Although the MDS is a daily flow requirement, monthly flows were analyzed to display overall effects of the alternatives on the baseline streamflow at this gage. The period analyzed for MDS effects was 1981-2000 (20 years).

When evaluating the alternatives for Bostwick Division irrigation benefits only, each alternative results in an increase in the number of times the MDS is violated and an increase in the total volume of additional water needed to meet the MDS. Baseline data for this period indicated that the MDS was violated 1,386 times with a variation of 1,488 to 2,073 times for the alternatives. The annual average volume needed for compliance in the baseline was 9,633 ac-ft with a variation of 9,107 ac-ft to 15,377 ac-ft for the alternatives. Additional information can be found in the tables summarizing the results of this analysis in Appendix A.

3.4.1.3 Farm Delivery Changes

For the irrigation benefit analysis estimation included in Section 3.4.3, Table 3 shows the average farm deliveries to the Bostwick Division that were used as an input to the analysis:

TABLE 3. AVERAGE ANNUAL FARM DELIVERIES TO BOSTWICK DISTRICTS (INCHES)

		Alternatives								
	Baseline	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Bostwick	11.5	11.7	12	12.2	13	13.1	13.7	13.8	12.4	12.4

All alternatives show an increase in farm delivery compared to the baseline. The average annual farm delivery requirement for this area is about 24 inches.

3.4.2 Alternative Design and Cost Estimates

Design assumptions and cost of the alternatives are discussed below. The cost estimates are summarized in Table 6 and presented in detail in Appendices B and C.

3.4.2.1 Canal Components

3.4.2.1.1 Canal Flow

The canal flow for the various alternatives was set either at 580 cfs (the current canal capacity) or 751 cfs (the original design canal capacity). The current reduced canal capacity of 580 cfs is due to the degradation of the original canal prism and restrictions at several locations.

3.4.2.1.2 Canal Rehabilitation

The Courtland Canal was originally designed with a combination of earth and concrete lined canal sections. The original design required the construction of a trapezoidal canal prism. Over time, the existing canal prism has become rounded,

and presently, the existing canal prism exhibits geometry somewhat less than trapezoidal. Sections of concrete lining have deteriorated which has resulted in reduced canal capacity. Additionally, the maximum flow rate of the Courtland Canal has degraded to a flow rate of 580 cfs (the Courtland Canal has been in service approximately 50 years). Canal rehabilitation would address the degradation of the existing canal prism through reshaping and return the flow rate to the original design flow rate of 751 cfs for Courtland Canal.

The Courtland Canal prism reshaping for earth-lined sections was based on using a maximum velocity of not more than 2.0 feet per second (fps) due to the embankment material's tractive forces encountered (for silts and silt loams conveying clear water, the maximum permissible velocity is 2.0 fps). The original design for full flow resulted in a velocity of approximately 2.4 fps and the material used to construct the earth-lined portions of the canal prism is identified as silts with some fine sands. As noted above, these higher-than-desirable flow velocities resulted in the erosion of the canal prism that has been observed. The rehabilitated canal prism would be sized to accommodate a 2.0 fps velocity for a flow rate of 751 cfs with a slope of approximately 0.00011. The length of the Courtland Canal subjected to canal prism reshaping was estimated at 29.6 miles (from Superior – Courtland Diversion Dam to Lovewell).

The original design of Courtland Canal included limited sections of non-reinforced concrete lined-canal. Over the years, these concrete lined sections have deteriorated beyond the point of repair. The Courtland canal rehabilitation would involve the removal of the existing concrete-lined sections. The rehabilitated canal prism would be sized to accommodate an estimated 2.9 fps velocity for a flow rate of approximately 751 cfs with a slope of 0.00008. Approximately, 15,000-ft of existing concrete-lined canal would be removed and replaced with 60 mils thick geomembrane on the canal prism invert and side slopes. Additionally, 8-inches of gravel cover over the membrane would be placed in the invert of the canal prism. The geomembrane would be exposed on the canal prism side slopes.

Currently there are six county road crossings using modified railroad tanker cars that are undersized and restrict canal flows. The crossings are to be replaced with road bridges that will accommodate the original design flow of 751 cfs.

Canal excavation, backfill and compacted backfill quantities were computed based on estimated canal cross sections. Quantities for canal earthwork, including common excavation, backfill and compacted backfill, were based on a typical canal section.

3.4.2.1.3 Modifications for Winter Operations

A bubbler system is proposed for each of the radial gates at the 11 check structures on Courtland Canal and canal headworks at the Diversion Dam in order to provide for

winter operations. The bubbler system would prevent the buildup of ice at the gates, thereby maintaining necessary flow control in the canal during the winter season. The cost estimate also includes furnishing and installing single phase 5 kilovolts (kV) power line with wood poles based on a 1.0 mile pull. The power would also be used for the Remote Terminal Unit (RTU) and radial gate motor operators.

3.4.2.1.4 Canal Automation

The automation component consisted of automation of the radial gates at 11 check structures and the canal headworks at the Diversion Dam. A local control mode would be used, based on upstream and downstream water depths to control the radial gate.

A RTU would provide the control at the individual radial gate. The RTU would consist of a PC-based controller which would receive input from gate position and water depth sensors. The RTU would provide local control of the radial gate based on control algorithms and control software.

Power would be provided to the RTU. The radial gates would be provided with a motor operator to allow the RTU to automatically raise or lower the gate position.

Stilling wells would be installed at the 11 check structures for monitoring the depth upstream and downstream of the radial gate[2]. A pressure transducer would be placed in each stilling well for water depth measurement. The pressure transducer would transmit water depth data back to the RTU.

3.4.2.2 Components to Increase Storage Capacity in Lovewell Reservoir

Lovewell Dam impounds water from White Rock Creek and from diversions of the Republican River made available by the Superior-Courtland Diversion Dam through the Courtland Canal. Based on Lovewell Reservoir Area and Capacity Tables dated June 1995, the existing Lovewell Reservoir has an active conservation capacity of 24,022 ac-ft at the top of active conservation Elevation 1582.6, and an additional 50,460 ac-ft of flood control space between reservoir Elevation 1582.6 and Elevation 1595.3. A surcharge space of 94,146 ac-ft is available between the top of flood control pool and the maximum water surface elevation of 1610.3 feet.

Lovewell Dam, completed in 1957, is a zoned earthfill embankment with a structural height of 93 feet and total crest length of 8,500 feet. The main portion of the dam across the valley floor and creek channel, station 2+33 to station 56+69, has a crest width of 30 feet and crest elevation of 1616 feet. A dike section extending along the left abutment, starting at station 61+50, has a crest width of 20 feet and crest elevation of 1614 feet. Between stations 56+69 and 61+50, the crest transitions from Elevation 1616 to Elevation 1614. Near the left

[2] Typically, stilling wells should be located at least 50 to 100 ft upstream and 100 to 200 ft downstream from check structures.

end of the dike section there is an existing railroad grade utilized primarily to transport agricultural commodities.

The spillway, located on the right abutment, is a gated-chute type structure with a stilling basin and short outlet channel. The spillway has two bays, each 25 feet wide, with an ogee crest at Elevation 1575.3. Flows are controlled by two 25- by 20-foot radial gates. The spillway discharge capacity is 35,000 ft^3/s at the design maximum water surface Elevation 1610.3, and 14,600 ft^3/s at the top of flood control pool Elevation 1595.3.

The outlet works, adjacent to and south of the spillway on the right abutment, provide releases into the Lower Courtland Canal. The outlet works consist of a trash-racked inlet, an emergency gate, a radial regulating gate, a stilling basin, a radial wasteway gate, two canal radial regulating gates, and a ramp flume. The design capacity of the outlet works is 635 cfs at reservoir Elevation 1571.7.

Existing State Highway 14 crosses the Lovewell Reservoir approximately 5 miles above the dam axis. The highway is a paved 28-foot-wide roadway with a 371-foot-long bridge with approaches across White Rock Creek. The top of the road is at approximate Elevation 1603. The State of Kansas has provided a flood easement to the United States up to Elevation 1595.3.

There are 62 privately owned cabins located in an area west of the State Park on the north side of Lovewell Reservoir. All of the cabins have been constructed above the top of active conservation pool (Elevation 1582.6). Most of these cabins are located above the top of the highest proposed increased conservation pool (Elevation 1592.0). The cabin owners lease their lots from the Kansas Division of Wildlife and Parks. A single lane boat ramp and about 12 boat docks are maintained by the cabin owners but are designated for public use. Those alternatives which increase the conservation storage in Lovewell Reservoir may impact some of the private cabins. The exact number of cabins to be affected is unknown at this time. Updated topographic maps will be needed to analyze potential impacts if additional studies take place in the future

The recreation facilities at Lovewell include a marina, leased cabins, approximately 56 trailors, numerous campsites, boat ramps, boat docks, fuel storage and distribution, picnic shelters, shower and restroom facilities, and parking lots. Specifics of the recreation facilities as related to this Study are discussed in Appendix C.

For this Study, two alternatives were considered to provide additional active conservation storage capacity in Lovewell Reservoir: 1) increasing Lovewell capacity by 16,000 ac-ft, and, 2) increasing Lovewell capacity by 35,000 ac-ft. These alternatives involve modifications to the existing dam and appurtenant structures to allow an increase in the active conservation capacity and the total

reservoir capacity, while maintaining the existing flood control and surcharge capacities. Increasing the reservoir conservation storage would allow storage of excess Republican River flows delivered to the reservoir through the Courtland Canal and also excess White Rock Creek flows. Increasing conservation storage capacity at Lovewell Reservoir may be considered a viable option for storing any excess flows as long as the required modifications to Lovewell Dam and appurtenant structures, and the resulting changes in operation of the facilities, do not increase risks to the public. Proposals that converted a portion of the flood control storage to conservation storage without modifications to the dam were considered but rejected due to the increased flood risks. Evaluation of the potential risks to the public considering the existing and modified structures and operations are summarized in Section 3.4.2.2.3 below.

3.4.2.2.1 Increase Lovewell Capacity – 16,000 ac-ft

Raising the crest elevation of the left abutment dike section from Elevation 1614 feet to the main dam crest Elevation of 1616 feet would provide an increase in total reservoir capacity of about 16,000 ac-ft. The additional 16,000 ac-ft of reservoir storage would be allocated to active conservation capacity by raising the top of active conservation pool from Elevation 1582.6 to Elevation 1587.3. To maintain the existing flood control capacity, the top of flood control pool would be raised from Elevation 1595.3 to Elevation 1598.3. The original reservoir surcharge capacity would remain at about 94,000 ac-ft with the dike section crest elevation raised to the main dam crest Elevation 1616.0 and the freeboard volume would change to reflect the capacity changes.

The appraisal level design and cost estimates for increasing the reservoir capacity by 16,000 ac-ft include raising the existing dike crest elevation to match the dam crest Elevation 1616, extending the left end of the dike about 400 feet at the new crest elevation, and raising the existing spillway ogee crest by about 3 feet. Raising the dike crest elevation requires excavating unsuitable material from the existing dike and foundation for the dike extension on the left end, placing and compacting embankment fill, and furnishing and placing riprap, bedding, and gravel surfacing. Raising the spillway crest requires excavation of existing crest structure concrete to obtain a suitable bonding surface, and placing new concrete to provide an ogee crest at Elevation 1578.3. Modifications to the outlet works are not required. Relocation of an existing railroad near the left end of the dike and the State Highway 14 roadway and bridge at the upper end of the reservoir appear to be unnecessary.

3.4.2.2.2 Increase Lovewell Capacity – 35,000 ac-ft

Raising the crest elevation of the existing dam and dike section to Elevation 1619 would increase the total reservoir capacity about 35,000 ac-ft. The additional 35,000 ac-ft of storage would be allocated to active conservation capacity by raising the top of active conservation pool from Elevation 1582.6 to Elevation 1592.0. To maintain the existing flood control capacity, the top of the flood control pool would be raised from Elevation 1595.3 to Elevation 1601.6. The

original reservoir surcharge capacity would remain at about 94,000 ac-ft with the dam and dike crest elevations raised to Elevation 1619 and the freeboard volume would change to reflect the capacity changes.

The appraisal level design and cost estimates for increasing the reservoir capacity by 35,000 ac-ft include raising the dam crest elevation by 3 feet, raising the dike section crest by 5 feet, and extending the left end of the dike about 1,000 feet at the new crest elevation. The existing spillway ogee crest would be raised about 6 feet. In addition, the spillway gates would have to be modified to accommodate the potential loading from higher reservoir water surfaces.

Raising the crest of the dam and dike sections will require excavation of unsuitable materials from the existing crests and the foundation for the dike extension, placing and compacting embankment fill, and furnishing and placing riprap, bedding, and gravel surfacing. Soil-cement or geo-grid reinforced fill would be used to allow a relatively steep downstream slope for the raised section, minimizing the amount of earthfill required for the dam raise.

Raising the spillway crest requires excavation of existing crest structure concrete to obtain a suitable bonding surface, and placing new concrete to provide an ogee crest at Elevation 1581.6. In addition, the existing spillway gates and hoisting equipment would have to be removed, modified, and reinstalled to accommodate the higher maximum reservoir water surface elevation. A relocation of an existing railroad line near the left end of the dike section will be necessary. In addition there will likely be a need to raise or protect the existing Highway 14 roadway crossing at the upper end of the reservoir. Costs for addressing impacts to the railroad and highway were not specifically identified. It was assumed that these costs would be covered under 'unlisted items' in the cost estimate. Modifications to the outlet works are not required.

3.4.2.2.3 Lovewell Dam Safety Issues

Enlargement of Lovewell Dam and Reservoir would be accomplished consistent with Reclamation's Guidelines for Achieving Public Protection in Dam Safety Decision Making, dated June 15, 2003. Reclamation policy would require a Dam Safety Decision approving the enlargement. The Dam Safety Decision document would be supported by an analysis of dam safety risks for the modified structure. Previous dam safety studies for Lovewell Dam for hydrologic events show that the dam overtops by up to 5 feet for 19 hours during the Probable Maximum Flood (PMF). The most recent PMF, developed in 1986, consists of a general storm event with a peak inflow of 301,300 ft^3/s and a 6.2-day volume of 382,600 ac-ft. Flood routings using the Standing Operating Procedures operation criteria show that the dike crest at Elevation 1614 feet would overtop at 63 percent of the PMF. During the 1997 Comprehensive Facility Review (CFR) for Lovewell Dam, a screening level risk assessment was completed which concluded that hydrologic risks could not be adequately determined due to inadequate flood frequency information. The CFR recommended a flood frequency analysis, flood

routings, and revised inundation mapping to refine the results of the screening level assessment.

A "Volume Analysis and Revised Flood Frequency Analysis for Lovewell Dam" was completed in May 2003[3], and "Analyses Addressing Hydrologic/Hydraulic Issues for Lovewell Dam," which included flood routings for the proposed modifications to increase the capacity of Lovewell Reservoir, was completed in September 2003[4]. Routings for a 10,000-year flood show about 9 feet of freeboard and spillway discharges less than the design maximum of 35,000 ft^3/s for the existing dam and for the dam with either of the proposed modifications to increase storage capacity. In a hydrologic risk framework, these results show an annual failure probability significantly less than 0.0001 for the existing dam and for either of the proposed modifications to increase reservoir storage. Estimates of the annualized loss of life due to hydraulic loading also indicate diminishing justification to reduce risk for the existing dam. Analyses completed to date indicate the proposed modification would result in very minor changes in hydrologic risks for the facility.

The 1997 CFR screening level risk assessment estimated the annual probability of failure and annual risk of loss of life for piping/internal erosion and landslides on the right abutment as very low, indicating diminishing justification to take action to reduce risk for these potential failure modes. The proposed modifications to increase reservoir capacity are expected to have little impact on the estimated piping/internal erosion or landslide failure risks because of the relatively small increases in the normal reservoir operating levels.

The proposed modifications are expected to have very little impact upon dam safety risks for Lovewell Dam. Additional dam safety issue analysis would be required when a preferred alternative is selected for modifications. Appropriate risk reduction actions, if any, would be incorporated into the final design. It is expected additional risk reduction measures would be minor relative to the overall scope of the proposed modifications.

3.4.2.3 Other Storage Alternatives

Three other storage alternatives in the Kansas portion of the study area were evaluated by the Value Study Report referenced in Section 1.5. These alternatives were investigated for supplying water for meeting only downstream MDS-related

---

[3] "Volume Analysis and Revised Flood Frequency Analysis for Comprehensive Facility Review, Lovewell Dam, Pick-Sloan Missouri Basin Project, Kansas, Great Plans Region," Bureau of Reclamation, Flood Hydrology Group, Technical Service Center, Denver, Colorado, May 2003.

[4] "Analyses Addressing Hydrologic/Hydraulic Issues, Lovewell Dam, Pick-Sloan Missouri Basin Program, Kansas, Great Plains Region," *Technical Memorandum No. LOV-8130-TM-2003-1*, Bureau of Reclamation, Technical Service Center, Denver, Colorado, September 2003.

needs in Kansas, which could include private irrigators who are junior to the MDS. These alternatives included[5]:

- Alternative J – Off-stream storage created by enlarging the South Dam of the Jamestown Waterfowl Management Area

- Alternative K – Off-stream storage created by enlarging the North Dam of the Jamestown Waterfowl Management Area

- Alternative L – Off-stream storage created by constructing a new dam structure on Beaver Creek in Section 12, Township 6 South, Range 4 West

Since the operation of these types of storage options was not modeled by the hydrology model OPSTUDY at this time, no further analysis was performed for these alternatives. For the purposes of this Study, the cost-estimates from the Value Study Report are considered comparable to the cost-estimates included for Alternatives A through I outlined in this report. The findings of the Value Study Report are outlined below.

At the time of this Appraisal Study, it is undetermined as to whether Reclamation, the State of Kansas, or some other entity would own and operate any of the above facilities should they be constructed. If it is determined that Reclamation will own and operate the facilities, the dams would be subject to regulation under Reclamation's Dam Safety Program.

3.4.2.3.1 Alternatives J and K. Off-stream Storage – Jamestown Waterfowl Management Area

The State Lake-Jamestown Waterfowl Management Area, also known as Sportsman Lake, is located approximately 7 miles south of Courtland, Kansas. The existing lake is created by two small structures, a "south dam" and a "north dam." Both sections of the lake are relatively shallow, with a total estimated storage of 2,000-3,000 ac-ft.

Alternative J – South Dam Enlargement
By raising the existing dam about 10 feet, it is estimated that an additional 20,000 ac-ft of storage could be provided. An appraisal level estimate was prepared for a dam with a crest elevation at 1400 feet. The maximum dam height is estimated to be 20 feet. The design assumed a 20-foot-wide dam crest that was 8,000-foot long. The upstream slope was assumed to be 3:1 and the downstream slope 2:1.

The 20,000 ac-ft of water could potentially be delivered through the Courtland West Canal. The Courtland West Canal has a capacity of at least 80 cfs until a point in the middle of Section 33, Township 4 South and Range 5 West. From

[5] In the Value Study Report, Alternatives J, K, and L were designated as Proposal F1, F2, and G, respectively.

that point a 4-mile-long pipeline would drop the water to Marsh Creek just above where it flows into Jamestown Reservoir. An 80 cfs continuous flow would deliver the 20,000 ac-ft in 126 days, which would be expected to be allowed within the irrigation off-season. This would affect the Operation and Maintenance (O&M) with a longer operating season.

Alternative K – North Dam Enlargement
By raising the existing north dam about 10 feet, it is estimated that an additional 10,300 ac-ft of storage could be provided. An appraisal level estimate was prepared for a dam with a crest elevation at 1400 feet. The maximum dam height is estimated to be 10 feet. The design assumed a 20-foot-wide dam crest that was 2,400-foot long. The upstream slope was assumed to be 3:1 and the downstream slope 2:1.

The 10,300 ac-ft of water could potentially be delivered through the Courtland West Canal. The Courtland West Canal has a capacity of at least 80 cfs until a point in the middle of Section 33, Township 4 South and Range 5 West. From that point a 4-mile-long pipeline would drop the water to Marsh Creek just above where it flows into Jamestown Reservoir. A 40 cfs continuous flow would deliver the 10,300 ac-ft in 126 days, which would be expected to be allowed within the irrigation off-season. This would affect the O&M with a longer operating season.

3.4.2.3.2 Alternative L. Off-stream Storage – Kansas Tributaries, Beaver Creek

The Value Study Report identified a site on Beaver Creek as a potential storage site in Kansas. The site is located in Section 12, Township 6 South, Range 4 West, and would hold an estimated 8,500 ac-ft. The dam structure associated with this size impoundment would be approximately 40-foot high with a 2400-foot crest length.

The site has a drainage area of approximately 36 square miles. No streamflow data are available for Beaver Creek at this location, but a preliminary estimate using hydrologic data for White Rock Creek would indicate inflow to the Beaver Creek site would be approximately 3,200 ac-ft per year. Water could also be delivered to the reservoir by the Courtland Canal. The Courtland Canal passes the reservoir site about ½-mile to the east.

3.4.2.4 Recreation Mitigation

Costs for relocating recreational facilities that could be affected by those alternatives which include raising Lovewell Dam were derived from aerial photography and estimates and assumptions summarized below and in Appendix C. The estimates of inundated areas on the aerial photos were based on elevations that did not precisely match the estimated elevations of the two dam

raise options[6]. These estimates were developed using the best available information at this time. The cost of relocating or extending the recreational facilities affected by the high raise of the conservation pool in Lovewell Reservoir (Alternatives F and G) to Elevation 1592 is probably overestimated, since the aerial photo delineation took in a larger area than would actually be affected. Conversely, the cost of relocating or extending the recreational facilities affected by the low raise of the conservation pool in Lovewell Reservoir (Alternatives D, E, H and I) to Elevation 1587.3 is probably underestimated since the aerial photo delineation took in a smaller area than would actually be affected.

The National Park Service's "Cost Estimating Guideline with Class C Cost Data" was used to determine unit costs for the various recreation facilities. Quantities were estimated from the aerial photographs but should be considered to be gross estimations as the discernable detail on the aerial photos was limited. This cost data guideline was used because it has been shown that Reclamation costs are similar to those borne by the Park Service. Class C cost estimates are referred to as "conceptual" or "order-of-magnitude" estimates. Class C cost estimates are usually used for:

- Appraisal studies
- Selection from among alternative designs
- Development of project scope and program

Additionally, a Class C estimate is a conceptual cost estimate based on square footage cost of similar construction. Class C cost estimates are usually prepared without a defined scope of work. A location factor is assigned to account for regional variations such as geographic accessibility, work force availability, cost of building materials, etc. For the purposes of this Study, a location factor of minus eight was used[7]. This is the location factor assigned by the Park Service for the National Tall Grass Prairie Preserve, the closest Park Service managed area to Lovewell Reservoir.

For each option, two component costs were estimated: the costs associated with facilities in Lovewell State Park and the costs associated with Lovewell State Wildlife Area. The detailed cost estimates, including the design assumptions, for the recreational facilities are included in Appendix C. The estimated costs are summarized in Table 4 below. These costs do not include the costs of mobilization, unlisted items, contingencies and non-contract costs.

[6] The aerial photos delineated elevation 1595' to represent the high raise (Alternative F and G) and elevation 1583 to represent the low raise (Alternatives D, E, H and I). However, the actual elevation levels are projected to be 1592 and 1587.3 respectively.

[7] This translates into an 8 percent reduction in the estimated cost of the facilities.

TABLE 4. ESTIMATED COSTS SUMMARY FOR THE RECREATIONAL FACILITIES

Option	State Park Costs	State Wildlife Area Costs	Total Costs
Low Raise (to 1587.3')	$130,000	$36,000	$166,000
High Raise (to 1592.0')	$1,900,000	$250,000	$2,150,000

3.4.2.5 Cost Estimates

This section discusses estimated field and non-contract costs and summarizes costs for the nine alternatives.

3.4.2.5.1 Contract Cost Estimates

Construction contract cost estimates are included in Appendix B. Construction contract costs referred to as field cost in the Appendix include 5 percent for mobilization, 20 percent for unlisted items, and 25 percent for contingencies. Definitions for these items follow:

Mobilization. Percentage allowance, for: movement of personnel, equipment, supplies, and incidentals to the project site; establishment of offices, buildings, plants and other facilities; premiums for project bonds and insurance;

Unlisted Items. Percentage allowance for additional items of work which will appear in the final design required for a fully finished feature.

Contingencies. Percentage allowance to cover minor differences between actual and estimated quantities, unforeseeable difficulties at the site, possible minor changes in plans, and other uncertainties.

3.4.2.5.2 Non-contract Cost Estimate

Non-contract activities are usually based on a percentage of construction costs. The costs are shown in Table 5.

TABLE 5. NON-CONTRACT COSTS

Activity	Percent of Contract Costs
Planning	5.0
Investigations	3.5
Design and Specifications	3.0
Contract Administration	6.0
Water Rights	0.5
Environmental Permits[8]	5.0
Right-of-Way (ROW)	2.0
TOTAL	25

[8] The environmental permitting multiplier includes the cost for activities such as environmental mitigation and cultural resource mitigation.

The total project cost for each of the alternatives is shown in Table 6. The costs of Alternatives J, K, and L were derived by increasing the costs identified for those alternatives in the Value Study Report by 5 percent to account for cost of inflation.

TABLE 6. TOTAL PROJECT COST FOR EACH OF THE ALTERNATIVES

Alternative	Feature	Pay Item Cost	Field Cost[1]	Total Project Cost[2] (8/2002)	Total Project Cost[2] (11/2003)
A	Reshape Courtland Canal	$1,359,553			
	Removal of Existing Concrete Lining	$1,402,155			
	Geomembrane Lining	$2,459,485			
	Bubblers	$272,000			
	County Bridges	$994,000			
	Total	$6,487,193	$10,000,000	$12,500,000	$13,000,000
B	Automate Gates	$308,000			
	Stilling Wells	$362,250			
	Bubblers	$272,000			
	Total	$942,250	$1,500,000	$1,900,000	$2,000,000
C	Automate Gates	$308,000			
	Stilling Wells	$362,250			
	Bubblers	$272,000			
	County Bridges	$994,000			
	Reshape Courtland Canal	$1,359,553			
	Removal of Existing Concrete Lining	$1,402,155			
	Geomembrane Lining	$2,459,485			
	Total	$7,157,443	$11,500,000	$14,500,000	$15,000,000
D	Automate Gates	$308,000			
	Stilling Wells	$362,250			
	Bubblers	$272,000			
	Raise Lovewell 16,000 AF	$624,100			
	Recreation Mitigation	$166,000			
	Total	$1,732,350	$2,700,000	$3,400,000	$3,600,000

[1] Field Cost includes mobilization, unlisted and contingency costs.
[2] Total Project Cost includes non-contract costs of 25 percent.

TABLE 6. TOTAL PROJECT COST FOR EACH OF THE ALTERNATIVES

Alternative	Feature	Pay Item Cost	Field Cost[1]	Total Project Cost[2] (8/2002)	Total Project Cost[2] (11/2003)
E	Automate Gates	$308,000			
	Stilling Wells	$362,250			
	Bubblers	$272,000			
	County Bridges	$994,000			
	Reshape Courtland Canal	$1,359,553			
	Removal of Existing Concrete Lining	$1,402,155			
	Geomembrane Lining	$2,459,485			
	Raise Lovewell 16,000 AF	$624,100			
	Recreation Mitigation	$166,000			
	Total	$7,947,543	$12,500,000	$15,500,000	$16,500,000
F	Automate Gates	$308,000			
	Stilling Wells	$362,250			
	Bubblers	$272,000			
	Raise Lovewell 35,000 AF	$2,698,100			
	Recreation Mitigation	$2,150,000			
	Total	$5,790,350	$9,100,000	$11,500,000	$12,000,000
G	Automate Gates	$308,000			
	Stilling Wells	$362,250			
	Bubblers	$272,000			
	County Bridges	$994,000			
	Reshape Courtland Canal	$1,359,553			
	Removal of Existing Concrete Lining	$1,402,155			
	Geomembrane Lining	$2,459,485			
	Raise Lovewell 35,000 AF	$2,698,100			
	Recreation Mitigation	$2,150,000			
	Total	$12,005,543	$19,000,000	$24,000,000	$25,000,000
H	Raise Lovewell 16,000 AF	$624,100			
	Recreation Mitigation	$166,000			
	Total	$790,100	$1,250,000	$1,550,000	$1,650,000

[1] Field Cost includes mobilization, unlisted and contingency costs.
[2] Total Project Cost includes non-contract costs of 25 percent.

TABLE 6. TOTAL PROJECT COST FOR EACH OF THE ALTERNATIVES

Alternative	Feature	Pay Item Cost	Field Cost[1]	Total Project Cost[2] (8/2002)	Total Project Cost[2] (11/2003)
I	County Bridges	$994,000			
	Reshape Courtland Canal	$1,359,553			
	Removal of Existing Concrete Lining	$1,402,155			
	Geomembrane Lining	$2,459,485			
	Raise Lovewell 16,000 AF	$624,100			
	Recreation Mitigation	$166,000			
	Total	$7,005,293	$11,000,000	$14,000,000	$14,500,000
J	Jamestown Enlargement – South				$14,490,000
K	Jamestown Enlargement – North				$6,720,000
L	Beaver Creek				$12,600,000

[1] Field Cost includes mobilization, unlisted and contingency costs.
[2] Total Project Cost includes non-contract costs of 25 percent.

3.4.2.5.3 Annual Operation, Maintenance and Replacement (OM&R) Costs

No quantitative analysis of the OM&R was performed for this Study. Future more detailed studies would include the estimated costs for OM&R for each of the potential alternatives. Generally, it is expected that those alternatives involving existing facilities would have a smaller increase in annual OM&R costs as compared to those alternatives involving new project facilities. However, for those alternatives involving systems automation, it is recognized that trained electronics personnel would be necessary. The following table summarizes qualitatively the expected changes in OM&R costs for each of the alternatives:

TABLE 7. SUMMARY OF ALTERNATIVES–OM&R IMPACTS

Alternative	Implementation Costs	OM&R Costs	Comments/Observations
A	$13,000,000	2	Longer operation period.
B	$2,000,000	2	Automation requires trained staff. Longer operation period.
C	$15,000,000	2	Automation requires trained staff. Longer operation period.
D	$3,600,000	2	Automation requires trained staff. Longer operation period.
E	$16,500,000	2	Automation requires trained staff. Longer operation period.
F	$12,000,000	1	Automation requires trained staff. Longer operation period.
G	$25,000,000	1	Automation requires trained staff. Longer operation period.
H	$1,650,000	3	Only minor changes in O&M procedures on an existing facility.
I	$14,500,000	2	Longer operation period.
J	$14,490,000	2	Major modifications of existing facility.
K	$6,720,000	2	Major modifications of existing facility.
L	$12,600,000	1	New facility.

1-Major Increase in OM&R; 2-Moderate Increase in OM&R; 3-No Change in OM&R

3.4.3 Economic Benefit Evaluation

This economic portion of the Study estimates the economic benefits accruing from the changes to operations associated with each alternative. These benefits will then be compared to project costs. Annual O&M costs are usually not part of an appraisal-level study but would be included in a feasibility study.

The hydrology analyses described above modeled operation of the system under each alternative scenario with the intent to maximize irrigation benefits. Additional hydrological analyses to model system operation to emphasize other potential resource needs, such as MDS, were not performed at this level of study. As a result, only irrigation benefits have been quantitatively estimated. Allocation of water to provide MDS benefits could reduce the water available for irrigation, resulting in a reduction of irrigation benefits and a potential increase in MDS related benefits. The extent to which such increased MDS benefits might offset the lost irrigation benefits is unknown at this time.

Potential irrigation benefits or MDS benefits of a Beaver Creek Dam and Reservoir or an increase in the size of Jamestown Reservoir were not estimated. The hydrology model was not revised to incorporate these additional facilities.

The alternatives which include increasing the size of Lovewell Reservoir would have the potential to increase the recreational use of facilities at the Reservoir. While these potential benefit increases were not quantitatively estimated at this level of study, they are qualitatively assessed below. Increasing the storage in Lovewell Reservoir and/or increasing canal capacity would also allow storage to remain in Harlan County Lake for longer periods of time. This could potentially increase recreational use of facilities at Harlan County Lake.

3.4.3.1 Irrigation Benefit Estimation

Irrigation benefits were estimated by isolating the incremental net farm income from the relatively small changes in the irrigation water supply associated with the alternatives. To determine the incremental income, the net farm income in a "without project" baseline condition was compared to a "with project" baseline condition. For small changes in the water supply, the best indicator of benefits comes from predicted changes in yields. For the purposes of this Study, the change in yield of only the most dominant crop for the area, corn, was evaluated. A spreadsheet model developed by the University of Nebraska was used to estimate the yields for the varying levels of water supply[9].

This benefit analysis of the potential irrigation benefits was conducted to conform with National Economic Development (NED) standards as published in "The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (Principles and Guidelines). Therefore, normalized prices published by the USDA Economic Research Service (U.S. Department of Agriculture, ERS) were used to determine the change in gross revenues. Gross revenues on a per acre basis were calculated by multiplying yield changes per acre by price per bushel.

Variable costs of production, resulting from the projected change in the amount of irrigation water applied, were taken from farm budgets prepared by the University of Nebraska[10]. The only cost which was expected to change with yield was the harvesting cost[11]. This same assumption applies to the cultural practices such as plowing, disking, and cultivating and the management skills of the farmer.

The annual irrigation benefits were transformed into a present worth value by taking the annual benefit into the future 100 years and then discounting it back to the present. The fiscal year 2003 federal discount rate of 5.875 percent was used in this report.

---

[9] Further information on the modeling and the benefit analysis is provided in Appendix D.

[10] For further discussion of the methodology utilized, please refer to Appendix D of this report.

[11] Other production costs are assumed to not change. For example, the same amount of fertilizer will be applied to corn that produces 140 bushels as will be applied to 144-bushel corn.

3.4.3.1.1 Irrigation Benefits of Corn Production

The range of current corn yields was derived from data included in previously completed economic studies and from the Nebraska Agricultural Statistics. Average district-level irrigated yields for 1991-95 are shown in Table 1 of Appendix D.

The simple average of irrigated yields for the two irrigation districts came to 153.4 bushels. This average irrigated yield was considered the yield being obtained by farmers in recent years with the available water supply.

The yield estimation model was modified to account for the range of water supplies estimated by the hydrology models. The estimated yield for the Baseline Alternative came to 154.5 bushels of corn per acre. This is 0.9 bushels higher than the reported average for the two districts. Overall, water supplies ranged from a low of 11.5 acre-inches to a high of 13.8 acre-inches. Estimated yields ranged from a low of 154.5 bushels per acre to a high of 161.1 bushels. The yields estimated by the model are shown in Table 8.

TABLE 8. ESTIMATED YIELDS FOR THE SELECTED WATER SUPPLY RANGE

Alternative Name	Inches of Water to Farm	Corn Yield (bu)
Baseline	**11.5**	**154.5**
A	11.7	155.2
B	12.0	156.2
C	12.2	156.8
D	13.0	159.2
E	13.1	159.4
F	13.7	160.9
G	13.8	161.1
H	12.4	157.4
I	12.4	157.4

bu = bushels

Based on the above estimated yields, gross revenues under each alternative were calculated using the Economic Research Service (ERS) normalized price of $2.25/bushel. Total variable costs of production (custom work, seed, fertilizer, chemicals) came to $135.54 per acre excluding custom costs of harvest[12]. After subtracting all the costs of production, the estimated net revenues for corn production under each alternative were computed. Gross revenues from the analysis ranged from a low of $347.55 per acre to $362.58 per acre. Net revenues per acre, after subtracting out all costs of production, ranged from $191.93 to $206.09. The net revenues obtained from each alternative had higher net revenues

[12] Custom harvest costs that changed under the selected alternatives came from a transportation charge of $0.13 per bushel.

than the Baseline Alternative. Alternatives F and G had the largest changes in net revenue. Gross and net revenues per alternative are shown in Table 3 of Appendix D. Appendix D provides details on all the above calculations.

Based on the estimated net revenues, or benefits, per acre, the total annual net benefits were computed by multiplying the per acre benefit by the 65,435 acres[13] expected to receive benefits. The estimated baseline total annual benefits were $12,559,172[14]. Assuming this amount of benefits accrue each year over the next 100 years and is then discounted back to today's dollars using a discount rate of 5.875 percent, the net present value is $213,064,200.

This calculation was performed for each alternative, and the incremental change caused by the alternative was calculated by taking the difference between the net present value of the baseline and the alternative. Table 9 shows the total benefits for the baseline and other alternatives and the incremental net present value of irrigation benefits for each alternative.

TABLE 9. INCREMENTAL IRRIGATION BENEFITS FOR EACH ALTERNATIVE

Alternative	Baseline Benefits for All Acres	Alternative Benefit for All Acres	Incremental Net Present Value Relative to the Baseline
Baseline	**$ 213,064,200**		
A		$ 214,703,193	$ 1,638,993
B		$ 217,056,592	$ 3,992,391
C		$ 218,566,319	$ 5,502,118
D		$ 224,094,585	$ 11,030,384
E		$ 224,727,338	$ 11,663,138
F		$ 228,246,335	$ 15,182,134
G		$ 228,779,179	$ 15,714,979
H		$ 220,020,541	$ 6,956,341
I		$ 220,020,541	$ 6,956,341

Alternative G had the biggest water supply increase and the greatest benefits, followed by Alternative F.

3.4.3.2 Evaluation of Recreation Benefits

Based on existing research, recreation use of a reservoir often increases as water levels rise. As long as most recreation facilities are still accessible, higher water levels are typically preferred given the increased surface acreage and improved aesthetics (i.e. reduced mud, flats, and "bath tub" rings). For Alternatives D-I, which include the two options for raising the conservation pool in Lovewell

[13] Of this total, 22,935 acres are located in Nebraska and 42,500 acres are in Kansas.

[14] Net income of $191.93 times 65,435 acres.

Reservoir, it is therefore possible that recreational use of the reservoir might increase if the existing recreational facilities expected to be inundated by higher water levels were replaced or extended. However, quantification of these benefits would require a level of data collection and analysis that is beyond the scope of an appraisal study, and as a result, the evaluation of these potential benefits is treated qualitatively in this report.

The recreation analysis at Lovewell Reservoir looked at the projected monthly availability of recreation facilities for each alternative as compared to the baseline alternative. Two iterations of analysis were performed:

- First Iteration: An analysis that did not take into consideration possible relocation or extension of the facilities

- Second Iteration: An analysis that assumes inundation of facilities is mitigated by relocation or extension of the facilities.

The results of the second iteration analysis under average water conditions are presented below. Complete results for both the first and second iteration analyses are presented for average, wet, and dry water conditions in Appendix E.
For dam raising alternatives D-I, most of the potential recreation benefits (relative to the baseline) would not be realized unless the investment was made to relocate/extend the recreational facilities which would be affected by higher water levels. The cost associated with this mitigation (discussed in Section 3.4.2.4 above) has been included in the alternative specific cost estimates. These facility relocation/extension costs assume the facilities would be replaced in-kind. For the purposes of this Study, it was assumed that in-kind replacement of boat ramps, which allowed for the use of the ramps at the higher water levels, would continue to provide service down to the lowest water levels currently being served. For some facilities, this may not be possible due to the topography in the area, and in these cases the benefits at lower water levels may not be fully realized.

3.4.3.2.1 Methodology

Recreation facilities were separated into water-based and water-influenced facilities. Water-based facilities reflect those that depend on access to the water, including facilities such as boat ramps, marinas, and swimming beaches. At Lovewell Reservoir, there are six boat ramps (concessions area (2), marina, cabin area, Oak Hill, and Highway 14), one marina, and one swimming beach. Water-influenced facilities include campgrounds, picnic areas, trailer sites, and cabins. While use of these land-based but water-influenced facilities may be affected by water level fluctuation due to changing reservoir aesthetics, the thrust of the analysis is on the evaluation of possible flooding effects due to lost access.

To provide data for both the first and second iteration facility availability analyses, information was needed for both high end and low end usability thresholds where each of the facilities become unavailable. For example, boat ramps are only usable across the range of water levels which maintain access to the ramp. Water levels below the low end or above the high end of the ramp would result in the ramp being unusable. This high-and low-end concept was used for the water-based facilities. Under the second iteration analysis presented below, for alternatives that involve raising Lovewell Dam (i.e., Alternatives D through I), it is assumed that potentially inundated recreational facilities would be relocated or extended. As a result, only the low end thresholds would be relevant to this analysis since the current high end thresholds would no longer be a constraint.

Since the water-influenced facilities are land-based, low-end usability thresholds are not applicable (i.e., low water levels do not preclude use). Given the assumption that these facilities would be moved to higher ground if necessary, they should be available for all months and alternatives under the second iteration analysis. Therefore, these facilities are not discussed in the remainder of this section. Table E-1 in Appendix E shows the availability thresholds used in the second iteration analysis.

Projected end of month (EOM) water levels at Lovewell Reservoir, measured in terms of feet above mean sea level (msl), were obtained from the hydrology model. Three different hydrologic conditions were evaluated for each alternative – average, dry, and wet. Average conditions were based on average EOM water levels for each month. Dry conditions were based on the water level representing the 10th percentile of projected water levels for each month (i.e., water levels are expected to be higher than the dry condition level 90 percent of the time). Wet conditions were based on the water level representing the 90th percentile of projected water levels for each month (i.e., water levels are expected to be higher than the wet condition level only 10 percent of the time).

The monthly water levels for each alternative under average, dry, and wet conditions were compared to the facility usability thresholds to estimate monthly facility availability. Since monthly water levels reflect a single day at the end of each month, the analysis provides a general indicator of possible impacts and does not account for changes in daily water levels within each month. Water level data was obtained for all months, but the information is only presented for the months of May through September when recreation activity is highest. Facility availability for each alternative is also compared to the baseline alternative to identify differences.

3.4.3.2.2 Results

The facility availability results for all three hydrologic conditions are displayed in Appendix E. The results for the average hydrologic conditions are discussed below.

Baseline. Based on the high and low end facility availability thresholds and the EOM water levels for the baseline alternative, none of the six boat ramps are projected to be available on average during the months of July through September. In addition, the high water ramps (Oak Hill and Highway 14) are projected to be unavailable on average during May and June. The Lovewell marina is projected to be unavailable on average during July through September and Lovewell beach is projected to be unavailable on average in August. The unavailability of these facilities is due to low water levels.

Alternative A. Courtland Canal to Design Capacity, Winterize. Based on average hydrologic conditions, facility availability for this alternative is the same as the baseline.

Alternative B. Automate, Winterize Courtland Canal. Based on average hydrologic conditions, facility availability for this alternative is the same as the baseline.

Alternative C. Automate, Winterize, Courtland Canal to Design Capacity. Based on average hydrologic conditions, facility availability for this alternative is the same as the baseline.

Alternative D. Automate, Winterize Courtland Canal; Raise Lovewell 16,000 ac-ft.

Compared to the baseline, additional facility availability is expected to occur on average as follows: Oak Hill and Highway 14 ramps in May and June; marina in July; and the beach in August.

Alternative E. Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft. This alternative follows essentially the same pattern of facility availability as Alternative D. The only difference lies in the additional availability of the concessions area ramps in July. This also reflects an additional gain in facility availability compared to the baseline alternative. Total gain in facility availability compared to the baseline is as follows: concessions ramps in July; Oak Hill and Highway 14 ramps in May and June; marina in July; and the beach in August.

Alternative F. Automate, Winterize Courtland Canal; Raise Lovewell 35,000 ac-ft.

In addition to the gains made from the baseline by Alternative E, Alternative F also provides that the marina and cabin area boat ramps are available in August. The total gain in facility availability compared to the baseline is as follows: concessions, marina, and cabin area ramps in July; Oak Hill and Highway 14 ramps in May and June; marina in July; and the beach in August.

Alternative G. Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 ac-ft. This alternative provides the same gains made as Alternative F.

Alternative H. Raise Lovewell 16,000 ac-ft. Of the alternatives which involve raising Lovewell Dam, this alternative provides for the fewest gains relative to the baseline. Relative to the baseline, the alternative provides the additional availability of only the Oak Hill and Highway 14 boat ramps during the months of May and June.

Alternative I. Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft. This alternative would provide the same gains over the baseline as those identified for Alternative D, namely the Oak Hill and Highway 14 ramps in May and June, the marina in July, and the beach in August.

3.4.3.3 Benefit-Cost Analysis

A benefit-cost ratio analysis provides a discounted measure of a project worth and is calculated by dividing the discounted worth of the benefit stream by the discounted worth of the cost stream. A discounted present worth of benefits was found by projecting annual benefits 100 years into the future and then discounting them back to the present using a discount rate of 5.875 percent.

A similar process would be followed for the implementation costs for each alternative if the implementation costs were borne over a period of years. However, for this analysis, the implementation costs are assumed to all accrue in year one of construction, and as a result, no interest during construction was identified for any of the alternatives. Therefore, the stated cost is the net present value of that cost and the benefit values can be compared directly to the cost values shown in Table 10.

When the benefit-cost ratio analysis is used, the selection criterion is to accept all the independent projects with a benefit-cost ratio of 1.0 or greater. Ranking of the alternatives from "best" to "worst" according their benefit-cost ratios should not be done as this may lead to erroneous assumptions about the "best" alternative to select. Instead, the benefit-cost ratios should only be used to provide a "go or no-go" type of decision that can be consistently applied across the alternatives being studied.

Total implementation costs for each alternative were estimated and ranged from $1,650,000 for Alternative H to $25,000,000 for Alternative G. The estimated implementation costs are shown in Table 10 along with the estimated benefits[15].

As can be seen, benefits do not exceed costs for all of the alternatives. The alternatives where benefits exceed costs include Alternatives B, D, F, and H.

[15] As noted previously, the benefits for Alternatives J, K, and L were not estimated as the OPSTUDY model could not model the operation of these facilities.

Alternative B has benefits that exceed costs by $1,992,391. Benefits for Alternatives D, F, and H exceed their implementation costs by $7,430,384, $3,182,134, and $5,306,341, respectively.

The benefits and costs of the proposed alternatives can also be presented as a ratio. Ratios are advantageous in that the "accept" or "reject" decision is easily made. The criterion used in this analysis for accepting an alternative is if the benefit-cost ratio is equal to or greater than 1.0. Alternatives having benefit-cost ratios of less than 1.0 are normally rejected. While some of the alternatives have benefit-cost ratios less than unity, they could be revisited in the early stages of a feasibility study. The benefit-cost ratio is not used for ranking the alternatives. Benefit-cost ratios for the alternatives are shown in Table 11.

TABLE 10. ESTIMATED BENEFITS AND COSTS OF IMPLEMENTATION FOR EACH ALTERNATIVE

Alternative	Estimated Agricultural Benefits	Implementation Cost
A	$1,638,993	$13,000,000
B	$3,992,391	$ 2,000,000
C	$5,502,118	$15,000,000
D	$11,030,384	$3,600,000
E	$11,663,138	$16,500,000
F	$15,182,134	$12,000,000
G	$15,714,979	$25,000,000
H	$6,956,341	$1,650,000
I	$6,956,341	$14,500,000

TABLE 11. BENEFIT-COST RATIOS FOR EACH ALTERNATIVE

Alternative	Benefit-Cost Ratio
A	0.13
B	2.00
C	0.37
D	3.06
E	0.71
F	1.27
G	0.63
H	4.22
I	0.48

3.4.4 Environmental Evaluations

There are environmental resource impacts associated with each alternative. The effects of these impacts can be cumulative if alternatives are combined. The following is a brief summary of the environmental issues that may be associated with the various alternatives. Other potential impacts will be identified during the National Environmental Policy Act (NEPA) scoping process if any alternatives are to be studied further at the feasibility level.

Increased diversions and storage would most likely have a negative impact on Republican River riparian habitat, fisheries and recreation opportunities (fishing) below the diversion point. Additional diversions could result in degraded riparian habitat, reduced fish habitat, impacts on fish health, fish kills, and degraded fishing experience in river reaches below the diversion point.

Lovewell Reservoir is within the Central Flyway and has been an important resource for migratory birds, particularly migrating waterfowl. Reservoir expansion could have short-term negative effects on migratory waterfowl due to construction disturbance, but would most likely have a long-term beneficial effect because of the expanded water surface.

It is likely that the Fish and Wildlife Coordination Act (FWCA) of 1946 would apply if enlargements are proposed at Lovewell Reservoir. The FWCA amendments enacted in 1958 require consultation with the U.S. Fish and Wildlife Service (Service) and the fish and wildlife agencies of States where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted . . . or otherwise controlled or modified by any agency under a Federal permit or license. Consultation is to be undertaken for the purpose of preventing loss of and damage to wildlife resources." The amendments authorize the transfer of funds to the Service to conduct related investigations. State Agencies in both Nebraska and Kansas may have to be consulted.

The Service was consulted during the preparation of the Basin environmental impact statement for contract renewal. Based on the information contained in the June 2000 Final Environmental Impact Statement, Republican River Basin Repayment and Long-Term Service Contract Renewals, the Service identified the following threatened and endangered species to occur within the Basin (which includes Lovewell Reservoir): bald eagle, Eskimo curlew, interior least tern, piping plover, and whooping crane. Initially it is not believed that implementation of any of the alternatives would significantly adversely affect any of the previously listed species. The Service will be contacted for an updated list of threatened, endangered, proposed, candidate species, and species of concern that may be present within or migrate through the proposed project area. The NEPA compliance document would include an analysis to determine if there are any impacts to identified species.

As previously mentioned, possible permits that may be required include National Pollutant Discharge Elimination System (NPDES) from Nebraska and Kansas and a 404 permit from the Corps. Each of these permits may contain specific environmental stipulations to reduce or compensate for resource-related impacts associated with the activity.

Water quality trends in the Basin have been altered by the major lakes and reservoirs located in the Basin. Diminished streamflow has lowered water quality; with high-quality low flows being depleted, the filling of reservoirs has become more dependent upon high flows of lower quality, causing their quality to further deteriorate. Agricultural practices and agricultural runoff have contributed to the increase in fecal coliform, turbidity, suspended solids, and nitrates throughout the basin.

Surface water within the Basin is turbid and contains a moderate concentration of dissolved minerals. Streams have good oxygen concentrations to support warm-water aquatic life. They carry a fairly high level of nutrient materials, as evidenced by the high concentrations of nitrates and phosphates. Water quality analysis and results indicate that water quality in the Basin is generally good, with the exception of selenium.

Selenium is a naturally occurring trace element found within the Basin. Reclamation studies conducted in 1994 indicate that selenium is elevated at some sampling sites. While selenium levels can be influenced by the weathering of natural rock formations, the levels have probably been increased by human activities including irrigation, which has accelerated the natural leaching process. Although no specific studies have been conducted to determine if reproductive impairments are occurring, no obvious indications of impairment, such as missing age (size) classes of fish species or the disappearance of species have been reported.

It is unknown what role project water plays in the overall Basin selenium load. Reclamation initiated water quality studies in 1994 to evaluate selenium within the basin and the potential risks to aquatic resources. Forty six samples were collected from sites located from near Benkelman, Nebraska, to Norway, Kansas. Samples were collected from sites influenced by project, non-project, and a combination of project and non-project irrigation drain waters. While the data results indicate strong evidence of food-chain bioaccumulation of selenium in aquatic invertebrates and fish, no obvious indications of reproductive impairments have been reported.

3.4.4.1 Alternatives A, B, and C: Alternatives That Only Involve the Diversion Dam and Canal

- Removal of trees on the outside and inside canal prisms may require mitigation.

- If any dredged material is removed from the canal, a spoil site(s) will need to be identified.

- If canal lining is installed, there may be a need to identify location(s) of deer escape structures.

- It may be necessary to apply for a NPDES permit from the appropriate State Agency responsible for environmental quality.

3.4.4.2 Alternatives D, E, H, and I: Alternatives That Also Involve Raising Lovewell 16,000 Ac-Ft.

- The impacts associated with automating and winterizing the Courtland Canal would be similar to those listed above.

- Raising the operating pool elevation at Lovewell Reservoir could result in potential impacts to private cabins due to increased shoreline erosion. The potential exists for increased shoreline erosion reservoir-wide if the operating pool elevation at Lovewell Reservoir is raised. This could result in potential impacts to: (1) private cabins, (2) existing recreational facilities, (3) reservoir fisheries, and (4) mature established trees. Mitigation might be required.

- Shoreline erosion results in increased sedimentation and potential water quality problems.

- Benefits to recreation and fisheries may occur if the conservation pool in Lovewell Reservoir is raised.

3.4.4.3 Alternatives F and G: Alternatives That Also Involve Raising Lovewell 35,000 Ac-Ft.

- The impacts associated with these alternatives are somewhat similar to Alternatives D and E; however, because the operating pool would be increased an additional 19,000 ac-ft, impacts may be significantly greater. For example, higher operating pool elevations under Alternatives F and G might affect a greater number of homes in the private cabin area. To determine the extent of reservoir impacts, it will be necessary to delineate the new water surface elevations.

3.4.5 Socioeconomics

Socioeconomics describes an area in terms of social and cultural values and issues. This includes population numbers, income, and agricultural resources. The counties included in this overview include Franklin, Harlan, Nuckolls, and Webster Counties in Nebraska and Republic and Jewell Counties in Kansas. The information presented here is a partial listing of the data contained in the document entitled "Resource Management Assessment, Republican River Basin, Water Service Contract Renewal"[16] and can be seen in its entirety in that publication.

3.4.5.1 Overview

The socioeconomic structure in the Basin is characterized as a rural, agriculture-based lifestyle. The area is sparsely populated. Business and commerce centers are smaller towns with a high percentage of trade and service businesses being locally owned.

Farming and ranching is a way of life and is the primary economic force in the region. Recreation and tourism has influenced farming and ranching, however. Influences from recreation and tourism include the agricultural sector making changes in reservoir operations and irrigation water deliveries to minimize perceived negative impacts to recreation.

3.4.5.2 Agricultural Production and Value

The agricultural industry has traditionally dominated the economic base and land use in the Basin, a trend that continues today. However, the number of farms has been declining over time, from a high of 7,816 farms averaging about 320 acres in size in 1949 to 3,223 farms averaging 690 acres in 1992. The annual value of agricultural production for the two irrigation districts (Bostwick Irrigation District in Nebraska and Kansas Bostwick Irrigation District No. 2) increased from $12,513,503 in 1978 to $14,258,274 in 1992. The annual value of crop production for the five counties in the study area was about $420.4 million in 1992. Thus, the value of crop production from the two irrigation districts accounts for about 3.4 percent of the total value of production in the counties in 1992. These averages were obtained from the 1992 Census of Agriculture. On a per acre basis, the value of crop production averaged $238.78 (in 1978) across the two irrigation districts and $331.99 per acre in 1992.

3.4.6 Cultural Resources Evaluations

The primary cultural resource requirements applicable to the proposed project are Section 106 of the National Historic Preservation Act and 36 CFR Part 800, the regulations which implement Section 106. These regulations specify a consultation process with the State Historic Preservation Officer, the public, interested parties and Indian Tribes. Through the consultation process,

[16] Resource Management Assessment, Republican River Basin: Water Service Contract Renewal, U.S. Department of Interior, Bureau of Reclamation, Great Plains Region, July 1996.

Reclamation would determine if the proposed project would have an adverse effect on any historic properties (cultural resources which are eligible for inclusion in the *National Register of Historic Places*). If Reclamation determines that there will be an adverse effect, it will enter into a memorandum of agreement with the consulting parties to address the adverse effect. The usual method of mitigating adverse effects to archaeological sites is through archaeological excavation of a portion of the site. Public education or interpretation is another possible method of mitigating an adverse effect.

3.4.6.1 Alternatives A, B, and C: Alternatives That Only Involve the Diversion Dam and Canal

The Superior-Courtland Diversion Dam and Courtland Canal are in themselves cultural resources; actions that would modify these structures would require Section 106 consultation. However, it is not known if consultations would result in a determination that the modifications constitute an adverse effect to the Diversion Dam or canal. Adverse effects to such structures are usually mitigated through thorough documentation, some form of interpretation for the public, or both.

3.4.6.2 Alternatives D, E, F, G, H, and I: Alternatives That Also Involve Raising Lovewell Reservoir

The proposals to increase storage capacities of Lovewell Reservoir may require considerable cultural resources investigations. Additional lands currently outside Federal property boundaries will be directly impacted resulting from increased pool elevations. There are approximately 15 "locations" currently outside Federal property boundaries that may be flooded with the proposed larger reservoir increase. Reclamation will likely obtain title to or easement on these parcels of land. Any lands becoming Federal property, either by fee title or easement, will require cultural resource surveys.

The higher reservoir operation elevations will impact existing riprap, roads, bridges, cabins and recreation facilities. Any construction activity related to these features will require cultural resource surveys.

All archeological sites eligible for inclusion on the *National Register of Historic Places (National Register)* will have to be mitigated prior to any federal undertaking which would impact these sites. Within current Federal property boundaries there are 55 known archeological sites located near the edge of the current normal pool elevation of 1,583 feet and/or extending to an elevation of about 1,600 feet. Of those 55 sites, eleven (11) sites are not eligible for the *National Register* and require no additional work. Sixteen (16) sites are located at the current normal pool elevation and require additional *National Register* testing to determine eligibility. Twenty-one (21) sites are located at the current normal pool elevation plus 5 feet and require additional *National Register* testing. Seven (7) sites are located 5 to 10 feet above current normal pool elevation and require additional *National Register* testing. Included in these numbers are seven (7)

archeological sites which have been identified to be part of an Archeological District or Multiple Property nomination form for the National Register. Additional sites are expected to be identified with the cultural resource activities associated with any future investigations.

The Kansas State Historic Preservation Office (SHPO) is viewing "normal" reservoir operations as Section 106 processes. Any modifications to the existing reservoir will have SHPO involvement. Tribal consultation will also be required on all undertakings.

There are three known Euro-American cemeteries at or near Lovewell Reservoir. One and possibly two may be impacted by raising the water level in Lovewell Reservoir. Monitoring, stabilization and possibly relocation of graves may be required.

Native American burials have been discovered at Lovewell Reservoir. Sixteen burials were excavated from one archaeological site in 1982 and at least five more burials have been discovered since then. It is quite likely that additional Native American burials will be encountered and that additional archaeological excavation and ground disturbance will reveal more Native American burials.

Some of the previously discovered burials have been found to be affiliated with the Pawnee, Wichita, and Arikara (Three Affiliated Tribes) while others have been affiliated with the Oneota tradition. The discovery or excavation of additional Native American human remains are of concern to those tribes, and may be of concern to other tribes which have a connection to the area. Not only would the Tribes be involved in the Section 106 consultations regarding raising Lovewell, they would also be parties to a comprehensive agreement developed pursuant to Native American Graves Protection and Repatriation Act (NAGPRA).

The abandoned town of Rubens, located on the western end of the current reservoir location, would have to be documented. State documents need to be reviewed and may reveal if there was a separate town cemetery located nearby.

3.4.6.3 Other Storage Alternatives

No information is available on cultural resources associated with any of the off-stream storage alternatives. It is reasonable to assume that some archaeological sites or other cultural resource sites are located in the vicinity of the off-stream storage alternatives, but no statements can be made regarding effects to cultural resources based on present information.

3.4.7 Legal and Institutional Evaluations

3.4.7.1 Legal

3.4.7.1.1 Water Rights

The current right to store water in Lovewell Reservoir is held by the KBID for use of irrigation of Bostwick Division lands. If a permanent right to store additional water in Lovewell is desired, an additional storage right may be necessary, depending on purpose and the amount of additional storage. If additional water is stored in a new or other existing storage facility(s), a new storage water right designating the purpose of the storage would be necessary. A natural flow right may also be required. The reach of the Republican River between Harlan County Dam and Hardy, Nebraska is closed to new surface water rights and groundwater well permits at this time.

The settlement stipulation provides for a priority date of February 26, 1948 for Kansas Bostwick Irrigation District diversions of natural flow at Superior-Courtland Diversion Dam. This priority date would not be in effect for other purposes. In the settlement stipulation, it is stated that each of the States has closed or substantially limited its portion of the Basin above Hardy, Nebraska to new surface water rights and groundwater well permits. Obstacles to obtaining additional storage rights at Lovewell Reservoir given current moratoriums and the established MDS would need to be discussed and coordinated with officials from both States.

Presently Kansas administers ground water and surface water use. Nebraska does not require water right permits for ground water use. In Nebraska, the local NRDs are responsible for the administration of ground water use and the Nebraska Department of Natural Resources is responsible for the administration of surface water use.

3.4.7.1.1.1 Nebraska Surface Water Rights below Harlan County Dam and above State line

- There are 4.25 cfs of water rights above the Superior-Courtland Diversion Dam that are senior to the Bostwick Unit's earliest direct flow right dated April 3, 1946.

- There are 94.04 cfs direct flow water rights in the Basin above the Superior-Courtland Diversion Dam and below Harlan County Dam that are junior to the Bostwick Unit's earliest direct flow right dated 4/3/46. This includes water rights on tributaries that discharge into the Republican River above the Diversion Dam. Included are: 9.12 cfs in Harlan County above the Franklin Pump Canal; 28.25 cfs in Franklin County above the Franklin Pump Canal; 28.17 cfs in Franklin County below the Franklin Pump Canal; 28.50 cfs in Webster County.

- There are 4.04 cfs water rights on the mainstream on the Republican River below the Superior-Courtland Diversion Dam and above the State line that are senior to the Bostwick Unit's earliest direct flow right dated 4/3/46. These are in Nuckolls County.

- There are 21.40 cfs direct flow water rights on the mainstream of the Republican River below the Superior-Courtland Diversion Dam and above the State line that are junior to the earliest direct flow right of the Bostwick Unit dated 4/3/46. 2.76 cfs of the total are in Webster County and the remaining 18.64 cfs are in Nuckolls County.

3.4.7.1.1.2 Kansas Water Rights, State line to Clay Center

- All water within the State of Kansas is dedicated to the people of the State, subject to the control and regulation of the State and may be appropriated for beneficial use. Water appropriation rights may be obtained for surface or groundwater. Water rights are administered through the Kansas Water Appropriation Act, which is based on the Doctrine of Prior Appropriation. The date of priority of a water right and not the purpose of use determines the right to divert and use water at any time when supply is not sufficient to satisfy all water rights. The protection of instream flow from encroachment by new appropriations has been addressed at 33 locations on 23 streams and rivers by the establishment of MDS which have a priority date of April 12, 1984. Two of the locations are on the Republican River, one at Concordia and the other at Clay Center. All water rights in Kansas are administered by the Kansas Department of Agriculture, Division of Water Resources.

- Vested Rights: A vested right continues the beneficial use of water prior to June 28, 1945. There are 5 vested rights in the Basin from the State line to Clay Center. The authorized quantity is 342.5 ac-ft, the authorized rate is 17.18 cfs, and the authorized total is 766 acres.

3.4.7.1.1.3 Bostwick Division Water Rights

Reclamation has the storage rights for water in Harlan County Lake and also the storage use rights for lands in Nebraska. KBID has the rights associated with Lovewell Reservoir.

In addition to the storage rights, the Districts have natural flows rights for the irrigation of project lands. All of the natural flow rights are senior to the MDS priority date. During the time of the year that irrigation water is needed, the flows in the Basin are usually less than the amount of the districts' natural flow rights for extended periods of time. Therefore the natural flows are supplemented by storage water.

- Bostwick Irrigation District in Nebraska: The Bostwick Division in Nebraska has numerous water rights from the State of Nebraska for direct diversion from the Republican River. The earliest right is for Superior Canal and it has a priority date of April 3, 1946. Water rights have been added and transfers have occurred to provide coverage for changes in irrigated lands.

- KBID: Current KBID water rights for Lovewell Reservoir.

  KBID currently has two water rights from the State of Kansas which involve the diversion of water into Lovewell Reservoir, subsequent storage of water in Lovewell Reservoir, and diversion of water from Lovewell Reservoir for irrigation purposes.
  First, KBID has the right to divert and use water from the Republican River in Nebraska. That right, Water Right, File No. 385, from the State of Kansas, authorizes KBID to divert a maximum of 102,521 ac-ft of water per calendar year at a rate not to exceed 700 cfs for irrigation. The right has a priority date of July 16, 1948. Water diverted under this water right can be stored in Lovewell Reservoir without regard to the storage limits imposed by Water Right, File No. 4673.

  Second, KBID holds Water Right, File No. 4673, from the State of Kansas which authorizes diversion of a maximum of 19,700 ac-ft of water per calendar year at a maximum rate of 635 cfs from White Rock Creek. This right has a priority date of October 7, 1955, and includes 41,690 ac-ft of authorized storage in Lovewell Reservoir for subsequent irrigation use. This authorized storage can occur above the inactive pool (shutoff limit imposed by KBID's contract with Reclamation).

  Any change of the type of beneficial use of this water from irrigation to some other type of use would require approval of an application for a change in type of use, but the water right would retain its same priority date.

3.4.7.1.1.4 New Water Rights in Kansas

Use of water for any type of use in excess of the quantities or rates set forth above will require the approval of a new application to appropriate water for beneficial use. Such a permit would hold a priority date as of the date the application is filed and as such it would be subject to administration to prevent impairment to water rights senior to that permit.

New appropriations from surface water of the Republican River are specifically governed by the Kansas Administrative Regulation (KAR) 5-3-11(d)(6) (III) which provides in part:

"A. Each application to appropriate surface water for direct diversion from the Lower Republican River Basin, and its tributaries within the Lower Republican River Basin, shall be approved if it does not impair existing water rights nor prejudicially and unreasonably affect the public interest. No new permits to appropriate water shall be issued for appropriations that will be primarily dependent on surface water return flows from the Bostwick irrigation district.

B. Every application to appropriate surface water for direct diversion which is approved by the chief engineer shall be subject to the following conditions:

The approval of application or water right for direct diversion of surface water shall not be exercised if:

1. *Exercising the approval of application or water right causes impairment of senior water rights or senior approvals of applications.*

2. *The Kansas Water Office has requested that junior water rights be administered to meet the minimum desirable stream flow rates at the gage at Clay Center on the Lower Republican River;*

3. *The proposed point of diversion is above the Concordia minimum desirable stream flow gage and the Kansas Water Office has requested that junior water rights be administered to meet the minimum desirable streamflows at Concordia; or*

4. *The Chief Engineer is enforcing the terms of paragraph 6(b) of the Milford Water Reservation Right, identified as File No. 22,197-AR-6.*

C. Applications to appropriate surface water from tributaries to the mainstream of the Lower Republican by means of dams may be approved only if the approval will not result in impairment of existing rights, nor prejudicially an unreasonably affect the public interest. Any dam permitted on an ephemeral stream shall meet the requirements of K.A.R. 5-40-1 et seq. and be equipped with a controlled outlet with a minimum diameter of four inches. Any dam permitted on an intermittent or perennial stream shall be equipped with a controlled outlet with a minimum diameter of four inches. The controlled outlet shall be placed to allow water to pass through the dam at or near streambed elevation."

In the event that it becomes necessary to obtain new appropriations for water being stored in Lovewell Reservoir or any other proposed structure, the above criteria in Paragraph A must be met in order for the application to be approved and the conditions consistent with the provisions of Paragraphs B and C would be placed on the approval of the application.

3.4.7.1.1.5 Milford Water Reservation Right

The Water Reservation Right to Divert and Store Water in Milford Lake under Authority of the State Water Plan Storage Act, KSA 82a-1301 et seq., has a priority date of April 3, 1974, and is denominated as File No. 22,197-AR-6. The authorized point of diversion is the SW 1/4 SE 1/4 S17, T11S, R5E in Geary County, Kansas.

The State of Kansas, through the KWO, is authorized to utilize 100 percent of the total storage space between Elevation 1080.0 above MSL and Elevation 1144.4 MSL, which was 372,300 ac-ft of storage space in 1994. The KWO is currently authorized to market the yield of Milford Lake through a 2 percent drought, which was calculated in 1996 to be 124,381 ac-ft per year. If the reservoir is at or below Elevation 1144.4 and at or above Elevation 1140.0, any flows in excess of 50 cfs not needed to satisfy prior downstream rights may be stored. If the reservoir is below Elevation 1140.0, it is deemed to be in a drought condition and all natural flows not needed to satisfy senior downstream rights may be stored under the Reservation Right. Water Reservation Rights are enforceable based on their priority dates against all water rights with a priority date junior to the water reservation right.

3.4.7.1.1.6 Summary

Storage of water under the KBID water rights can occur with the existing priority dates as long as the total volume from the Republican River does not exceed the 102,521 ac-ft diversion limit. This limit was not a constraint in the model runs for this appraisal study. White Rock Creek water can be stored for subsequent irrigation use up to a storage limit of 41,690 ac-ft with the existing priority date. Water for any other purpose would require either a change of the type of use in the current water rights held by KBID or a new water right. Any change of the type of use would require approval of an application for a change in type of use, but the water right would retain its same priority date. Any new water right would have a priority date junior to all existing rights. The Settlement document does not address water stored or diverted for other purposes.

3.4.7.1.2 Congressional Authority and Appropriation

Reclamation requires specific Congressional Authorization to conduct a feasibility study by Section 8 of the Act of July 9, 1965 (Public Law [P.L.] 89-72, 79 Stat. 213). Congressional authority may be required and appropriations would be necessary for any construction, including construction of additional storage in Lovewell Reservoir, and/or to substantially modify the operation of existing facilities beyond what was contemplated in the Definite Plan Report (DPR) of the

Bostwick Division. It is believed that Congressional Authority exists for those alternatives involving improving operational efficiencies such as system automation or O&M improvements on existing Reclamation facilities.

3.4.7.2 Institutional

3.4.7.2.1 General

The study area in this appraisal study is the reach of the Basin from Harlan County Dam in Nebraska to the upper reaches of Milford Lake in Kansas. Both of these features were built and operated by the Corps. There is one Federal Reclamation project in the area, the Bostwick Division of the P-SMBP built by Reclamation. Reclamation and the two Bostwick Irrigation Districts have authorized use of irrigation space in Harlan County Lake in accordance with the Consensus Plan developed by the Corps and Reclamation. There is one other storage reservoir, Lovewell Reservoir in Kansas, which provides irrigation storage for lands in Kansas and also provides some flood control space. Other institutions that have responsibilities and authority in the area are:

- Nebraska Department of Natural Resources
- Kansas Department of Agriculture
- Kansas Water Office and the Kansas Water Authority
- Lower Republican Natural Resources District in Nebraska
- Middle Republican Natural Resources District in Nebraska
- Various involved Counties in both States
- Lower Republican Basin Advisory Committee in Kansas

3.4.7.2.2 Republican River Compact

The Republican River Compact was ratified by the three States, and consented to by the Congress by the Act of May, 26, 1943, (P.L. 60, ch 104, 57 Stat. 86). The purposes of the Compact are to provide for the most efficient use of the waters of the Basin for multiple purposes; to provide for an equitable distribution of such waters; to remove all causes, present and future, which might lead to controversies; to promote interstate comity; to recognize that the most efficient utilization of the waters within the basin is for BCU; and to promote joint action by the States and the United States in the efficient use of water and the control of destructive floods.

3.4.7.2.3 Republican River Basin Lawsuit

There was a disagreement on the use of the water in the basin and in May 1998 the State of Kansas filed a complaint with the Court alleging that Nebraska violated the Compact. After 17 months of intense negotiations an out-of-court settlement was reached and which was approved by the Court in May 2003.

3.4.7.2.4 Final Settlement Stipulation (FSS)

The litigation resulted in the FSS with the following key stipulations:

- Counts all groundwater use that is determined to deplete stream flow as part of the States consumptive use.
- Waives and forever bars all past claims for damages.
- Gives the States the flexibility to use its allocation wherever it sees fit.
- Increases flexibility by measuring Compact compliance on a 5-year running average, as opposed to annually, except in dry years when compliance is measured on a two-or three-year running average basis.
- Provides that the States, in collaboration with the United States, will pursue system improvements to make more efficient use of the water that is available in the basin.
- Provides for a five-year study of the impact of small ponds and terraces on stream flow.

3.4.7.2.5 Repayment Contracts

Reclamation has repayment contracts with two entities, the Bostwick Irrigation District in Nebraska and the KBID. These contracts stipulate the payments the Districts must make to Reclamation to repay the irrigation costs of the existing structures assigned to them for repayment. Additional contractual arrangements with the Districts or other entities would need to be negotiated for the repayment of costs assignable to the Districts or other entities for increasing storage and/or canal improvements.

3.4.8 Summary of the Evaluation of Alternatives

Relative to the preceding sections, the key information to assist in determining if there are viable alternatives that justify further Federal participation in a feasibility study is arrayed in Table 12. This table includes an evaluation of each alternative relative to the study's planning objectives identified in Section 2.4.5. This evaluation was conducted under the assumption that the additional water made available by the alternatives would be allocated to irrigation benefits. It should be noted that this assumption was made only for the purposes of this Study and this evaluation. As previously discussed, the volume of additional water varies from

between 4,200 to 17,300 ac-ft per year. Different allocations of the additional supply, such as allocating exclusively to MDS or something in between, could be considered at the next level of study. Table 13 displays an evaluation of the alternatives relative to an allocation emphasizing MDS. However, the amount of data available associated with this type of allocation was limited and therefore is more subjective than the information contained in Table 12.

Table 12 does not include a column for the sixth objective identified in Section 2.4.5, "recognize possible environmental and cultural impacts" as the evaluation process did not identify differences which would result in a variation of scoring for the alternatives.

Table 13 includes an evaluation of each alternative relative to the benefits to MDS only. In Table 13, additional flows and/or storage for each alternative would be used in attempt to meet established MDS levels. The Bostwick Division would not receive additional water if all flows were used for MDS. There may be irrigation benefits realized by non-project/private irrigators by meeting established MDS levels, but these benefits were not computed in Table 13.

3.4.9 Uncertainties

A number of uncertainties have been identified through the course of the study which could not be fully quantified or evaluated in the appraisal phase study. These uncertainties should however be recognized and resolved to whatever extent possible at the next level of study. Some of these uncertainties include:

- It is expected that OM&R costs will likely change from the baseline, particularly for the alternatives involving automation to the canals. OM&R costs have not been quantified in this Study, Table 7 in Section 3.4.2 provides a qualitative summary of the OM&R changes.

- Recreation benefits resulting from enlarging Lovewell Reservoir have not been quantified. Benefits may be realized from both the larger surface area of the reservoir and from facilities remaining available for use over longer periods of time.

- For the alternatives involving enlarging Lovewell Reservoir, because of the many known cultural resources sites at the Reservoir, the impacts to cultural resources may exceed the cost estimated in the non-contract cost multiplier for Environmental Permitting as listed in Table 5 in Section 3.4.2.

- For alternatives involving enlarging Lovewell Reservoir the cost of acquiring rights-of-way may exceed the cost estimate of 2 percent of the construction costs as listed in Table 5.

TABLE 12. SUMMARY OF ALTERNATIVE EVALUATIONS—IRRIGATION BENEFITS ONLY

Alternative	Implementation Cost (Irrigation Only)	Objective 1	Objective 2		Ratio	Objective 4 (inches)	Conditions) (vs. Baseline)
A	$13,000,000	$1,640,000	-	NE	Smallest Increase	0.13	0.2	No Change
B	$2,000,000	$3,990,000	+	NE	Moderate Increase	2.00	0.5	No Change
C	$15,000,000	$5,500,000	+	NE	Moderate Increase	0.37	0.7	No Change
D	$3,600,000	$11,000,000	+	NE	Moderate Increase	3.06	1.5	Moderate Increase
E	$16,500,000	$11,700,000	+	NE	Largest Increase	0.71	1.6	Moderate Increase
F	$12,000,000	$15,200,000	+	NE	Largest Increase	1.27	2.2	Largest Increase
G	$25,000,000	$15,700,000	+	NE	Largest Increase	0.63	2.3	Largest Increase
H	$1,650,000	$6,960,000	-	NE	Smallest Increase	4.22	0.9	Smallest Increase
I	$14,500,000	$6,960,000	-	NE	Smallest Increase	0.48	0.9	Moderate Increase
J	$14,490,000	NE	NE	NE	Likely Decrease	NE	NE	NE
K	$6,720,000	NE	NE	NE	Likely Decrease	NE	NE	NE
L	$12,600,000	NE	NE	NE	Likely Decrease	NE	NE	NE

Objectives

Objective 1 – Minimize bypass at Superior-Courtland Diversion Dam
Objective 2 – Provide augmentation storage water for MDS
Objective 3 – Develop cost-effective solutions
Objective 4 - Provide additional water supply to Bostwick Division lands – (additional inches of water)
Objective 5 – Provide additional recreation benefits

+ = highly complies with objective
- = does not comply with objective
NE = Not Estimated or Evaluated

Alternatives

A – Courtland Canal to Design Capacity, Winterize
B – Automate, Winterize
C – Automate, Winterize, Courtland Canal to Design Capacity
D - Automate, Winterize, Raise Lovewell 16,000 ac-ft
E - Automate, Winterize, Raise Lovewell 16,000 ac-ft, Courtland Canal to Design Capacity
F – Automate, Winterize, Raise Lovewell 35,000 ac-ft.
G – Automate, Winterize, Raise Lovewell 35,000 ac-ft, Courtland Canal to Design Capacity
H - Raise Lovewell 16,000 ac-ft
I – Raise Lovewell 16,000 ac-ft, Courtland Canal to Design Capacity
J – Off-Stream Storage, Jamestown Waterfowl Management Area South Dam
K - Off-Stream Storage, Jamestown Waterfowl Management Area North Dam
L – Off-Stream Storage, Beaver Creek

TABLE 13.–SUMMARY OF ALTERNATIVE EVALUATIONS–MDS ENHANCEMENT ONLY

Alternative	Implementation Cost		Objective 1	Objective 2	(in MDS violations)		(vs. Baseline)	(Average Hydrologic Conditions) (vs. Baseline)
A	$13,000,000	NE	-	-	Small Decrease	NE	No Change	No Change
B	$2,000,000	NE	+	-	Small Decrease	NE	No Change	No Change
C	$15,000,000	NE	+	-	Small Decrease	NE	No Change	No Change
D	$3,600,000	NE	+	0	Moderate Decrease	NE	No Change	Moderate Increase
E	$16,500,000	NE	+	0	Moderate Decrease	NE	No Change	Moderate Increase
F	$12,000,000	NE	+	+	Largest Decrease	NE	No Change	Largest Increase
G	$25,000,000	NE	+	+	Largest Decrease	NE	No Change	Largest Increase
H	$1,650,000	NE	-	0	Moderate Decrease	NE	No Change	Smallest Increase
I	$14,500,000	NE	-	0	Moderate Decrease	NE	No Change	Moderate Increase
J	$14,490,000	NE	NE	+	Largest Decrease	NE	NE	NE
K	$6,720,000	NE	NE	+	Largest Decrease	NE	NE	NE
L	$12,600,000	NE	NE	+	Largest Decrease	NE	NE	NE

Objectives

Objective 1 – Minimize bypass at Superior-Courtland Diversion Dam
Objective 2 – Provide augmentation storage water for MDS
Objective 3 – Develop cost-effective solutions
Objective 4 - Provide additional water supply to Bostwick Division lands – (additional inches of water)
Objective 5 – Provide additional recreation benefits

+ = highly complies with objective
0 = complies with objective
- = does not comply with objective
NE = Not Estimated or Evaluated

Alternatives

A – Courtland Canal to Design Capacity, Winterize
B – Automate, Winterize
C – Automate, Winterize, Courtland Canal to Design Capacity
D - Automate, Winterize, Raise Lovewell 16,000 ac-ft
E - Automate, Winterize, Raise Lovewell 16,000 ac-ft, Courtland Canal to Design Capacity
F - Automate, Winterize, Raise Lovewell 35,000 ac-ft.
G – Automate, Winterize, Raise Lovewell 35,000 ac-ft, Courtland Canal to Design Capacity
H – Raise Lovewell 16,000 ac-ft
I – Raise Lovewell 16,000 ac-ft, Courtland Canal to Design Capacity
J – Off-Stream Storage, Jamestown Waterfowl Management Area South Dam
K- Off-Stream Storage, Jamestown Waterfowl Management Area North Dam
L – Off-Stream Storage, Beaver Creek

- Because of the limits associated with the existing water rights, there are uncertainties regarding the volumes of water available for storage.

- For alternatives that provide non-project benefits, several authority/legislative issues would need to be addressed, such as conveyance and storage of non-project water in Bostwick project facilities and the repayment of the implementation costs assigned to the Districts and/or the States.

Chapter 4 – Findings

4.1 Findings

Prolonged droughts and devastating floods prompted irrigation and flood control development with Federal involvement. The States realized that there needed to be legal recognition of how the waters of the Republican River would be utilized so they entered into a Compact that was consented to by the Congress by the Act of May 26, 1943 (P.L. 60, ch. 104, 57 Stat. 86). The Flood Control Act of 1944 authorized the construction of major water resource development in the basin as part of the Pick-Sloan Missouri Basin Program. The Corps finished the construction of Harlan County Dam in 1952 and Reclamation initiated construction of the Bostwick Division in 1948 with the first irrigation water delivered in 1952.

The irrigation districts have experienced significant water delivery shortages due to decreasing water supplies and it is anticipated that these shortages will continue to occur as well as shortages downstream in the Republican River Valley. In addition, streamflows will periodically be less than the MDS established flows in Kansas. Presently some water supplies in the Basin are not being fully utilized. With improvements in the existing systems and possibly with additional storage capability, the system could be managed to alleviate some of the water shortage problems and provide some streamflow augmentation in the lower reaches in Kansas. Nebraska and Kansas are interested in pursuing a feasibility study to further assess possible system improvements and both have indicated their willingness to cost-share the study.

4.1.1 Recommendation

Based upon the States' continued support for further study and the potential viability of some alternatives, there is justification for further Federal participation in a cost-shared feasibility study. It is recommended that a feasibility study be undertaken to investigate solutions.

4.2 Preliminary Plan of Study – Feasibility Study

The preliminary plan of study (POS) is provided as Appendix F. The POS for the feasibility study defines the planning approach, activities to be accomplished, schedule, and associated costs that the Federal Government and the local sponsor(s) will be supporting financially. The study cost estimate and detailed work schedule are included with the POS, but will not be fully developed and finalized until there is specific Congressional authorization for a feasibility study. The POS defines participating requirements between Reclamation and the local sponsor(s) as well as those who will be performing and reviewing the activities involved in the feasibility study.

Appendix A

Hydrology Report

Hydrology Report

Hydrology

A modified version of the OPSTUDY computer model used for Reclamation's Contract Renewal Study in the Republican River Basin was used for the evaluation of the water supply for the alternatives presented in this study. The original model utilized monthly hydrologic data covering the period 1931 thru 1993. For this study, the model was updated to include historic hydrologic data thru 2000.

Reservoir Inflows and Reach Gain Calculations

In the Republican River Study for Contract Renewal, historical reservoir inflows and reach gains were calculated for 25 node basins for the period of record 1931 to 1993. A similar process was used to extend the inflows and reach gains records for the 1994 to 2000 period, providing a completed period of record in this analysis from 1931 to 2000.

In the study, the historical flows and reach gains were adjusted to a 1993 level-of-development. For the purposes of this study it was determined that the impacts of additional development in the basin during this period were minimal, and the historical flows would represent present level development, thus no adjustments were made.

Data for the flow analysis were taken from U.S. Geological Survey streamflow records. Evaporation and project diversion records were taken from the Annual Operations Plans.

Reservoir Evaporation Rates

Input to the Hydrology model required a monthly evaporation rate for each reservoir within the Republican River Basin. Using the monthly evaporation volumes from the annual operating plans, and the historic end of month surface area, monthly evaporation rates were calculated for the 1993 to 2000 period. This format was identical to the process used in the Contract Renewal Study.

Calculation of Monthly Crop Irrigation Requirements

In order to calculate the diversion requirements for each of the irrigation districts, it was necessary to determine crop irrigation requirements for three selected areas within the basin. Similar to the Contract Renewal analysis, each of the three areas represents similar climatological conditions within the basin. Area I was the western one-third of the basin, Area II was the middle of the basin and Area III represented the eastern one-third of the basin. Using the same climatological stations, the historical records associated with

them, and the CONUSE52 consumptive use program, monthly crop irrigation requirements for the 1993 through 2000 period were computed.

Systems Operations and Computer Modeling

Since this appraisal study concentrates on improving the water supply below Harlan County Lake, efforts to improve the original model were centered on that same area of the basin. A schematic diagram of the Lower Republican River Basin is shown in Figure 1. Following are modifications that were made to the original model code:

- The model was modified to incorporate Harlan County Lake Consensus Plan criteria which resulted from the contract renewal process. The following steps summarize the algorithm that was included into the model to simulate that plan. Since this model is using 1993-level-of-development streamflows, it should be noted that period-of-record average January-thru-May Harlan County Lake inflows and evaporation used as consensus criteria were developed based on the 1993 level flows rather than historic Harlan County Lake inflows as specified in the plan agreement.

    1. At the beginning of January for each year, compute Harlan County Lake shared shortage release.

    2. Estimate the May 31 end-of-month (EOM) content in Harlan County Lake as previous year's end-of-December content plus the lesser of the previous 5-year January-thru-May running average inflow or the 1931-2000 average January-thru-May average inflow (57,600 acre-feet), minus the 1931-2000 average January-thru-May evaporation (8,800 acre-feet). The May 31 EOM content is limited to the top-of-conservation pool.

    3. Estimate the maximum irrigation supply available as estimated end-of-May content minus bottom of irrigation pool plus summer evaporation adjustment value (20,000 acre-feet). If result is negative, then set to zero.

    4. If current modeling month is January, use the shared shortage table (Table 1) to interpolate to the estimated irrigation release.

TABLE 1. SHARED SHORTAGE ADJUSTMENT TABLE

Irrigation Water Available (ac-ft)	Irrigation Water Released (ac-ft)
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

5. Calculate the shutoff content as the estimated May 31 content minus the estimated maximum available irrigation supply. Result should not be less than content at elevation 1927.0.

6. At end of May, calculate actual available irrigation water supply as the May EOM content. If the actual available supply was less than the previously estimated May supply (see #2 above), reduce the shutoff content by the difference between the two values. The shutoff content is limited to a minimum content corresponding to a reservoir stage of 1927.0 feet.

7. If the calculated shutoff content is below the bottom of the irrigation pool, limit the annual releases from Harlan County Lake to 119,000 acre-feet.

- Model code simulating canal diversions below Harlan County Lake were reviewed and modified to more accurately reflect actual operations. Under existing operating rules, Lovewell Reservoir demands to fill to a target storage content are limited to the natural flow gains below Harlan County Lake to the Superior-Courtland Canals diversion structure. In addition, the irrigation districts above and along the Courtland Canal, Franklin, Franklin Pump, Naponee, Superior, Nebraska-Bostwick, and Kansas-Bostwick, have priority over any Lovewell storage demand to the natural flow gains below Harlan County Lake. The model will release Harlan County Lake storage to meet irrigation demands along the Courtland Canal and for the Lower Courtland Unit as a Lovewell Reservoir pass-thru demand.

- Since the Lower Courtland Unit has a water-supply advantage with Lovewell Reservoir over other Bostwick canals, a shared-shortage algorithm was incorporated into the model to better balance shortages. The algorithm calculates the shortage ratio for Lower Courtland on an annual (calendar year) basis and compares it to the composite annual shortage ratio for the remaining Bostwick canals. If the shortage ratio for Lower Courtland is less than that for the other Bostwick canals, then the Lower Courtland irrigation demand on Harlan County Lake is reduced in 5 percent increments. This is done iteratively on an annual basis until the Lower Courtland shortage ratio is more than the remaining Bostwick canals, or until the Lower Courtland Unit demand on Harlan County Lake is reduced to zero.

Alternatives Evaluation

Table 2 defines the baseline and nine alternatives evaluated with the model. The hydrologic effectiveness of an alternative was based on its incremental improvement over baseline conditions in supplying water for irrigation needs in the Bostwick Division. It should be noted that the modeling efforts in this appraisal study do not create new water in the basin, but rather look at the redirection of Republican River streamflows into Lovewell Reservoir via the Courtland Canal.

The alternatives cover four general areas where improvements could be made to enhance the water supply:

1. Winterizing the Courtland Canal so that it can be operated year round. In the baseline condition, the Courtland Canal is not winterized and does not operate during December, January, and February.

2. Automate the Superior-Courtland diversion dam to eliminate the present 40 cfs bypass requirement.

3. Renovate the Courtland Canal to bring it up to its design capacity of 751 cfs at the head end of the canal.

4. Raise Lovewell conservation storage capacity 16,000 acre-feet or 35,000 acre-feet.

Table 3 summarizes the model simulated results for the alternatives. Winterizing the Courtland Canal (Alternative A), results in an average December-thru-February increase of 4,800 acre-feet into Lovewell Reservoir as compared to baseline conditions.

Increasing the Courtland Canal to design capacity, also defined in Alternative A, results in the ability to move more water through the system to meet irrigation demands along the canal. Model simulations for this scenario result in a slight decline in Harlan County

Lake May EOM water supply and a slight increase in Lovewell Reservoir May EOM water supply.
A combination of all four areas of improvement can result in a significant water supply increase for the Bostwick districts. Lower Courtland Unit stands to receive the largest benefits, mainly due to the storage benefits from Lovewell Reservoir. However, decreases in simulated streamflows at Clay Center indicate that a gain in irrigation water supply will be at the expense of streamflows in the Republican River. This could result in a conflicting effect if the additional water supply was targeted to be used to supplement streamflows in Kansas, rather than as an irrigation supply for Bostwick districts.

As shown on Table 3, the farm deliveries for each alternative were computed so that these values could be used in the economic calculations.

It should be noted that the model does not have the capability to calculate variations in irrigation return flows associated changes in diversions and on-farm applications. Hence, an increase in irrigation diversions in the Lower Courtland unit would probably result in greater return flows to the river, which is not simulated by the current version of the model.

Minimum Daily Streamflow Analysis

The Minimum Daily Streamflow (MDS), as passed by the Kansas legislature in 1984 is not a target flow but a trigger event. When streamflow is reduced in the lower basin, it was necessary for the Kansas Water Office (KWO) to act on its statutory charge to call for administration of water rights junior to the MDS. The Kansas Department of Agriculture, Division of Water Resources, administers these rights.

The MDS section of Kansas Water Law specifies the minimum streamflow to meet water quality and quantity needs of aquatic life and senior water rights downstream. Water users who received a water right after enactment of MDS have water rights junior to MDS. When the water supply is
insufficient for all users, water right holders with junior rights may be restricted or cut off.

Using the flow data from the Alternative analyses, the Republican River at Clay Center flows were examined to determine the effects of the alternative on the MDS at that location. Although the MDS is a daily flow requirement, monthly flows were analyzed to display overall effects of the alternatives on the baseline streamflow at this gage.

In each of the Alternatives, the number of times the MDS is violated increases as does the total volume of additional water needed to meet the MDS. The MDS evaluation data is included as Table 4.

Figure 1 - Schematic Diagram of Lower Republican River Basin

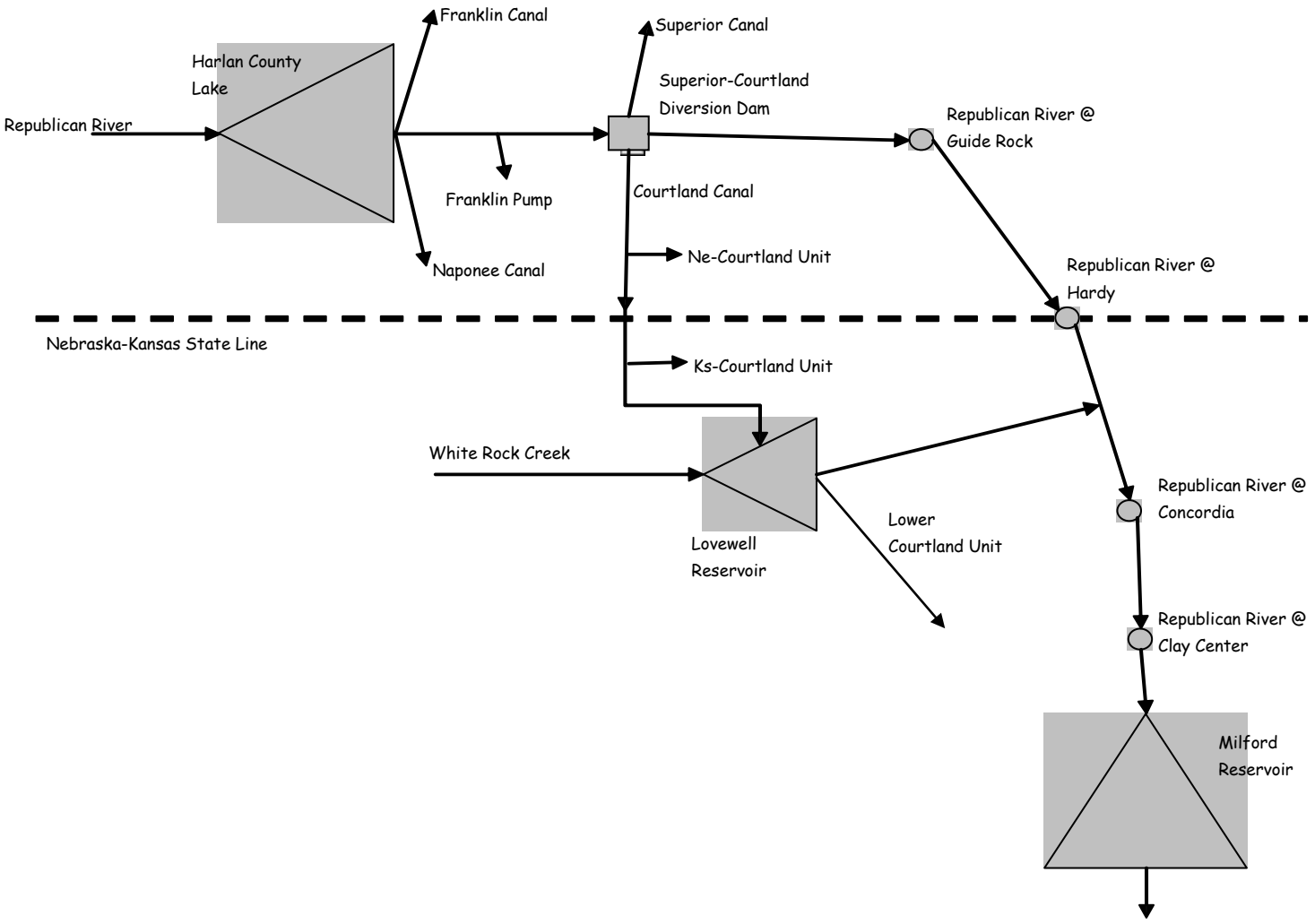


TABLE 2.–LOWER REPUBLIC APPRAISAL STUDY ALTERNATIVE DEFINITIONS

	Alternative									
Component	**Baseline**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Courtland Canal Capacity at Diversion Dam	580 cfs (35.0 kaf/mo)	751 cfs (45.3 kaf/mo)	580 cfs (35.0 kaf/mo)	751 cfs (45.3 kaf/mo)	580 cfs (35.0 kaf/mo)	751 cfs (45.3 kaf/mo)	580 cfs (35.0 kaf/mo)	751 cfs (45.3 kaf/mo)	580 cfs (35.0 kaf/mo)	751 cfs (45.3 kaf/mo)
Courtland Canal Capacity above Lovewell	500 cfs (30.2 kaf/mo)	681 cfs (41.1 kaf/mo)	500 cfs (30.2 kaf/mo)	681 cfs (41.1 kaf/mo)	500 cfs (30.2 kaf/mo)	681 cfs (41.1 kaf/mo)	500 cfs (30.2 kaf/mo)	681 cfs (41.1 kaf/mo)	500 cfs (30.2 kaf/mo)	681 cfs (41.1 kaf/mo)
Bypass at Diversion Dam for the Irrigation Season	40 cfs (2.4 kaf/mo)	40 cfs (2.4 kaf/mo)	0 cfs	0 cfs	0 cfs	0 cfs	0 cfs	0 cfs	40 cfs (2.4 kaf/mo)	40 cfs (2.4 kaf/mo)
Bypass at Diversion Dam for Remainder of Year	10 cfs (0.6 kaf/mo)	10 cfs (0.6 kaf/mo)	0 cfs	0 cfs	0 cfs	0 cfs	0 cfs	0 cfs	10 cfs (0.6 kaf/mo)	10 cfs (0.6 kaf/mo)
Lovewell TOC (Kaf)	35.7	35.7	35.7	35.7	51.7	51.7	70.7	70.7	51.7	51.7
Lovewell BOC (Kaf)	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Winter Diversions (Ice)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Increased Storage Use	NA	NA	NA	NA	Irrigation	Irrigation	Irrigation	Irrigation	Irrigation	Irrigation

A. Courtland Canal to Design Capacity, Winterize
B. Automate, Winterize
C. Automate, Winterize, Courtland Canal to Design Capacity
D. Automate, Winterize, Raise Lovewell 16,000 acre-feet
E. Automate, Winterize, Raise Lovewell 16,000 acre-feet, Courtland Canal to Design Capacity
F. Automate, Winterize, Raise Lovewell 35,000 acre-feet
G. Automate, Winterize, Raise Lovewell 35,000 acre-feet, Courtland Canal to Design Capacity
H. Raise Lovewell 16,000 acre-feet
I. Raise Lovewell 16,000 acre-feet, Courtland Canal to Design capacity

TABLE 3.–SUMMARY OF MODEL SIMULATION RESULTS

Average End-of-May Available Water Supply in Reservoirs: (Kaf)

	Baseline	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alt H	Alt I
Harlan	75.6	71.8	78.2	72.9	78.6	73.8	80.4	75.1	76.5	72.6
Change from Baseline		-3.8	2.6	-2.7	3.0	-1.8	4.8	-0.5	0.9	-3.0
Lovewell	19.8	21.0	21.5	21.5	32.5	32.5	42.8	43.2	29.0	29.1
Change from Baseline		1.2	1.6	1.7	12.7	12.7	22.9	23.4	9.2	9.3

Harlan supply calculated as May EOM minus June 1 shutoff content determined by concensus criteria.
Lovewell supply calculated as May EOM minus dead pool.

Average Annual Diversions to Bostwick Districts: (Kaf)

	Baseline	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alt H	Alt I
Franklin	26.0	25.0	26.6	25.5	27.1	26.2	27.3	26.8	26.4	25.6
Franklin Pump	3.9	3.7	3.9	3.8	4.0	3.9	4.0	4.0	3.9	3.8
Naponee	3.5	3.3	3.5	3.4	3.6	3.5	3.6	3.6	3.5	3.4
Superior	13.0	12.6	13.7	13.2	13.8	13.5	13.8	13.6	13.1	12.8
Ne-Courtland	3.4	3.3	3.6	3.5	3.6	3.5	3.6	3.6	3.4	3.3
Ks-Courtland	35.0	33.6	37.0	35.6	37.2	36.2	37.1	36.8	35.3	34.3
Courtland Unit	40.9	46.0	42.9	47.7	51.5	55.0	58.7	60.6	48.6	51.5
Total Diversions	125.6	127.4	131.2	132.7	140.9	141.8	148.1	148.9	134.3	134.7
Change from Baseline		1.8	5.6	7.0	15.2	16.2	22.5	23.2	8.6	9.0

Average Annual Shortages to Bostwick Districts: (Kaf)

	Baseline	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alt H	Alt I
Franklin	6.8	7.9	6.2	7.3	5.7	6.6	5.5	6.0	6.4	7.3
Franklin Pump	0.9	1.1	0.9	1.0	0.8	0.9	0.8	0.8	0.9	1.0
Naponee	0.9	1.0	0.8	0.9	0.7	0.8	0.7	0.7	0.8	0.9
Superior	4.8	5.2	4.0	4.5	3.9	4.2	3.9	4.1	4.6	4.9
Ne-Courtland	1.5	1.7	1.3	1.5	1.3	1.4	1.3	1.4	1.5	1.6
Ks-Courtland	15.8	17.2	13.8	15.2	13.6	14.5	13.7	14.0	15.4	16.5
Courtland Unit	39.1	34.0	37.1	32.3	28.4	25.0	21.3	19.4	31.4	28.5
Total Short	69.7	67.9	64.1	62.6	54.4	53.5	47.2	46.4	61.0	60.6
Change from Baseline		-1.7	-5.6	-7.0	-15.2	-16.2	-22.5	-23.3	-8.7	-9.0

TABLE 3.—SUMMARY OF MODEL SIMULATION RESULTS (CONTINUED)

Average Discharge from Courtland Canal into Lovewell: (Kaf)

	Baseline	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alt H	Alt I
Annual	25.2	32.8	30.3	35.5	35.1	39.1	39.7	42.5	29.4	32.9
Non-Irrig Seas	11.2	13.8	15.6	15.0	21.6	20.6	26.7	25.1	16.1	15.3
Irrigation Seas	14.0	19.0	14.8	20.5	13.4	18.6	12.9	17.5	13.3	17.6
Dec thru Feb	0.0	4.8	5.4	5.2	7.2	7.0	7.5	7.4	0.0	0.0

Average Total Outflow from Harlan County Reservoir: (Kaf)

	Baseline	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alt H	Alt I
Annual	100.1	100.7	99.7	100.5	99.4	100.2	98.9	100.0	99.9	100.5
Non-Irrig Seas	10.7	9.2	11.4	9.8	11.2	9.9	12.0	10.2	10.6	9.4
Irrigation Seas	89.4	91.6	88.3	90.7	88.1	90.3	87.0	89.8	89.3	91.2

Average Annual Discharge for Republican River at Hardy: (Kaf)

	Baseline	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alt H	Alt I
Annual	124.5	118.1	112.0	111.4	103.9	103.6	97.9	97.5	118.0	117.8
Change from Baseline		-6.4	-12.5	-13.1	-20.6	-20.8	-26.6	-26.9	-6.5	-6.7

Average Annual Discharge for Republican River at Clay Center: (Kaf)

	Baseline	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alt H	Alt I
Annual	454.5	450.4	445.3	445.0	432.6	432.9	423.3	423.8	444.0	444.3
Change from Baseline		-4.1	-9.3	-9.5	-21.9	-21.6	-31.2	-30.7	-10.6	-10.3

Average Annual Farm Deliveries to Bostwick Districts: (Inches)

	Baseline	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alt H	Alt I
NE-Courtland	16.2	15.6	17.1	16.5	17.2	16.8	17.2	17.0	16.4	15.9
KS-Courtland	15.6	15.0	16.5	15.9	16.6	16.2	16.6	16.4	15.8	15.3
Courtland Unit	9.3	10.5	9.7	10.9	11.8	12.6	13.4	13.8	11.1	11.8
Franklin	10.9	10.5	11.1	10.7	11.3	11.0	11.4	11.2	11.0	10.7
Naponee	13.6	13.1	13.9	13.4	14.1	13.7	14.2	14.0	13.8	13.4
Franklin Pump	13.9	13.4	14.1	13.7	14.4	14.1	14.5	14.3	14.1	13.7
Superior	10.6	10.2	11.1	10.8	11.2	11.0	11.2	11.1	10.7	10.4
Weighted Averages										
Bostwick	11.5	11.7	12.0	12.2	13.0	13.1	13.7	13.8	12.4	12.4

TABLE 4.—MDS RESULTS

Republican River at Clay Center, Kansas
Comparison of Alternative to Baseline
Average Monthly AF Needed to Satisfy the MDS
Period of Record 1981-2000

Alternative	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	512	380	91	78	157	1307	1807	1458	1454	880	842	667	9633
A	512	380	906	716	694	1074	1420	1338	1454	879	843	667	10884
B	626	540	1020	847	811	1180	1339	1545	1669	1234	1294	746	12851
C	660	563	1089	850	768	1179	1322	1276	1648	1129	1218	746	12449
D	512	380	906	769	694	1074	1420	1338	1454	879	843	667	10937
E	660	563	1089	939	874	1461	2122	1631	1648	1111	1218	746	14063
F	660	563	1089	939	915	1506	2808	2180	1648	1108	1214	746	15377
G	660	563	1089	939	910	1461	2694	2158	1648	1112	1218	746	15198
H	512	380	91	78	157	1324	2565	2075	1454	858	841	667	11003
I	509	404	89	8	155	1190	2220	1859	1341	446	423	463	9107

Republican River at Clay Center, Kansas
Comparison to the Baseline Alternative
Number of times each month the MDS is in violation
Period of Record 1981-2000

Alternative	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline	153	174	43	35	53	193	175	129	115	101	106	109
A	153	174	189	176	116	158	155	120	115	101	106	109
B	158	194	169	170	127	127	136	132	121	105	127	98
C	166	207	200	172	113	127	124	120	121	103	128	128
D	153	174	190	191	120	127	128	120	115	99	106	109
E	166	207	200	202	155	192	205	134	121	101	128	128
F	166	207	200	202	168	204	270	182	121	98	127	128
G	166	207	200	202	167	192	246	171	121	101	128	128
H	153	144	43	35	53	198	258	175	115	99	106	109
I	153	178	43	35	53	198	258	175	115	102	106	109

Appendix B

Cost Estimate Worksheets

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__1__ OF __2__

FEATURE: 07-Sep-04
Appraisal Level
Lower Republican River
Alternative A
Courtland Canal to Design Capacity and Winterize

PROJECT: **Missouri River Basin**

REGION: **GP** **WOID: 6B465**

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Reshape Courtland Canal (29.6 miles from Guide Rock to Lovewell):					
		Tractive forces; side slope = 2.75; Max velocity = 2 fps (Survey Xsection reccmd)					
	1	Canal excavation		239,350	cyd	$3.50	$837,725.00
	2	Canal backfill and compact		347,885	cyd	$1.50	$521,827.50
		Removal of existing concrete canal lining L1 and L2 canal types					
	3	Removal existing concrete canal lining		82,760	syd	$15.00	$1,241,400.00
	4	Excavation for lining		45,930	cyd	$3.50	$160,755.00
		Geomembrane 60 mils to invert and side slopes for concrete lining sections					
	5	Furnishing and installing exposed geomembrane 60 mils to invert and side slopes		117,495	syd	$8.00	$939,960.00
	6	Furnishing and installing gravel for canal invert (8-inches)		43,415	cyd	$35.00	$1,519,525.00
		Furnishing and Installing bubblers at 11 checks and Diversion Dam:	D-8140				
	7	Furnishing and installing 2-inch galvanized steel diffuser pipe		800	ft	$20.00	$16,000.00
		at 11 checks and at Diversion Dam.					
	8	Furnishing and installing 2-inch galvanized steel manifold pipe at		200	ft	$20.00	$4,000.00
		at 11 checks and at Diversion Dam.					
	9	Furnishing and installing air compressor (4 cfm, 5 hp size)		12	each	$1,000.00	$12,000.00
		at 11 checks and Diversion Dam.					
	10	Furnishing and installing single phase 5kv power line (w/wood poles)		12	each	$20,000.00	$240,000.00
		for the bubblers (1 mile pull per location) at 10 checks and at					
		Diversion Dam.					
		County road bridges:	D-8140				
		(Construct 6 new county road bridges according to photos from M. Kube)					
	11	Remove & dispose of 14-ft dia steel pipe culvert at road crossings		6	each	$5,000.00	$30,000.00
		Length = 50 ft					
	12	Excavation and dispose of earth material at 6 road crossings.		8,000	cyd	$8.00	$64,000.00
	13	Construct 65 ft span x 24 ft wide county road bridges.		6	each	$150,000.00	$900,000.00
		(BI-48 prestressed concrete beams superstructure w/4"asphalt					
		surfacing, cast-in-place abutments (spread footing or driven piles),					
		wingwalls, and W-beam guardrails)					

QUANTITIES PRICES

BY **J.Keith**		**BY** **D. Donaldson**	**CHECKED**
DATE PREPARED **10/28/2003**	**APPROVED**	**DATE** **11/14/2003**	**PRICE LEVEL** **Appraisal**

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative A
Courtland Canal to Design Capacity and Winterize

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal 1 (Sheets 1 and 2)					$6,487,192.50
		Mobilization (+/- 5% of Subtotal 1)					$320,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$6,807,192.50
		Unlisted Items (+/- 20% of Subtotal 2)					$1,392,807.50
		Contract Cost					$8,200,000.00
		Contingencies (+/- 25% of Contract Cost)					$1,800,000.00
		Field Cost					$10,000,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$2,500,000.00
		Total Project Cost (August 2002 Dollars)					$12,500,000.00
		Escalation (+/- 5% of Total Project Cost, August 2002 Dollars)					$500,000.00
		Total Project Cost Escalated to November 2003 Dollars					**$13,000,000.00**

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 10/28/2003	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative B
Automate, Winterize

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Automate gates at 12 sites - Local Control Only					
	1	Furnishing and Installing Remote Terminal Unit (RTU), PC type box,	D-8140	12	ls	$10,000.00	$120,000.00
		for the control of the existing motorized radial gates					
		including basic RTU software and RTU special function software.					
	2	Furnishing and installing 120V power for RTU from Power drop.	D-8140	12	ls	$4,000.00	$48,000.00
		Assume 250' steel conduit and single phase power cable.					
	3	Furnishing & Installing motor operator w/ combination motor/starter		20	ls	$7,000.00	$140,000.00
		NMA Type 4 enclosure, 240 V single phase. (5 Bays @ headwrks)					
		Stilling wells at 11 sites:	D-8140				
	4	Furnishing and installing 36B25 RCP installed vertically on conc pad.		325	ft	$350.00	$113,750.00
		Assume 5' dia x 13' deep excavation in soil prior to installation.					
	5	Furnishing and installing 4-inch PVC pipe.		1,500	ft	$24.00	$36,000.00
	6	Furnishing and installing pressure transducer.		25	ls	$2,500.00	$62,500.00
	7	Furnishing and installing buried metallic cable between stilling		6,250	ft	$8.00	$50,000.00
		well and RTU - four wire twisted pairs.					
	8	Furnishing and installing buried power cable to stilling well.		6,250	ft	$16.00	$100,000.00
		Furnishing and Installing bubblers at 11 checks and Diversion Dam:	D-8140				
	9	Furnishing and installing 2-inch galvanized steel diffuser pipe		800	ft	$20.00	$16,000.00
		at 11 checks and at Diversion Dam.					
	10	Furnishing and installing 2-inch galvanized steel manifold pipe at		200	ft	$20.00	$4,000.00
		at 11 checks and at Diversion Dam.					
	11	Furnishing and installing air compressor (4 cfm, 5 hp size)		12	each	$1,000.00	$12,000.00
		at 11 checks and Diversion Dam.					
	12	Furnishing and installing single phase 5kv power line (w/wood poles)		12	each	$20,000.00	$240,000.00
		for the bubblers (1 mile pull per location) at 10 checks and at					
		Diversion Dam.					

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 10/28/2003	**APPROVED**	**DATE** 9/7/2004	**PRICE LEVEL** Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative B
Automate, Winterize

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal 1 (Sheets 1 and 2)					$942,250.00
		Mobilization (+/- 5% of Subtotal 1)					$47,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$989,250.00
		Unlisted Items (+/- 20% of Subtotal 2)					$210,750.00
		Contract Cost					$1,200,000.00
		Contingencies (+/- 25% of Contract Cost)					$300,000.00
		Field Cost					$1,500,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$400,000.00
		Total Project Cost (August 2002 Dollars)					$1,900,000.00
		Escalation (+/- 5% of Total Project Cost, August 2002 Dollars)					$100,000.00
		Total Project Cost Escalated to November 2003 Dollars					**$2,000,000.00**

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 10/28/2003	**APPROVED**	**DATE** 9/7/2004	**PRICE LEVEL** Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative C
Automate, Winterize, Courtland Canal to Design Capacity

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Automate gates at 12 sites - Local Control Only					
	1	Furnishing and Installing Remote Terminal Unit (RTU), PC type box,	D-8140	12	ls	$10,000.00	$120,000.00
		for the control of the existing motorized radial gates					
		including basic RTU software and RTU special function software.					
	2	Furnishing and installing 120V power for RTU from Power drop.	D-8140	12	ls	$4,000.00	$48,000.00
		Assume 250' steel conduit and single phase power cable.					
	3	Furnishing & Installing motor operator w/ combination motor/starter		20	ls	$7,000.00	$140,000.00
		NMA Type 4 enclosure, 240 V single phase. (5 Bays @ headwrks)					
		Stilling wells at 11 sites:	D-8140				
	4	Furnishing and installing 36B25 RCP installed vertically on conc pad.		325	ft	$350.00	$113,750.00
		Assume 5' dia x 13' deep excavation in soil prior to installation.					
	5	Furnishing and installing 4-inch PVC pipe.		1,500	ft	$24.00	$36,000.00
	6	Furnishing and installing pressure transducer.		25	ls	$2,500.00	$62,500.00
	7	Furnishing and installing buried metallic cable between stilling		6,250	ft	$8.00	$50,000.00
		well and RTU - four wire twisted pairs.					
	8	Furnishing and installing buried power cable to stilling well.		6,250	ft	$16.00	$100,000.00
		Furnishing and Installing bubblers at 11 checks and Diversion Dam:	D-8140				
	9	Furnishing and installing 2-inch galvanized steel diffuser pipe		800	ft	$20.00	$16,000.00
		at 11 checks and at Diversion Dam.					
	10	Furnishing and installing 2-inch galvanized steel manifold pipe at		200	ft	$20.00	$4,000.00
		at 11 checks and at Diversion Dam.					
	11	Furnishing and installing air compressor (4 cfm, 5 hp size)		12	each	$1,000.00	$12,000.00
		at 11 checks and Diversion Dam.					
	12	Furnishing and installing single phase 5kv power line (w/wood poles)		12	each	$20,000.00	$240,000.00
		for the bubblers (1 mile pull per location) at 10 checks and at					
		Diversion Dam.					

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 7/3/2002	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__2__ OF __3__

FEATURE: 07-Sep-04
Appraisal Level
Lower Republican River
Alternative C
Automate, Winterize, Courtland Canal to Design Capacity

PROJECT: **Missouri River Basin**

REGION: **GP** **WOID: 6B465**

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		County road bridges:	D-8140				
		(Construct 6 new county road bridges according to photos from M. Kube)					
	13	Remove & dispose of 14-ft dia steel pipe culvert at road crossings		6	each	$5,000.00	$30,000.00
		Length = 50 ft					
	14	Excavation and dispose of earth material at 6 road crossings.		8,000	cyd	$8.00	$64,000.00
	15	Construct 65 ft span x 24 ft wide county road bridges.		6	each	$150,000.00	$900,000.00
		(BI-48 prestressed concrete beams superstructure w/4"asphalt					
		surfacing, cast-in-place abutments (spread footing or driven piles),					
		wingwalls, and W-beam guardrails)					
		Reshape Courtland Canal (29.6 miles from Guide Rock to Lovewell):					
		Tractive forces; side slope = 2.75; Max velocity = 2 fps (Survey Xsection reccmd)					
	16	Canal excavation		239,350	cyd	$3.50	$837,725.00
	17	Canal backfill and compact		347,885	cyd	$1.50	$521,827.50
		Removal of existing concrete canal lining L1 and L2 canal types					
	18	Removal existing concrete canal lining		82,760	syd	$15.00	$1,241,400.00
	19	Excavation for lining		45,930	cyd	$3.50	$160,755.00
		Geomembrane 60 mils to invert and side slopes for concrete lining sections					
	20	Furnishing and installing exposed geomembrane 60 mils to invert and side slopes		117,495	syd	$8.00	$939,960.00
	21	Furnishing and installing gravel for canal invert (8-inches)		43,415	cyd	$35.00	$1,519,525.00

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 10/30/03	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative C
Automate, Winterize, Courtland Canal to Design Capacity

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal 1 (Sheets 1 and 2)					$7,157,442.50
		Mobilization (+/- 5% of Subtotal 1)					$360,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$7,517,442.50
		Unlisted Items (+/- 20% of Subtotal 2)					$1,482,557.50
		Contract Cost					$9,000,000.00
		Contingencies (+/- 25% of Contract Cost)					$2,500,000.00
		Field Cost					$11,500,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$3,000,000.00
		Total Project Cost (August 2002 Dollars)					$14,500,000.00
		Escalation (+/- 5% of Total Project Cost, August 2002 Dollars)					$500,000.00
		Total Project Cost Escalated to November 2003 Dollars					**$15,000,000.00**

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 10/28/2003	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__1__ OF __2__

FEATURE: 07-Sep-04
Appraisal Level
Lower Republican River
Alternative D
Automate, Winterize, Raise Lovewell 16,000 acre-ft

PROJECT: **Missouri River Basin**

REGION: **GP** **WOID: 6B465**

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Automate gates at 12 sites - Local Control Only					
	1	Furnishing and Installing Remote Terminal Unit (RTU), PC type box,	D-8140	12	ls	$10,000.00	$120,000.00
		for the control of the existing motorized radial gates					
		including basic RTU software and RTU special function software.					
	2	Furnishing and installing 120V power for RTU from Power drop.	D-8140	12	ls	$4,000.00	$48,000.00
		Assume 250' steel conduit and single phase power cable.					
	3	Furnishing & Installing motor operator w/ combination motor/starter		20	ls	$7,000.00	$140,000.00
		NMA Type 4 enclosure, 240 V single phase. (5 Bays @ headwrks)					
		Stilling wells at 11 sites:	D-8140				
	4	Furnishing and installing 36B25 RCP installed vertically on conc pad.		325	ft	$350.00	$113,750.00
		Assume 5' dia x 13' deep excavation in soil prior to installation.					
	5	Furnishing and installing 4-inch PVC pipe.		1,500	ft	$24.00	$36,000.00
	6	Furnishing and installing pressure transducer.		25	ls	$2,500.00	$62,500.00
	7	Furnishing and installing buried metallic cable between stilling		6,250	ft	$8.00	$50,000.00
		well and RTU - four wire twisted pairs.					
	8	Furnishing and installing buried power cable to stilling well.		6,250	ft	$16.00	$100,000.00
		Furnishing and Installing bubblers at 11 checks and Diversion Dam:	D-8140				
	9	Furnishing and installing 2-inch galvanized steel diffuser pipe		800	ft	$20.00	$16,000.00
		at 11 checks and at Diversion Dam.					
	10	Furnishing and installing 2-inch galvanized steel manifold pipe at		200	ft	$20.00	$4,000.00
		at 11 checks and at Diversion Dam.					
	11	Furnishing and installing air compressor (4 cfm, 5 hp size)		12	each	$1,000.00	$12,000.00
		at 11 checks and Diversion Dam.					
	12	Furnishing and installing single phase 5kv power line (w/wood poles)		12	each	$20,000.00	$240,000.00
		for the bubblers (1 mile pull per location) at 10 checks and at					
		Diversion Dam.					

QUANTITIES		PRICES	
BY **J.Keith**		**BY** **D. Donaldson**	**CHECKED**
DATE PREPARED **7/3/2002**	**APPROVED**	**DATE** **11/14/2003**	**PRICE LEVEL** **Appraisal**

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative D
Automate, Winterize, Raise Lovewell 16,000 acre-ft

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Raise Lovewell 16,000 acre-ft					
	13	Stripping/excavation 2 ft.		7,500	cy	$2.00	$15,000.00
	14	Furnish and place riprap		3,000	cy	$60.00	$180,000.00
		Riprap haul distance approximately 20-25 miles					
	15	Furnish and place bedding for riprap		1,500	cy	$35.00	$52,500.00
		Bedding haul distance approximately 10 miles					
	16	Furnish and place Zone 1 soil		21,000	cy	$10.00	$210,000.00
		Compact in 6 inch lifts					
		Soil haul distance less than 1 mile					
	17	Furnish and place gravel surfacing		1,500	cy	$35.00	$52,500.00
	18	Excavation of concrete for 3 foot spillway crest raise		66	cy	$350.00	$23,100.00
	19	Furnish and place concrete ogee crest spillway		140	cy	$650.00	$91,000.00
		Raise Lovewell - Impacts and Associated Costs to Recreation Facilities:					
	20	Lovewell State Park		1	ls	$130,000.00	$130,000.00
	21	Lovewell State Wildlife Area		1	ls	$36,000.00	$36,000.00
		Subtotal 1 (Sheets 1 and 2)					$1,732,350.00
		Mobilization (+/- 5% of Subtotal 1)					$87,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$1,819,350.00
		Unlisted Items (+/- 20% of Subtotal 2)					$380,650.00
		Contract Cost					$2,200,000.00
		Contingencies (+/- 25% of Contract Cost)					$500,000.00
		Field Cost					$2,700,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$700,000.00
		Total Project Cost (August 2002 Dollars)					$3,400,000.00
		Escalation (+/- 5% of Total Project Cost, August 2002 Dollars)					$200,000.00
		Total Project Cost Escalated to November 2003 Dollars					**$3,600,000.00**

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 7/3/2002	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative E
Automate, Winterize, Courtland Canal to Design Capacity, Raise Lovewell 16,000 acre-ft

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Automate gates at 12 sites - Local Control Only					
	1	Furnishing and Installing Remote Terminal Unit (RTU), PC type box,	D-8140	12	ls	$10,000.00	$120,000.00
		for the control of the existing motorized radial gates					
		including basic RTU software and RTU special function software.					
	2	Furnishing and installing 120V power for RTU from Power drop.	D-8140	12	ls	$4,000.00	$48,000.00
		Assume 250' steel conduit and single phase power cable.					
	3	Furnishing & Installing motor operator w/ combination motor/starter		20	ls	$7,000.00	$140,000.00
		NMA Type 4 enclosure, 240 V single phase. (5 Bays @ headwrks)					
		Stilling wells at 11 sites:	D-8140				
	4	Furnishing and installing 36B25 RCP installed vertically on conc pad.		325	ft	$350.00	$113,750.00
		Assume 5' dia x 13' deep excavation in soil prior to installation.					
	5	Furnishing and installing 4-inch PVC pipe.		1,500	ft	$24.00	$36,000.00
	6	Furnishing and installing pressure transducer.		25	ls	$2,500.00	$62,500.00
	7	Furnishing and installing buried metallic cable between stilling		6,250	ft	$8.00	$50,000.00
		well and RTU - four wire twisted pairs.					
	8	Furnishing and installing buried power cable to stilling well.		6,250	ft	$16.00	$100,000.00
		Furnishing and Installing bubblers at 11 checks and Diversion Dam:	D-8140				
	9	Furnishing and installing 2-inch galvanized steel diffuser pipe		800	ft	$20.00	$16,000.00
		at 11 checks and at Diversion Dam.					
	10	Furnishing and installing 2-inch galvanized steel manifold pipe at		200	ft	$20.00	$4,000.00
		at 11 checks and at Diversion Dam.					
	11	Furnishing and installing air compressor (4 cfm, 5 hp size)		12	each	$1,000.00	$12,000.00
		at 11 checks and Diversion Dam.					
	12	Furnishing and installing single phase 5kv power line (w/wood poles)		12	each	$20,000.00	$240,000.00
		for the bubblers (1 mile pull per location) at 10 checks and at					
		Diversion Dam.					

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 7/3/2002	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__2__ OF __3__

FEATURE: 07-Sep-04
Appraisal Level
Lower Republican River
Alternative E
Automate, Winterize, Courtland Canal to Design Capacity, Raise Lovewell 16,000 acre-ft

PROJECT: **Missouri River Basin**

REGION: **GP** **WOID: 6B465**

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		County road bridges:	D-8140				
		(Construct 6 new county road bridges according to photos from M. Kube)					
	13	Remove & dispose of 14-ft dia steel pipe culvert at road crossings		6	each	$5,000.00	$30,000.00
		Length = 50 ft					
	14	Excavation and dispose of earth material at 6 road crossings.		8,000	cyd	$8.00	$64,000.00
	15	Construct 65 ft span x 24 ft wide county road bridges.		6	each	$150,000.00	$900,000.00
		(BI-48 prestressed concrete beams superstructure w/4"asphalt					
		surfacing, cast-in-place abutments (spread footing or driven piles),					
		wingwalls, and W-beam guardrails)					
		Reshape Courtland Canal (29.6 miles from Guide Rock to Lovewell):					
		Tractive forces; side slope = 2.75; Max velocity = 2 fps (Survey Xsection reccmd)					
	16	Canal excavation		239,350	cyd	$3.50	$837,725.00
	17	Canal backfill and compact		347,885	cyd	$1.50	$521,827.50
		Removal of existing concrete canal lining L1 and L2 canal types					
	18	Removal existing concrete canal lining		82,760	syd	$15.00	$1,241,400.00
	19	Excavation for lining		45,930	cyd	$3.50	$160,755.00
		Geomembrane 60 mils to invert and side slopes for concrete lining sections					
	20	Furnishing and installing exposed geomembrane 60 mils to invert and side slopes		117,495	syd	$8.00	$939,960.00
	21	Furnishing and installing gravel for canal invert (8-inches)		43,415	cyd	$35.00	$1,519,525.00

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 7/3/2002	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

SHEET__3__ OF __3__

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative E
Automate, Winterize, Courtland Canal to Design Capacity, Raise Lovewell 16,000 acre-ft

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Raise Lovewell 16,000 acre-ft					
	22	Stripping/excavation 2 ft.		7,500	cy	$2.00	$15,000.00
	23	Furnish and place riprap		3,000	cy	$60.00	$180,000.00
		Riprap haul distance approximately 20-25 miles					
	24	Furnish and place bedding for riprap		1,500	cy	$35.00	$52,500.00
		Bedding haul distance approximately 10 miles					
	25	Furnish and place Zone 1 soil		21,000	cy	$10.00	$210,000.00
		Compact in 6 inch lifts					
		Soil haul distance less than 1 mile					
	26	Furnish and place gravel surfacing		1,500	cy	$35.00	$52,500.00
	27	Excavation of concrete for 3 foot spillway crest raise		66	cy	$350.00	$23,100.00
	28	Furnish and place concrete ogee crest spillway		140	cy	$650.00	$91,000.00
		Raise Lovewell - Impacts and Associated Costs to Recreation Facilities:					
	29	Lovewell State Park		1	ls	$130,000.00	$130,000.00
	30	Lovewell State Wildlife Area		1	ls	$36,000.00	$36,000.00
		Subtotal 1 (Sheets 1 and 2)					$7,947,542.50
		Mobilization (+/- 5% of Subtotal 1)					$400,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$8,347,542.50
		Unlisted Items (+/- 20% of Subtotal 2)					$1,652,457.50
		Contract Cost					$10,000,000.00
		Contingencies (+/- 25% of Contract Cost)					$2,500,000.00
		Field Cost					$12,500,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$3,000,000.00
		Total Project Cost (August 2002 Dollars)					$15,500,000.00
		Escalation (+/- 5% of Total Project Cost, August 2002 Dollars)					$1,000,000.00
		Total Project Cost Escalated to November 2003 Dollars					**$16,500,000.00**

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 7/3/2002	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative F
Automate, Winterize, Raise Lovewell to 35,000 acre-ft

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Automate gates at 12 sites - Local Control Only					
	1	Furnishing and Installing Remote Terminal Unit (RTU), PC type box,	D-8140	12	ls	$10,000.00	$120,000.00
		for the control of the existing motorized radial gates					
		including basic RTU software and RTU special function software.					
	2	Furnishing and installing 120V power for RTU from Power drop.	D-8140	12	ls	$4,000.00	$48,000.00
		Assume 250' steel conduit and single phase power cable.					
	3	Furnishing & Installing motor operator w/ combination motor/starter		20	ls	$7,000.00	$140,000.00
		NMA Type 4 enclosure, 240 V single phase. (5 Bays @ headwrks)					
		Stilling wells at 11 sites:	D-8140				
	4	Furnishing and installing 36B25 RCP installed vertically on conc pad.		325	ft	$350.00	$113,750.00
		Assume 5' dia x 13' deep excavation in soil prior to installation.					
	5	Furnishing and installing 4-inch PVC pipe.		1,500	ft	$24.00	$36,000.00
	6	Furnishing and installing pressure transducer.		25	ls	$2,500.00	$62,500.00
	7	Furnishing and installing buried metallic cable between stilling		6,250	ft	$8.00	$50,000.00
		well and RTU - four wire twisted pairs.					
	8	Furnishing and installing buried power cable to stilling well.		6,250	ft	$16.00	$100,000.00
		Furnishing and Installing bubblers at 11 checks and Diversion Dam:	D-8140				
	9	Furnishing and installing 2-inch galvanized steel diffuser pipe		800	ft	$20.00	$16,000.00
		at 11 checks and at Diversion Dam.					
	10	Furnishing and installing 2-inch galvanized steel manifold pipe at		200	ft	$20.00	$4,000.00
		at 11 checks and at Diversion Dam.					
	11	Furnishing and installing air compressor (4 cfm, 5 hp size)		12	each	$1,000.00	$12,000.00
		at 11 checks and Diversion Dam.					
	12	Furnishing and installing single phase 5kv power line (w/wood poles)		12	each	$20,000.00	$240,000.00
		for the bubblers (1 mile pull per location) at 10 checks and at					
		Diversion Dam.					

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 10/30/2003	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__2__ OF __2__

FEATURE: 07-Sep-04
Appraisal Level
Lower Republican River
Alternative F
Automate, Winterize, Raise Lovewell to 35,000 acre-ft

PROJECT: **Missouri River Basin**

REGION: **GP** **WOID: 6B465**

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Raise Lovewell 35,000 acre-feet					
	13	Stripping of upper 3 feet of soil, riprap, bedding		41,000	cy	$2.50	$102,500.00
	14	Furnish and place riprap		9,600	cy	$60.00	$576,000.00
		Riprap haul distance approximately 20-25 miles					
	15	Furnish and place bedding for riprap		4,800	cy	$35.00	$168,000.00
		Bedding haul distance approximately 10 miles					
	16	Furnish and place Zone 1 soil		54,000	cy	$10.00	$540,000.00
		Compact in 6 inch lifts					
		Soil haul distance less than 1 mile					
	17	Furnish and place soil-cement		17,500	cy	$38.00	$665,000.00
		Assume 9% cement by dry weight					
		Compact in 9 inch lifts					
		Soil haul less than 1 mile					
	18	Furnish and place 12 inches of gravel surfacing		9,200	cy	$35.00	$322,000.00
		Gravel haul distance approximately 10 miles					
	19	Excavation of concrete for 6 foot spillway crest raise		66	cyd	$350.00	$23,100.00
	20	Furnish and place concrete ogee crest spillway		310	cyd	$650.00	$201,500.00
	21	Move and reinstall radial gates (plug number due to unknown quantities)		1	ls	$100,000.00	$100,000.00
		Raise Lovewell - Impacts and Associated Costs to Recreation Facilities:					
	22	Lovewell State Park		1	ls	$1,900,000.00	$1,900,000.00
	23	Lovewell State Wildlife Area		1	ls	$250,000.00	$250,000.00
		Subtotal 1 (Sheets 1 and 2)					$5,790,350.00
		Mobilization (+/- 5% of Subtotal 1)					$290,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$6,080,350.00
		Unlisted Items (+/- 20% of Subtotal 2)					$1,219,650.00
		Contract Cost					$7,300,000.00
		Contingencies (+/- 25% of Contract Cost)					$1,800,000.00
		Field Cost					$9,100,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$2,400,000.00
		Total Project Cost (August 2002 Dollars)					$11,500,000.00
		Escalation (+/- 5% of Total Project Cost, August 2002 Dollars)					$500,000.00
		Total Project Cost Escalated to November 2003 Dollars					**$12,000,000.00**

QUANTITIES		PRICES	
BY **J.Keith**		**BY** **D. Donaldson**	**CHECKED**
DATE PREPARED **10/30/2003**	**APPROVED**	**DATE** **11/14/2003**	**PRICE LEVEL** **Appraisal**

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__1__ OF __3__

FEATURE: 07-Sep-04
Appraisal Level
Lower Republican River
Alternative G
Automate, Winterize, Courtland Canal to Design Capacity, Raise Lovewell 35,000 acre-ft

PROJECT: **Missouri River Basin**

REGION: **GP** **WOID: 6B465**

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Automate gates at 12 sites - Local Control Only					
	1	Furnishing and Installing Remote Terminal Unit (RTU), PC type box,	D-8140	12	ls	$10,000.00	$120,000.00
		for the control of the existing motorized radial gates					
		including basic RTU software and RTU special function software.					
	2	Furnishing and installing 120V power for RTU from Power drop.	D-8140	12	ls	$4,000.00	$48,000.00
		Assume 250' steel conduit and single phase power cable.					
	3	Furnishing & Installing motor operator w/ combination motor/starter		20	ls	$7,000.00	$140,000.00
		NMA Type 4 enclosure, 240 V single phase. (5 Bays @ headwrks)					
		Stilling wells at 11 sites:	D-8140				
	4	Furnishing and installing 36B25 RCP installed vertically on conc pad.		325	ft	$350.00	$113,750.00
		Assume 5' dia x 13' deep excavation in soil prior to installation.					
	5	Furnishing and installing 4-inch PVC pipe.		1,500	ft	$24.00	$36,000.00
	6	Furnishing and installing pressure transducer.		25	ls	$2,500.00	$62,500.00
	7	Furnishing and installing buried metallic cable between stilling		6,250	ft	$8.00	$50,000.00
		well and RTU - four wire twisted pairs.					
	8	Furnishing and installing buried power cable to stilling well.		6,250	ft	$16.00	$100,000.00
		Furnishing and Installing bubblers at 11 checks and Diversion Dam:	D-8140				
	9	Furnishing and installing 2-inch galvanized steel diffuser pipe		800	ft	$20.00	$16,000.00
		at 11 checks and at Diversion Dam.					
	10	Furnishing and installing 2-inch galvanized steel manifold pipe at		200	ft	$20.00	$4,000.00
		at 11 checks and at Diversion Dam.					
	11	Furnishing and installing air compressor (4 cfm, 5 hp size)		12	each	$1,000.00	$12,000.00
		at 11 checks and Diversion Dam.					
	12	Furnishing and installing single phase 5kv power line (w/wood poles)		12	each	$20,000.00	$240,000.00
		for the bubblers (1 mile pull per location) at 10 checks and at					
		Diversion Dam.					

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 10/30/2003	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__2__ OF __3__

FEATURE: 07-Sep-04
Appraisal Level
Lower Republican River
Alternative G
Automate, Winterize, Courtland Canal to Design Capacity, Raise Lovewell 35,000 acre-ft

PROJECT: **Missouri River Basin**

REGION: **GP** **WOID: 6B465**

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		County road bridges:	D-8140				
		(Construct 6 new county road bridges according to photos from M. Kube)					
	13	Remove & dispose of 14-ft dia steel pipe culvert at road crossings		6	each	$5,000.00	$30,000.00
		Length = 50 ft					
	14	Excavation and dispose of earth material at 6 road crossings.		8,000	cyd	$8.00	$64,000.00
	15	Construct 65 ft span x 24 ft wide county road bridges.		6	each	$150,000.00	$900,000.00
		(BI-48 prestressed concrete beams superstructure w/4"asphalt					
		surfacing, cast-in-place abutments (spread footing or driven piles),					
		wingwalls, and W-beam guardrails)					
		Reshape Courtland Canal (29.6 miles from Guide Rock to Lovewell):					
		Tractive forces; side slope = 2.75; Max velocity = 2 fps (Survey Xsection reccmd)					
	16	Canal excavation		239,350	cyd	$3.50	$837,725.00
	17	Canal backfill and compact		347,885	cyd	$1.50	$521,827.50
		Removal of existing concrete canal lining L1 and L2 canal types					
	18	Removal existing concrete canal lining		82,760	syd	$15.00	$1,241,400.00
	19	Excavation for lining		45,930	cyd	$3.50	$160,755.00
		Geomembrane 60 mils to invert and side slopes for concrete lining sections					
	20	Furnishing and installing exposed geomembrane 60 mils to invert and side slopes		117,495	syd	$8.00	$939,960.00
	21	Furnishing and installing gravel for canal invert (8-inches)		43,415	cyd	$35.00	$1,519,525.00

QUANTITIES PRICES

BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 10/30/2003	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

SHEET__3__ OF __3__

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative G
Automate, Winterize, Courtland Canal to Design Capacity, Raise Lovewell 35,000 acre-ft

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCK

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Raise Lovewell 35,000 acre-feet					
	22	Stripping of upper 3 feet of soil, riprap, bedding		41,000	cy	$2.50	$102,500.00
	23	Furnish and place riprap		9,600	cy	$60.00	$576,000.00
		Riprap haul distance approximately 20-25 miles					
	24	Furnish and place bedding for riprap		4,800	cy	$35.00	$168,000.00
		Bedding haul distance approximately 10 miles					
	25	Furnish and place Zone 1 soil		54,000	cy	$10.00	$540,000.00
		Compact in 6 inch lifts					
		Soil haul distance less than 1 mile					
	26	Furnish and place soil-cement		17,500	cy	$38.00	$665,000.00
		Assume 9% cement by dry weight					
		Compact in 9 inch lifts					
		Soil haul less than 1 mile					
	27	Furnish and place 12 inches of gravel surfacing		9,200	cy	$35.00	$322,000.00
		Gravel haul distance approximately 10 miles					
	28	Excavation of concrete for 6 foot spillway crest raise		66	cyd	$350.00	$23,100.00
	29	Furnish and place concrete ogee crest spillway		310	cyd	$650.00	$201,500.00
	30	Move and reinstall radial gates (plug number due to unknown quantities)		1	ls	$100,000.00	$100,000.00
		Raise Lovewell - Impacts and Associated Costs to Recreation Facilities:					
	31	Lovewell State Park		1	ls	$1,900,000.00	$1,900,000.00
	32	Lovewell State Wildlife Area		1	ls	$250,000.00	$250,000.00
		Subtotal 1 (Sheets 1 and 2)					$12,005,542.50
		Mobilization (+/- 5% of Subtotal 1)					$600,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$12,605,542.50
		Unlisted Items (+/- 20% of Subtotal 2)					$2,394,457.50
		Contract Cost					$15,000,000.00
		Contingencies (+/- 25% of Contract Cost)					$4,000,000.00
		Field Cost					$19,000,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$5,000,000.00
		Total Project Cost (August 2002 Dollars)					$24,000,000.00
		Escalation (+/- 5% of Total Project Cost, August 2002 Dollars)					$1,000,000.00
		Total Project Cost Escalated to November 2003 Dollars					**$25,000,000.00**

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 10/30/2003	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative H
Raise Lovewell 16,000 acre-feet

PROJECT: Missouri River Basin

REGION: GP **WOID: 6B465**

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Stripping/excavation 2 ft.		7,500	cy	$2.00	$15,000.00
	2	Furnish and place riprap		3,000	cy	$60.00	$180,000.00
		Riprap haul distance approximately 20-25 miles					
	3	Furnish and place bedding for riprap		1,500	cy	$35.00	$52,500.00
		Bedding haul distance approximately 10 miles					
	4	Furnish and place Zone 1 soil		21,000	cy	$10.00	$210,000.00
		Compact in 6 inch lifts					
		Soil haul distance less than 1 mile					
	5	Furnish and place gravel surfacing		1,500	cy	$35.00	$52,500.00
	6	Excavation of concrete for 3 foot spillway crest raise		66	cy	$350.00	$23,100.00
	7	Furnish and place concrete ogee crest spillway		140	cy	$650.00	$91,000.00
		Raise Lovewell - Impacts & Assoc. Costs to Rec Facilities:					
	8	Lovewell State Park		1	ls	$130,000.00	$130,000.00
	9	Lovewell State Wildlife Area		1	ls	$36,000.00	$36,000.00
		Subtotal 1					$790,100.00
		Mobilization (+/- 5% of Subtotal 1)					$40,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$830,100.00
		Unlisted Items (+/- 20% of Subtotal 2)					$169,900.00
		Contract Cost					$1,000,000.00
		Contingencies (+/- 25% of Contract Cost)					$250,000.00
		Field Cost					$1,250,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$300,000.00
		Total Project Cost (August 2002 Dollars)					$1,550,000.00
		Escalation (+/- 5% of Total Project Cost, August 2002 Dollars)					$100,000.00
		Total Project Cost Escalated to November 2003 Dollars					**$1,650,000.00**

QUANTITIES		PRICES	
BY C. Duster / Todd Hill D-8313, x2993	**CHECKED**	**BY** D. Donaldson	**CHECKED**
DATE PREPARED 09/07/04	**APPROVED**	**DATE** 09/07/04	**PRICE LEVEL** Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative I
Raise Lovewell 16,000 acre-ft
Courtland Canal to Design Capacity

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCI

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		County road bridges:	D-8140				
		(Construct 6 new county road bridges according to photos from M. Kube)					
	1	Remove & dispose of 14-ft dia steel pipe culvert at road crossings		6	each	$5,000.00	$30,000.00
		Length = 50 ft					
	2	Excavation and dispose of earth material at 6 road crossings.		8,000	cyd	$8.00	$64,000.00
	3	Construct 65 ft span x 24 ft wide county road bridges.		6	each	$150,000.00	$900,000.00
		(BI-48 prestressed concrete beams superstructure w/4"asphalt					
		surfacing, cast-in-place abutments (spread footing or driven piles),					
		wingwalls, and W-beam guardrails)					
		Reshape Courtland Canal (29.6 miles from Guide Rock to Lovewell):					
		Tractive forces; side slope = 2.75; Max velocity = 2 fps (Survey Xsection reccmd)					
	4	Canal excavation		239,350	cyd	$3.50	$837,725.00
	5	Canal backfill and compact		347,885	cyd	$1.50	$521,827.50
		Removal of existing concrete canal lining L1 and L2 canal types					
	6	Removal existing concrete canal lining		82,760	syd	$15.00	$1,241,400.00
	7	Excavation for lining		45,930	cyd	$3.50	$160,755.00
		Geomembrane 60 mils to invert and side slopes for concrete lining sections					
	8	Furnishing and installing exposed geomembrane 60 mils to invert and side slopes		117,495	syd	$8.00	$939,960.00
	9	Furnishing and installing gravel for canal invert (8-inches)		43,415	cyd	$35.00	$1,519,525.00

QUANTITIES

BY	J.Keith	
DATE PREPARED	10/30/2003	APPROVED

PRICES

BY	D. Donaldson	CHECKED
DATE	11/14/2003	PRICE LEVEL Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 07-Sep-04

Appraisal Level
Lower Republican River
Alternative I
Raise Lovewell 16,000 acre-ft
Courtland Canal to Design Capacity

PROJECT: Missouri River Basin

REGION: GP

WOID: 6B465

FILE: C:\Documents and Settings\sward\Desktop\Republic River - BobMc\Sept 04\[LOCI

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Raise Lovewell 16,000 acre-ft					
	10	Stripping/excavation 2 ft.		7,500	cy	$2.00	$15,000.00
	11	Furnish and place riprap		3,000	cy	$60.00	$180,000.00
		Riprap haul distance approximately 20-25 miles					
	12	Furnish and place bedding for riprap		1,500	cy	$35.00	$52,500.00
		Bedding haul distance approximately 10 miles					
	13	Furnish and place Zone 1 soil		21,000	cy	$10.00	$210,000.00
		Compact in 6 inch lifts					
		Soil haul distance less than 1 mile					
	14	Furnish and place gravel surfacing		1,500	cy	$35.00	$52,500.00
	15	Excavation of concrete for 3 foot spillway crest raise		66	cy	$350.00	$23,100.00
	16	Furnish and place concrete ogee crest spillway		140	cy	$650.00	$91,000.00
		Raise Lovewell - Impacts and Associated Costs to Recreation Facilities:					
	17	Lovewell State Park		1	ls	$130,000.00	$130,000.00
	18	Lovewell State Wildlife Area		1	ls	$36,000.00	$36,000.00
		Subtotal 1 (Sheets 1 and 2)					$7,005,292.50
		Mobilization (+/- 5% of Subtotal 1)					$350,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$7,355,292.50
		Unlisted Items (+/- 20% of Subtotal 2)					$1,444,707.50
		Contract Cost					$8,800,000.00
		Contingencies (+/- 25% of Contract Cost)					$2,200,000.00
		Field Cost					$11,000,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$3,000,000.00
		Total Project Cost (August 2002 Dollars)					$14,000,000.00
		Escalation (+/- 5% of Total Project Cost, August 2002 Dollars)					$500,000.00
		Total Project Cost Escalated to November 2003 Dollars					**$14,500,000.00**

QUANTITIES		PRICES	
BY J.Keith		**BY** D. Donaldson	**CHECKED**
DATE PREPARED 7/3/2002	**APPROVED**	**DATE** 11/14/2003	**PRICE LEVEL** Appraisal

Appendix C

Recreation Mitigation Costs

Recreation Mitigation Costs

The following costs are derived from aerial photography and estimations and assumptions documented in the following tables. The National Park Service "Cost Estimating Guideline with Class C Cost Data" was used to determine unit costs for the various recreation facilities. Quantities were estimated from the aerial photographs but should be considered to be gross estimations as the discernable detail in the aerial photos was limited. The National Park Service Class C Cost Data was used as experience has shown that Reclamation costs are similar to those borne by the Park Service. Class C cost estimates are referred to in the industry as "conceptual" or "order-of-magnitude" estimates. Class C cost estimates are usually used for:

- Appraisal studies
- Selection from among alternative designs
- Development of project scope and program

Additionally, a Class C estimate is a conceptual cost estimate based on square footage cost of similar construction. Class C cost estimates are usually prepared without a defined scope of work. A location factor was also assigned to account for regional variations such as geographic accessibility, work force availability, cost of building materials, etc. For the purposes of this study, a location factor of minus .8 is used. This is the location factor assigned by the Park Service for the National Tall Grass Prairie Preserve, the closest Park Service managed area to Lovewell Reservoir.

IMPACTS AND ASSOCIATED COSTS TO RECREATION FACILITIES—LOVEWELL STATE PARK AND LOVEWELL STATE WILDLIFE AREA WATER ELEVATION 1,595 FT.

Element	Description	Assumptions	Unit Cost	Project Cost
Lovewell State Park				
	Willow Primitive Campground	Assume 24 campsites consisting of graveled use area, fire ring, picnic table, and access/interior loop road. Assume that 1/3 of the campground will be inundated at elevation 1595 ft (estimated from aerial photography). No impacts at elevation 1583 ft. Assume that existing fire rings and picnic tables can be moved to new location at no cost. Assume that new road and use area can be constructed in close proximity, on higher ground. Assume no toilets are impacted.		
Road: 500 lin. Ft.,	Graveled surface, 2 lane		$487,000/mile, $92.23 lin. Ft.	$46,115
Use area: 8 sites			$1,570/site	$12,560
Lovewell State Park				
	Willow Utility Campground	No impact at either elevation 1595 ft. or 1583 ft.		
Cottonwood Primitive Campground				
		Assume 24 campsites consisting of graveled use area, fire ring, picnic table, and access/interior loop road. Assume that 100% of the campground will be inundated at elevation 1595 ft. No impacts at elevation 1583 ft. Assume that fire rings and picnic tables can be moved to new location at no cost. Assume that new road and use area can be constructed in close proximity, on higher ground. Assume no toilets are impacted.		
Road: 630 lin. Ft.			$487,000/mile, $92.23 lin. Ft.	$58,105
Use area: 24 sites			$1,570/site	$37,680

Element	Description	Assumptions	Unit Cost	Project Cost
Cottonwood Utility Campground –No impact at either elevation 1595 ft. or 1583 ft.				
	Bluebird Group Camping Area	Aerial photography does not show any formalized facilities. Also, cannot find specific reference to formalized facilities in the 5 year operating plan. Therefore, assume that although the area will be inundated at elevation 1595 ft., only the access road will need to be relocated. Assume that moving the group camping area will merely involve designating another unencumbered area for group camping.		
Road: 2,350 lin. Ft.	Gravel surface, 2-lane		$487,000/mile, $92.23 lin. Ft.	$216,740
Cottonwood Utility Campground –No impact at either elevation 1595 ft. or 1583 ft.				
	Cedar Point Primitive Campground	Assume 24 campsites consisting of graveled use area, fire ring, picnic table, and access/interior loop road. Assume that 100% of the campground will be inundated at elevation 1595 ft. No impacts at elevation 1583 ft. Assume that fire rings and picnic tables can be moved to new location at no cost. Assume that new road and use area can be constructed in close proximity, on higher ground. Assume no toilets are impacted.		
Road: 820 lin. Ft.	Gravel surface, 2-lane		$487,000/mile, $92.23 lin. Ft.	$75,629
Use area: 24 sites	Gravel		$1,570/site	$37,680
Cottonwood Utility Campground –No impact at either elevation 1595 ft. or 1583 ft.				
	Cedar Point Utility Campground	No impact at either elevation 1595 ft. or 1583 ft.		

Element	Description	Assumptions	Unit Cost	Project Cost
Cottonwood Utility Campground –No impact at either elevation 1595 ft. or 1583 ft.				
	Walleye Point Primitive Campground	Assume 14 campsites consisting of graveled use area, fire ring, picnic table, and access/interior loop road. Assume that 100% of the campground will be inundated at elevation 1595 ft. No impacts at elevation 1583 ft. Assume that fire rings and picnic tables can be moved to new location at no cost. Assume that new road and use area can be constructed in close proximity, on higher ground. Assume no toilets are impacted.		
Road: 510 lin. Ft.	Gravel surface, 2-lane		$487,000/mile, $92.23 lin. Ft.	$47,037
Use area: 14 sites	Gravel		$1,570/site	$21,980
Cottonwood Utility Campground –No impact at either elevation 1595 ft. or 1583 ft.				
	Walleye Point Utility Campground	No impact at either elevation 1595 ft. or 1583 ft.		
Cottonwood Utility Campground –No impact at either elevation 1595 ft. or 1583 ft.				
	Picnic Shelters	From the aerial photos, it appears that 3 picnic shelters will be inundated at a water elevation 1595 ft. with none being impacted at 1583 ft. Actual square footage of the picnic shelters is unknown. For purposes of cost estimating square footage is assumed to be ____ (typical). It is assumed that fire rings and grills and picnic tables would be moved and would not need to be replaced.		
Roads: 730 lin. Ft.	Gravel surface, 2-lane		$487,000/mile, $92.23 lin. Ft.	$67,328
Picnic structure: quantity 3	300 sq. ft. each		$48.70 sq. ft.	$43,830

Element	Description	Assumptions	Unit Cost	Project Cost
Boat Ramps				
Boat ramp #1 – Concession Area: 200 lin. Ft. X 16 ft.	Concrete	Assume that boat ramp would be totally unusable at elevation 1595 and a replacement ramp constructed in a new location. Assume that new ramp would be 200 lin. Ft. in length, 2 lanes wide.	$97/sq. yd	$103,466
Boat Ramp #2 – Concession Area: 200 lin. Ft. X 16 ft.	Concrete	Assume that boat ramp would be totally unusable at elevation 1595 and a replacement ramp would be constructed in a new location. Assume that new ramp would be 200 lin. Ft. in length, 2 lanes wide.	$97/sq. yd	$103,466
Boat ramp #1 & #2 parking area – 75 spaces	Gravel surface	Assume that parking area would be relocated to support the relocated boat ramp. Square footage is estimated from aerial photography and is a rough estimate.	$920/space	$69,000
Cabin area boat ramp: 200 lin. Ft.	Concrete	Assume that boat ramp would be totally unusable at elevation 1595 and a replacement ramp would be constructed in a new location. Assume that new ramp would be 200 lin. Ft. in length, 1 lane wide.	$97/sq. yd	$103,466
Cabin area boat ramp parking area: 20 spaces	Gravel surface	Assume that parking area would be relocated to support the relocated boat ramp. Square footage is estimated from aerial photography and is a rough estimate. Assume gravel surface.	$97/sq. yd	$1,940
Marina				
Maintenance Buildings – quantity 3: 4,400 sq. ft. total		Estimated square footage is a rough estimate derived from aerial photos. Detail in photo is insufficient to provide more than a rough estimate. Assume buildings would be replaced in kind in a new location. Assume buildings are for seasonal use and are unheated with limited infrastructure	$64.90/sq. ft.	$285,560
Interior service road: 180 lin. Ft.	Gravel surface, 2-lane	Relocate to serve new utility buildings.	$487,000/mile, $92.23 lin. Ft.	$16,601
Courtesy dock: 100 Ft. X 6 ft.			$65/sq. ft.	$39,000
Fuel storage and distribution			**NO COST DATA**	

Element	Description	Assumptions	Unit Cost	Project Cost
Leased Cabins				
Cabin structures: 3 at 800 sq. ft. ea.: Total 2,400 sq. ft.		From aerial photography, assume 3 cabins inundated at elevation 1595 ft. Assume cabins would be newly constructed in a new location. Assume each cabin would be 800 sq. ft.	$119/sq. ft.	$285,600
Trailer Park				
Trailer pads with utilities – quantity 13		From aerial photography, assume 13 trailer spaces inundated at elevation 1595 ft. Further assume that each space is served by water, sewer, and electrical hookups. Assume that trailers would be moved and inundation would only affect space and utilities.	$22,700 ea.	$295,100
Access and interior roadway – 600 lin. Ft.	Gravel surface, 2-lane	Relocate to serve new trailer pads.	$487,000/mile, $92.23 lin. Ft.	$55,338
Sewer line – 600 lin. Ft.	PVC Sewer pipe, 6 inch		$36.80 lin. Ft.	$22,080
Water line – 600 lin. Ft.	PVC pipe, 4 inch		$31.40	$18,840
Water meter and Box – quantity 13	1 inch		$703	$9,139
Electrical line – 600 lin. Ft.	Single phase w/trenching and backfill		$19.50 lin. Ft.	$11,700
Courtesy Dock – Southwinds Day Use Area				
1 dock: 100 Ft. X 6 ft.		Move to higher ground.	$65/sq. ft.	$39,000
Lake Shore Stabilization – Riprap				
5,000 lin. Ft at 3 ft. X 6 ft. = 3,333 CY		Assume 5,000 lin. Ft. of riprap applied to shore line surfaces to retard wave action in proximity to recreation facilities.	$65/CY	$216,645

Element	Description	Assumptions	Unit Cost	Project Cost
Gross Total Cost				**$2,045,525**
Total Cost with Location Factor				**$1,881,883**
Lovewell Wildlife Area				
Road: 500 lin. Ft.	**Oak Hill Primitive Camping Area**	Unable to discern from provided aerial photography extent of inundation to facilities so will assume 100% inundation. Assume 10 primitive campsites consisting of graveled use area, fire ring, picnic table, and access/interior loop road. No impacts at elevation 1583 ft. Assume that existing fire rings and picnic tables can be moved to new location at no cost. Assume that new road and use area can be constructed in close proximity, on higher ground. Assume no toilets are impacted.	$487,000/mile, $92.23 lin. Ft.	$46,115
Use area: 10 sites			$1,570/site	$15,700
White Rock Creek Primitive Camping Area				
Road: 500 lin. Ft.		Unable to discern from provided aerial photography extent of inundation to facilities so will assume 100% inundation. Assume 10 primitive campsites consisting of graveled use area, fire ring, picnic table, and access/interior loop road. No impacts at elevation 1583 ft. Assume that existing fire rings and picnic tables can be moved to new location at no cost. Assume that new road and use area can be constructed in close proximity, on higher ground.	$487,000/mile, $92.23 lin. Ft.	
Use area: 10 sites		Gravel	$1,570/site	$15,700
Inlet Canal Primitive Camping Area				
Road: 500 lin. Ft.		Unable to discern from provided aerial photography extent of inundation to facilities so will assume 100% inundation. Assume 10 primitive campsites consisting of graveled use area, fire ring, picnic table, and access/interior loop road. No impacts at elevation 1583 ft. Assume that existing fire rings and picnic tables can be moved to new location at no cost. Assume that new road and use area can be constructed in close proximity, on higher ground.	$487,000/mile, $92.23 lin. Ft.	$46,115
Use area: 10 sites		Gravel	$1,570/site	$15,700

Element	Description	Assumptions	Unit Cost	Project Cost
Boat Ramps				
Oak Creek boat ramp	75 ft. X 12 ft., 6" concrete	Unable to discern from provided aerial photography extent of inundation to facilities so will assume 100% inundation and that the ramp will be reconstructed in a new location. Assume that new ramp would be 200 lin. Ft. in length, 1 lane wide. Concrete.	$97/sq. yd.	$29,100
White Rock Creek boat ramp	75 ft. X 12 ft., 6" concrete	Unable to discern from provided aerial photography extent of inundation to facilities so will assume 100% inundation and that the ramp will be reconstructed in a new location. Assume that new ramp would be 200 lin. Ft. in length, 1 lane wide. Concrete	$97/sq. yd.	$29,100
Oak Creek parking area – 8 spaces		Unable to discern from aerial photography size of parking. Therefore, will assume parking for 8 vehicles (as per management plan, average accommodation of parking areas).	$920/space	$7,360
White Rock Creek parking area – 8 spaces		Unable to discern from aerial photography size of parking. Therefore, will assume parking for 8 vehicles (as per management plan, average accommodation of parking areas).	$920/space	$7,360
Vault Toilets				
Vault toilet, single vault – 2		Unable to discern from aerial photography location and/or size of vault toilets. Therefore will assume inundation at elevation 1595 ft.	$15,100/ea.	$30,200
Fishing Access Parking Areas				
Parking area – 4 for a total of 32 spaces		Unable to discern from aerial photography location and whether any of the parking areas will be impacted and/or inundated at water elevation 1595 ft. Therefore will assume 4 of the existing 21 parking areas will be inundated. Parking areas accommodate 8 vehicles (768 sq. ft.) and are gravel.	$920/space	$29,440
Total Cost				**$271,890**
Total Cost with Location Factor				**$250,139**

IMPACTS AND ASSOCIATED COSTS TO RECREATION FACILITIES—LOVEWELL STATE PARK AND LOVEWELL STATE WILDLIFE AREA WATER ELEVATION 1,583 FT.

Element	Description	Assumptions	Unit Cost	Project Cost
	Lovewell State Park			
	Willow Primitive Campground	No impact		
	Willow Utility Campground	No impact		
	Cottonwood Primitive Campground	No impact		
	Cottonwood Utility Campground	No impact		
	Bluebird Group Camping Area	No impact		
	Cedar Point Primitive Campground	No impact		
	Cedar Point Utility Campground	No impact		
	Walleye Point Primitive Campground	No impact		
	Walleye Point Utility Campground	No impact		
	Picnic Shelters	No impact		
	Boat Ramps			
Boat ramp #1 – Concession Area: 100 lin. Ft. X 16 ft.	Concrete	Assume that existing ramp would be extended in length 100 lin. Ft..	$97/sq. yd	$51,733
Boat Ramp #2 – Concession Area: 100 lin. Ft. X 16 ft.	Concrete	Assume that existing ramp would be extended in length 100 lin. Ft.	$97/sq. yd	$51,733

Element	Description	Assumptions	Unit Cost	Project Cost
Boat ramp #1 & #2 parking area – 75 spaces	Gravel surface	No impact		
Cabin area boat ramp: 50 lin. Ft.	Concrete	Assume that existing ramp would be extended in length 50 lin. Ft.	$97/sq. yd	$25,866
Cabin area boat ramp parking area: 20 spaces	Gravel surface	No impact		
Marina				
Maintenance Buildings		No impact		
Interior service road: 180 lin. Ft.		No impact	.	
Courtesy dock: 100 Ft. X 6 ft.		Move to higher ground. Use existing dock, merely relocate. Note that this is not a "Class C" cost but is an estimate based on experience with similar facilities.		$5,000
Fuel storage and distribution			**NO COST DATA**	
Leased Cabins				
Cabin structures:		No impact		
Courtesy Dock – Southwinds Day Use Area				
1 dock: 100 Ft. X 6 ft.		Move to higher ground. Use existing dock, merely relocate. Note that this is not a "Class C" cost but is an estimate based on experience with similar facilities.		$5,000
Total Cost				**$139,332**
Total Cost with Location Factor				**$128,185**
Lovewell Wildlife Area				
	Oak Hill Primitive Camping Area	No impact.		

Element	Description	Assumptions	Unit Cost	Project Cost
	White Rock Creek Primitive Camping Area	No impact.		
	Inlet Canal Primitive Camping Area	No impact.		
Boat Ramps				
Oak Creek boat ramp	50 ft. X 12 ft., 6" concrete	Unable to discern from provided aerial photography extent of inundation to facilities so will assume that existing ramp will need to be extended 50 ft.	$97/sq. yd.	$19,400
White Rock Creek boat ramp	75 ft. X 12 ft., 6" concrete	Unable to discern from provided aerial photography extent of inundation to facilities so will assume that existing ramp will need to be extended 50 ft.	$97/sq. yd.	$19,400
Oak Creek parking area – 8 spaces		Assume no impact.		
White Rock Creek parking area – 8 spaces		Assume no impact		
Vault Toilets				
Vault toilet, single vault – 2		Unable to discern from aerial photography location and/or size of vault toilets. Therefore will assume no impact.		
Fishing Access Parking Areas				
Parking area – 4 for a total of 32 spaces		Unable to discern from aerial photography location and whether any of the parking areas will be impacted and/or inundated at water elevation 1583 ft. Therefore will assume there will be no impact.		
Total Cost				**$38,800**
Total Cost with Location Factor				**$35,696**

Appendix D

Benefit Estimation

Benefit Estimation

Introduction

Operational changes have been proposed for the Lower Republican River. These operational changes include modifying the timing of flows, bypass flows, and increasing the storage capacity of Lovewell Reservoir. The economic portion of the appraisal study estimates the economic benefits accruing from the changes to operations for comparing to project costs. This report provides a methodology for measuring irrigation benefits.

For purposes of this example, only the most dominant crop for the area, corn, has been modeled. The numbers used in the example are representative, but will be refined as the study progresses. Further enhancements to the study will be discussed at the end of this example.

Methodology

One method for estimating irrigation benefits is to isolate the incremental net farm income from small changes in the irrigation water supply. To determine the incremental income, the net farm income in a "without project" baseline condition is compared to a "with project" condition. For small changes in the water supply, the best indicator of benefits comes from predicted changes in yields. Agricultural economists with the University of Nebraska in Lincoln (UNL) have published articles and provided spreadsheet models which estimate yields for varying water supply levels, several crops, and some of the more prominent soil types in Nebraska. Included in the UNL publications are model coefficients for different regions of the state and the ability to modify the models to a particular range of water supplies.

The spreadsheet model incorporates plant growth dynamics with respect to soil and water. Thus, the model can predict yield changes assuming all other plant requirements such as fertilizer, etc are met. The model includes factors for the type of irrigation system used (e.g., furrow or sprinkler), the maximum yield that could be obtained and evapotranspiration (ET) rates. Input factors also include the ET and yield for dryland crops. The model then estimates incremental yields starting from the dryland yield average and up to the suggested maximum yield.

For this example, published average values for southcentral Nebraska were used in the crop yield model. These values include average irrigated corn yields from two irrigation districts, county-average dryland corn yields from the Nebraska Agricultural Statistics Service, irrigation efficiency rates, effective precipitation, and crop irrigation requirements.

Benefit Estimation

The benefit analysis has to conform to National Economic Development (NED) standards as published in "The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (Principles and Guidelines). Therefore, normalized prices published by the USDA Economic Research Service (USDA, ERS) were used to determine the change in gross revenues. Gross revenues on a per-acre basis are calculated by multiplying yield per acre by price per bushel.

Variable costs of production were taken from farm budgets prepared by the University of Nebraska. The only cost which is expected to change with yield is the harvesting cost. Other production costs are assumed to not change. For example, the same amount of fertilizer will be applied to corn that produces 140 bushels as will be applied to 144-bushel corn. The only change is the amount of irrigation water that has been applied. This same assumption applies to the cultural practices such as plowing, disking, and cultivating and the management skills of the farmer.

The annual irrigation benefits are transformed into a present worth value by taking the annual benefit into the future 100 years and then discounting it back to the present. The Fiscal year 2003 federal discount rate of 5.875 percent is used in this example.

Irrigation Benefits of Corn Production

The first step in determining the irrigation benefits was to calculate the changes in yields. To identify an appropriate range in yields, data was obtained from previously completed economic studies and from the Nebraska Agricultural Statistics. Average district-level irrigated yields for 1991-95 are shown in Table 1.

TABLE 1. AVERAGE IRRIGATED YIELDS, 1991-95.

	Irrigated Corn Yields						
	UNIT	**1991**	**1992**	**1993**	**1994**	**1995**	**AVG**
Kansas Bostwick	Bushel	166.0	N/A	153.4	135.8	163.9	154.8
Nebraska Bostwick	Bushel	156.2	N/A	156.2	133.3	162.5	152.0
Average							153.4

The simple average of irrigated yields for the two irrigation districts came to 153.4 bushels. The average irrigated yield is important in that this is the yield being obtained by farmers given the current water supply. The maximum yield obtained over the selected years was 166 bushels per acre.

The maximum irrigated yield is an input to the yield estimation model. Other inputs to the yield estimation model include ET. The average crop water use (ET) parameter for southcentral Nebraska (24.4 inches of water) was obtained from NebGuide G98-1354-A

and was not modified. Effective rainfall coefficients and crop irrigation requirements for Sandy Loam soils in Central Nebraska were also obtained from the NebGuide and were not modified for this example.

Once the yield estimation model was modified to account for the range of water supplies estimated by the hydrology models, the yield estimation model gave a range of corresponding yields. This is shown in Table 2.

TABLE 2. ESTIMATED YIELDS FOR THE SELECTED WATER SUPPLY RANGE.

Alternative Name	Inches of Water to Farm	Corn Yield (bushels/acre)
Baseline	11.5	154.5
A	11.7	155.2
B	12.0	156.2
C	12.2	156.8
D	13.0	159.2
E	13.1	159.4
F	13.7	160.9
G	13.8	161.1
H	12.4	157.4
I	12.4	157.4

The estimated yield for the Baseline Alternative came to 154.5 bushels of corn per acre. This is 0.9 bushels higher than the reported average for the two districts. Overall, water supplies ranged from a low of 11.5 acre-inches to a high of 13.8 acre-inches. Estimated yields ranged from a low of 154.5 bushels per acre to a high of 161.1 bushels.

Once the yields had been estimated, gross revenues under each Alternative could be calculated. The ERS normalized price of $2.25 was used. Total variable costs of production (custom work, seed, fertilizer, chemicals) came to $135.54 per acre excluding custom costs of harvest. Custom harvest costs that changed under the selected alternatives came from a transportation charge of $0.13 per bushel. After subtracting all the costs of production, the net revenue for corn production under each Alternative could be computed. This is shown in Table 3.

TABLE 3. CALCULATION OF GROSS AND NET REVENUES.

	ALTERNATIVES									
	Baseline	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Yield (bushels/acre)	154.5	155.2	156.2	156.8	159.2	159.4	160.9	161.1	157.4	157.4
Normalized Price	$2.25	$2.25	$2.25	$2.25	$2.25	$2.25	$2.25	$2.25	$2.25	$2.25
Gross Revenues	$347.55	$349.12	$351.37	$352.81	$358.10	$358.70	$362.06	$362.58	$354.21	$354.21
Variable Op Costs	$135.54	$135.54	$135.54	$135.54	$135.54	$135.54	$135.54	$135.54	$135.54	$135.54
Custom Harvest Costs										
Trucking	$20.08	$20.17	$20.30	$20.38	$20.69	$20.73	$20.92	$20.95	$20.47	$20.47
Net Income	$191.93	$193.41	$195.53	$196.89	$201.87	$202.44	$205.61	$206.09	$198.20	$198.20
Change in Net Revenue										
from Baseline		$ 1.47	$ 3.60	$ 4.96	$ 9.94	$ 10.51	$ 13.67	$ 14.16	$ 6.27	$ 6.27

Gross revenues from the analysis ranged from a low of $347.55 per acre to $362.58 per acre. Net revenues per acre, after subtracting out all costs of production, ranged from $191.93 to $206.09. The net revenues obtained from each alternative all had higher net revenues than the Baseline Alternative. Alternatives F and G had the largest changes in net revenue.

After finding the net revenues, or benefits, per acre, the total annual net benefits are computed by multiplying the per-acre benefit by the total number of acres that will receive a benefit. The total number of acres receiving benefits equal 65,435; of these, 22,935 are located in Nebraska and 42,500 acres are in Kansas. Therefore, the baseline total annual benefits are $12,559,172 (net income of $191.93 times 65,435 acres). If this amount of benefits accrue each year over the next 100 years and is then discounted back to today's dollars using a discount rate of 5.875 percent, the net present value will be $213,064,200. If the same process is followed for each selected Alternative, the incremental change caused by the Alternative can be calculated by taking the difference between the Baseline and the selected Alternative.

Table 4 shows the total benefits for the Baseline and other Alternatives and the incremental net present value of irrigation benefits for each Alternative.

TABLE 4. INCREMENTAL IRRIGATION BENEFITS FOR EACH ALTERNATIVE.

Alternative	Baseline Benefits for All Acres	Alternative Benefit Per Acre	Incremental Net Present Value Relative to the Baseline
Baseline	**$ 213,064,200**		
Alt A		$ 214,703,193	$ 1,638,993
Alt B		$ 217,056,592	$ 3,992,391
Alt C		$ 218,566,319	$ 5,502,118
Alt D		$ 224,094,585	$ 11,030,384
Alt E		$ 224,727,338	$ 11,663,138
Alt F		$ 228,246,335	$ 15,182,134
Alt G		$ 228,779,179	$ 15,714,979
Alt H		$ 220,020,541	$ 6,956,341
Alt I		$ 220,020,541	$ 6,956,341

Alternative F had the greatest water supply increase and the greatest benefits, followed by Alternative G.

Appendix E

Recreation Analysis

Recreation Facility Availability Analysis – Lovewell Reservoir

The recreation analysis at Lovewell Reservoir looks at the projected monthly availability of recreation facilities for each alternative as compared to the baseline alternative. The analysis was conducted in two iterations. The first iteration evaluated facility availability assuming current conditions without proposed movement or extensions of recreational facilities. The second iteration evaluated facility availability assuming the relocation and extension of recreation facilities.

Methodology

Recreation facilities were separated into water-based and water-influenced facilities. Water-based facilities reflect those that depend on access to the water, including facilities such as boat ramps, marinas, and swimming beaches. At Lovewell Reservoir, there are six boat ramps (concessions area (2), marina, cabin area, Oak Hill, and Highway 14), one marina, and one swimming beach. Water-influenced facilities include campgrounds, picnic areas, trailer sites, and cabins. While these land-based but water-influenced facilities may be affected by water level fluctuation, from an aesthetic perspective the thrust of the analysis is on the evaluation of possible flooding effects.

To provide data for the second iteration facility availability analysis, information was needed for both high end and low end usability thresholds where each of the facilities becomes unavailable. For example, boat ramps are only usable across the range of water levels which maintain access to the ramp. Water levels below the low end or above the high end of the ramp would result in the ramp being unusable. This high and low end concept was used for the water-based facilities.

As in the baseline condition, for those alternatives which do not involve some form of Lovewell Dam raise (i.e., Alternatives A through C), the high end criteria are never exceeded.[1] However, for alternatives that involve raising Lovewell Dam (i.e., Alternatives D through I), since it is assumed in this iteration of analysis that inundated recreational facilities would be relocated or extended only the low end thresholds would be relevant. The current high end thresholds would no longer a constraint.

Since the water-influenced facilities are land based, low end usability thresholds are not applicable (i.e., low water levels do not preclude use). Given the land-based water-influenced facilities would be available for all months and alternatives under the second iteration analysis, these facilities are not discussed

[1] This is also true for the "dry" and "wet" hydrologic conditions as well. See Appendix E.

in the remainder of this section. Table E-1 shows the availability thresholds used in the second iteration analysis.

TABLE E-1. RECREATION FACILITY USABILITY THRESHOLDS FOR LOVEWELL RESERVOIR

Recreation Facility	High End Threshold		Low End Threshold
	Alternatives Without Dam Raise (Baseline, A, B, C)	Alternatives With Dam Raise (D – I)	Applies to All Alternatives
I. Water-based Facilities:			
Boat Ramps:			
• Concessions Area	1583.0	N/A	1578.0
• Marina	1583.0	N/A	1579.0
• Cabin Area	1583.0	N/A	1579.0
• Oak Hill	1586.6	N/A	1582.5
• Highway 14	1586.6	N/A	1582.6
b. Lovewell marina	1583.0	N/A	1577.0
c. Lovewell swimming beach	1583.0	N/A	1573.0

Projected EOM water levels at Lovewell Reservoir, measured in terms of feet above mean sea level (msl), were obtained from the hydrology model. Three different hydrologic conditions were evaluated for each alternative – average, dry, and wet. Average conditions were based on average EOM water levels for each month. Dry conditions were based on the water level representing the 10^{th} percentile of projected water levels for each month (i.e., water levels are expected to be higher than the dry condition level 90 percent of the time). Wet conditions were based on the water level representing the 90^{th} percentile of projected water levels for each month (i.e., water levels are expected to be higher than the wet condition level only 10 percent of the time).

The monthly water levels for each alternative under average, dry, and wet conditions were compared to the facility usability thresholds to estimate monthly facility availability. Since water levels reflect a single day at the EOM, the analysis does not account for changes in daily water levels within each month. Water level data was obtained for all months, but, the information is only presented for the months of May through September when recreational activity is highest. Facility availability for each alternative is also compared to the baseline alternative to identify differences.

Results – Without Mitigation Analysis

This section presents the results of the without mitigation recreation facility availability analysis. This is a short-term analysis since it doesn't take into consideration possible movement or extension of the facilities. Since it is unclear at this point which of the proposed mitigation elements will actually be pursued,

this analysis provides information on the full spectrum of possible facility availability impacts.

The facility availability results are presented separately for the three hydrologic conditions – average, dry, and wet.

Average Hydrologic Conditions

The following section describes monthly recreation facility availability across alternatives for average hydrologic conditions. Table E-2 presents the results of the analysis for all alternatives for the May to September high use recreation season. A "yes" implies the end of month water level falls within the facility's usable range. Any differences in facility availability between the baseline alternative and the "action" alternatives are highlighted in bold and italics under each of the action alternatives.

TABLE E-2. FACILITY AVAILABILITY BY ALTERNATIVE UNDER AVERAGE HYDROLOGIC CONDITIONS

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
1) Baseline Alternative:							
Water Levels:			**1580.8**	**1580.9**	**1574.0**	**1572.2**	**1573.9**
Boat Ramps:							
• Concessions	1583	1578	Yes	Yes	No	No	No
Area	1583	1579	Yes	Yes	No	No	No
• Marina	1583	1579	Yes	Yes	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	Yes	Yes	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes
2) Alternative A (Courtland Canal to Design Capacity, Winterize):							
Water Levels:			**1581.3**	**1581.3**	**1574.8**	**1572.6**	**1574.1**
Boat Ramps:							
• Concessions	1583	1578	Yes	Yes	No	No	No
Area	1583	1579	Yes	Yes	No	No	No
• Marina	1583	1579	Yes	Yes	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	Yes	Yes	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
3) Alternative B (Automate, Winterize Courtland Canal):							
Water Levels:			**1581.5**	**1581.5**	**1574.2**	**1572.2**	**1574.0**
Boat Ramps:							
• Concessions	1583	1578	Yes	Yes	No	No	No
Area	1583	1579	Yes	Yes	No	No	No
• Marina	1583	1579	Yes	Yes	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	Yes	Yes	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes
4) Alternative C (Automate, Winterize, Courtland Canal to Design Capacity):							
Water Levels:			**1581.5**	**1581.5**	**1575.0**	**1572.7**	**1574.3**
Boat Ramps:							
• Concessions	1583	1578	Yes	Yes	No	No	No
Area	1583	1579	Yes	Yes	No	No	No
• Marina	1583	1579	Yes	Yes	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	Yes	Yes	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes
5) Alternative D (Automate, Winterize Courtland Canal; Raise Lovewell 16,000 AF):							
Water Levels:			**1584.8**	**1584.9**	**1577.0**	**1573.0**	**1574.7**
Boat Ramps:							
• Concessions	1583	1578	***No***	***No***	No	No	No
Area	1583	1579	***No***	***No***	No	No	No
• Marina	1583	1579	***No***	***No***	No	No	No
• Cabin Area	1586.6	1582.5	***Yes***	***Yes***	No	No	No
• Oak Hill	1586.6	1582.6	***Yes***	***Yes***	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***No***	***No***	***Yes***	No	No
Lovewell Beach	1583	1573	***No***	***No***	Yes	***Yes***	Yes
6) Alternative E (Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF):							
Water Levels:			**1584.8**	**1584.9**	**1578.3**	**1573.7**	**1575.3**
Boat Ramps:							
• Concessions	1583	1578	***No***	***No***	***Yes***	No	No
Area	1583	1579	***No***	***No***	No	No	No
• Marina	1583	1579	***No***	***No***	No	No	No
• Cabin Area	1586.6	1582.5	***Yes***	***Yes***	No	No	No
• Oak Hill	1586.6	1582.6	***Yes***	***Yes***	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***No***	***No***	***Yes***	No	No
Lovewell Beach	1583	1573	***No***	***No***	Yes	***Yes***	Yes

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
7) Alternative F (Automate, Winterize Courtland Canal; Raise Lovewell 35,000 AF):							
Water Levels:			**1587.4**	**1587.6**	**1580.7**	**1574.5**	**1576.0**
Boat Ramps:							
• Concessions	1583	1578	***No***	***No***	***Yes***	No	No
Area	1583	1579	***No***	***No***	***Yes***	No	No
• Marina	1583	1579	***No***	***No***	***Yes***	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***No***	***No***	***Yes***	No	No
Lovewell Beach	1583	1573	***No***	***No***	Yes	***Yes***	Yes
8) Alternative G (Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 AF):							
Water Levels:			**1587.5**	**1587.8**	**1581.7**	**1575.6**	**1576.9**
Boat Ramps:							
• Concessions	1583	1578	***No***	***No***	***Yes***	No	No
Area	1583	1579	***No***	***No***	***Yes***	No	No
• Marina	1583	1579	***No***	***No***	***Yes***	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***No***	***No***	***Yes***	No	No
Lovewell Beach	1583	1573	***No***	***No***	Yes	***Yes***	Yes
9) Alternative H (Raise Lovewell 16,000 AF):							
Water Levels:			**1583.6**	**1583.8**	**1576.6**	**1572.9**	**1574.6**
Boat Ramps:							
• Concessions	1583	1578	***No***	***No***	No	No	No
Area	1583	1579	***No***	***No***	No	No	No
• Marina	1583	1579	***No***	***No***	No	No	No
• Cabin Area	1586.6	1582.5	***Yes***	***Yes***	No	No	No
• Oak Hill	1586.6	1582.6	***Yes***	***Yes***	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***No***	***No***	No	No	No
Lovewell Beach	1583	1573	***No***	***No***	Yes	No	Yes
10) Alternative I (Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF):							
Water Levels:			**1583.6**	**1583.9**	**1577.8**	**1573.5**	**1575.0**
Boat Ramps:							
• Concessions	1583	1578	***No***	***No***	No	No	No
Area	1583	1579	***No***	***No***	No	No	No
• Marina	1583	1579	***No***	***No***	No	No	No
• Cabin Area	1586.6	1582.5	***Yes***	***Yes***	No	No	No
• Oak Hill	1586.6	1582.6	***Yes***	***Yes***	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***No***	***No***	***Yes***	No	No
Lovewell Beach	1583	1573	***No***	***No***	Yes	***Yes***	Yes

Key: No = Facility Unavailable, Yes = Facility Available

Yes or No in Bold, Italics, and Centered in Cell = different from baseline

Baseline Alternative

Based on the high and low end facility availability thresholds and the EOM water levels for the baseline alternative, none of the five boat ramps are projected to be available on average during the months of July through September. In addition, the high water ramps (Oak Hill and Highway 14) are projected to be unavailable on average during May and June. The Lovewell marina is projected to be unavailable on average during July through September and Lovewell beach is projected to be unavailable on average in August. All of these unavailability cases are the result of low water levels. Note that Table E-2 only presents facility availability for the water-based facilities since the water-influenced facilities (i.e., campgrounds, picnic areas, trailer sites, and cabins) are available across all months and alternatives under average conditions.

Alternative A - Courtland Canal to Design Capacity, Winterize

Facility availability for this alternative, based on average hydrologic conditions, is the same as the baseline alternative.

Alternative B - Automate, Winterize Courtland Canal

Facility availability for this alternative, based on average hydrologic conditions, is the same as the baseline alternative.

Alternative C - Automate, Winterize, Courtland Canal to Design Capacity

Facility availability for this alternative, based on average hydrologic conditions, is the same as the baseline alternative.

Alternative D - Automate, Winterize Courtland Canal; Raise Lovewell 16,000 ac-ft

Like the baseline alternative, none of the boat ramps are projected to be available on average during July through September. In addition, the concession area, marina, and cabin area ramps are also expected to be unavailable on average during May and June. The Lovewell marina is only expected to be available on average during July and the Lovewell Beach is expected to be unavailable on average during May and June. Generally speaking, facility unavailability in May and June is due to high water and July through September due to low water.

Focusing in on the differences with the baseline alternative, additional unavailability occurs in May and June for the concession area ramps, marina ramp, and cabin area ramp as well as the marina and beach. Conversely, additional availability occurs in May and June with the Oak Hill ramp and the Highway 14 ramp, and in July for the marina, and in August for the beach.

Alternative E - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft

This alternative follows essentially the same pattern of facility availability as Alternative D. The only difference lies in the additional availability of the concessions area ramp in July, this also reflects an additional gain in facility availability compared to the baseline alternative.

Alternative F - Automate, Winterize Courtland Canal; Raise Lovewell 35,000 ac-ft

None of the water-based facilities are expected to be available on average in May and June, and only the beach is expected to be available on average in August and September. Five of the seven water-based facilities are expected to be available on average in July, with only the high water ramps showing as unavailable. Facility unavailability in May and June is due to high water and July through September due to low water.

Compared to the baseline alternative, additional facility unavailability occurs in May and June for the concessions area ramps, marina ramp, cabin area ramp, marina, and beach. Conversely, additional facility availability occurs in July for the concessions area ramps, marina ramp, cabin area ramp, and marina and in August for the beach.

Alternative G - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 ac-ft

This alternative follows the same pattern of facility availability on average as Alternative F.

Alternative H - Raise Lovewell 16,000 ac-ft

The concessions area ramps, marina ramp, cabin area ramp, and marina are expected to be unavailable on average across all months under this alternative. In addition, the high water Oak Hill and Highway 14 boat ramps are only expected to be available during May and June, and the beach during July and September. Facility unavailability in May and June is due to high water and July through September due to low water.

Compared to the baseline alternative, additional facility unavailability occurs in May and June for the concessions area ramps, marina ramp, cabin area ramp, marina, and beach. Conversely, additional facility availability occurs in May and June for the high water Oak Hill and Highway 14 ramps.

Alternative I - Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft

This alternative follows essentially the same pattern of facility availability as Alternative H. The only difference lies in the additional availability of the marina in July and the beach in August, these differences also reflect additional gains in facility availability compared to the baseline alternative.

Dry Hydrologic Conditions

The following section describes monthly recreation facility availability across alternatives for dry hydrologic conditions. Note that facility unavailability is less significant under dry hydrologic conditions compared to average conditions given that dry conditions only occur 10 percent of the time. Table E-3 presents the results of the analysis for all alternatives for the May to September high use recreation season.

TABLE E-3. FACILITY AVAILABILITY BY ALTERNATIVE UNDER DRY HYDROLOGIC CONDITIONS

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
1) Baseline Alternative:							
Water Levels:			**1575.1**	**1576.4**	**1571.7**	**1571.3**	**1571.3**
Boat Ramps:							
• Concessions	1583	1578	No	No	No	No	No
Area	1583	1579	No	No	No	No	No
• Marina	1583	1579	No	No	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	No	No	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	No	No	No
2) Alternative A (Courtland Canal to Design Capacity, Winterize):							
Water Levels:			**1577.2**	**1578.6**	**1571.7**	**1571.2**	**1571.3**
Boat Ramps:							
• Concessions	1583	1578	No	***Yes***	No	No	No
Area	1583	1579	No	No	No	No	No
• Marina	1583	1579	No	No	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***Yes***	***Yes***	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	No	No	No
3) Alternative B (Automate, Winterize Courtland Canal):							
Water Levels:			**1577.8**	**1579.5**	**1571.7**	**1571.3**	**1571.3**
Boat Ramps:							
• Concessions	1583	1578	No	***Yes***	No	No	No
Area	1583	1579	No	***Yes***	No	No	No
• Marina	1583	1579	No	***Yes***	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***Yes***	***Yes***	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	No	No	No
4) Alternative C (Automate, Winterize, Courtland Canal to Design Capacity):							
Water Levels:			**1577.8**	**1579.5**	**1571.7**	**1571.3**	**1571.3**
Boat Ramps:							
• Concessions	1583	1578	No	***Yes***	No	No	No
Area	1583	1579	No	***Yes***	No	No	No
• Marina	1583	1579	No	***Yes***	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***Yes***	***Yes***	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	No	No	No

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
5) Alternative D (Automate, Winterize Courtland Canal; Raise Lovewell 16,000 AF):							
Water Levels:			**1577.8**	**1579.1**	**1571.7**	**1571.4**	**1571.4**
Boat Ramps:							
• Concessions	1583	1578	No	***Yes***	No	No	No
Area	1583	1579	No	***Yes***	No	No	No
• Marina	1583	1579	No	***Yes***	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***Yes***	***Yes***	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	No	No	No
6) Alternative E (Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF):							
Water Levels:			**1577.8**	**1580.0**	**1571.7**	**1571.4**	**1571.4**
Boat Ramps:							
• Concessions	1583	1578	No	***Yes***	No	No	No
Area	1583	1579	No	***Yes***	No	No	No
• Marina	1583	1579	No	***Yes***	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***Yes***	***Yes***	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	No	No	No
7) Alternative F (Automate, Winterize Courtland Canal; Raise Lovewell 35,000 AF):							
Water Levels:			**1578.0**	**1579.1**	**1571.7**	**1571.4**	**1571.4**
Boat Ramps:							
• Concessions	1583	1578	***Yes***	***Yes***	No	No	No
Area	1583	1579	No	***Yes***	No	No	No
• Marina	1583	1579	No	***Yes***	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***Yes***	***Yes***	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	No	No	No
8) Alternative G (Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 AF):							
Water Levels:			**1579.4**	**1580.0**	**1571.7**	**1571.4**	**1571.4**
Boat Ramps:							
• Concessions	1583	1578	***Yes***	***Yes***	No	No	No
Area	1583	1579	***Yes***	***Yes***	No	No	No
• Marina	1583	1579	***Yes***	***Yes***	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	***Yes***	***Yes***	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	No	No	No

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
9) Alternative H (Raise Lovewell 16,000 AF):							
		Water Levels:	**1575.1**	**1574.9**	**1571.7**	**1571.4**	**1571.4**
Boat Ramps:							
• Concessions	1583	1578	No	No	No	No	No
Area	1583	1579	No	No	No	No	No
• Marina	1583	1579	No	No	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	No	No	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	No	No	No
10) Alternative I (Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF):							
		Water Levels:	**1575.1**	**1575.8**	**1571.7**	**1571.4**	**1571.3**
Boat Ramps:							
• Concessions	1583	1578	No	No	No	No	No
Area	1583	1579	No	No	No	No	No
• Marina	1583	1579	No	No	No	No	No
• Cabin Area	1586.6	1582.5	No	No	No	No	No
• Oak Hill	1586.6	1582.6	No	No	No	No	No
• Highway 14							
Lovewell Marina	1583	1577	No	No	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	No	No	No

Key: No = Facility Unavailable, Yes = Facility Available
Yes or No in Bold, Italics, and Centered in Cell = different from baseline

Baseline Alternative

Under dry conditions for the baseline alternative, all facilities are expected to be unavailable due to low water except for the beach during May and June. Table E-3 only presents facility availability for the water-based facilities since the water-influenced facilities (i.e., campgrounds, picnic areas, trailer sites, and cabins) are available across all months and alternatives under dry conditions.

Alternative A - Courtland Canal to Design Capacity, Winterize

Under dry conditions, this alternative is similar to the baseline alternative except that additional facility availability occurs in May and June with the marina and in June with the concessions area ramps.

Alternative B - Automate, Winterize Courtland Canal

Under dry conditions, this alternative is similar to the baseline alternative except that additional facility availability occurs in May and June with the marina and in June with the concessions area ramps, marina ramp, and cabin area ramp.

Alternative C - Automate, Winterize, Courtland Canal to Design Capacity

Same as Alternative B.

Alternative D - Automate, Winterize Courtland Canal; Raise Lovewell 16,000 ac-ft

Same as Alternative B.

Alternative E - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft

Same as Alternative B.

Alternative F - Automate, Winterize Courtland Canal; Raise Lovewell 35,000 ac-ft

Same as Alternative B except for the additional availability of the concessions area ramp in May. The additional availability of the concessions area ramp in May also reflects a gain compared to the baseline alternative.

Alternative G - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 ac-ft

Under dry conditions, this alternative is similar to the baseline alternative except that additional facility availability occurs in May and June with the concessions area ramps, marina ramp, cabin area ramp, and marina.

Alternative H - Raise Lovewell 16,000 ac-ft

Same as baseline alternative.

Alternative I - Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft

Same as baseline alternative.

Wet Hydrologic Conditions

The following section describes monthly recreation facility availability across alternatives for wet hydrologic conditions. Note that facility unavailability is less significant under wet hydrologic conditions compared to average conditions given that wet conditions only occur 10 percent of the time. Table E-4 presents the results of the analysis for all alternatives for the May to September high use recreation season.

TABLE E-4.–FACILITY AVAILABILITY BY ALTERNATIVE UNDER WET HYDROLOGIC CONDITIONS

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
1) Baseline Alternative:							
Water Levels:			**1582.6**	**1582.6**	**1580.9**	**1572.0**	**1582.6**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	Yes	No	Yes
• Marina	1583	1579	Yes	Yes	Yes	No	Yes
• Cabin Area	1583	1579	Yes	Yes	Yes	No	Yes
• Oak Hill	1586.6	1582.5	Yes	Yes	No	No	Yes
• Highway 14	1586.6	1582.6	Yes	Yes	No	No	Yes
Lovewell Marina	1583	1577	Yes	Yes	Yes	No	Yes
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
2) Alternative A (Courtland Canal to Design Capacity, Winterize):							
Water Levels:			**1582.6**	**1582.6**	**1582.0**	**1575.1**	**1582.6**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	Yes	No	Yes
• Marina	1583	1579	Yes	Yes	Yes	No	Yes
• Cabin Area	1583	1579	Yes	Yes	Yes	No	Yes
• Oak Hill	1586.6	1582.5	Yes	Yes	No	No	Yes
• Highway 14	1586.6	1582.6	Yes	Yes	No	No	Yes
Lovewell Marina	1583	1577	Yes	Yes	Yes	No	Yes
Lovewell Beach	1583	1573	Yes	Yes	Yes	***Yes***	Yes
3) Alternative B (Automate, Winterize Courtland Canal):							
Water Levels:			**1582.6**	**1582.6**	**1582.0**	**1572.0**	**1582.6**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	Yes	No	Yes
• Marina	1583	1579	Yes	Yes	Yes	No	Yes
• Cabin Area	1583	1579	Yes	Yes	Yes	No	Yes
• Oak Hill	1586.6	1582.5	Yes	Yes	No	No	Yes
• Highway 14	1586.6	1582.6	Yes	Yes	No	No	Yes
Lovewell Marina	1583	1577	Yes	Yes	Yes	No	Yes
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes
4) Alternative C (Automate, Winterize, Courtland Canal to Design Capacity):							
Water Levels:			**1582.6**	**1582.6**	**1582.1**	**1575.7**	**1582.6**
Boat Ramps:							
• Concessions Area							
• Marina	1583	1578	Yes	Yes	Yes	No	Yes
• Cabin Area	1583	1579	Yes	Yes	Yes	No	Yes
• Oak Hill	1583	1579	Yes	Yes	Yes	No	Yes
• Highway 14	1586.6	1582.5	Yes	Yes	No	No	Yes
	1586.6	1582.6	Yes	Yes	No	No	Yes
Lovewell Marina	1583	1577	Yes	Yes	Yes	No	Yes
Lovewell Beach	1583	1573	Yes	Yes	Yes	***Yes***	Yes
5) Alternative D (Automate, Winterize Courtland Canal; Raise Lovewell 16,000 AF):							
Water Levels:			**1587.4**	**1587.4**	**1585.4**	**1577.1**	**1583.6**
Boat Ramps:							
• Concessions Area	1583	1578	***No***	***No***	***No***	No	***No***
• Marina	1583	1579	***No***	***No***	***No***	No	***No***
• Cabin Area	1583	1579	***No***	***No***	***No***	No	***No***
• Oak Hill	1586.6	1582.5	***No***	***No***	***Yes***	No	Yes
• Highway 14	1586.6	1582.6	***No***	***No***	***Yes***	No	Yes
Lovewell Marina	1583	1577	***No***	***No***	***No***	***Yes***	***No***
Lovewell Beach	1583	1573	***No***	***No***	***No***	***Yes***	***No***

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
6) Alternative E (Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF):							
Water Levels:			**1587.4**	**1587.4**	**1586.3**	**1581.5**	**1585.1**
Boat Ramps:							
• Concessions Area	1583	1578	***No***	***No***	***No***	***Yes***	***No***
• Marina	1583	1579	***No***	***No***	***No***	***Yes***	***No***
• Cabin Area	1583	1579	***No***	***No***	***No***	***Yes***	***No***
• Oak Hill	1586.6	1582.5	***No***	***No***	***Yes***	No	Yes
• Highway 14	1586.6	1582.6	***No***	***No***	***Yes***	No	Yes
Lovewell Marina	1583	1577	***No***	***No***	***No***	***Yes***	***No***
Lovewell Beach	1583	1573	***No***	***No***	***No***	***Yes***	***No***
7) Alternative F (Automate, Winterize Courtland Canal; Raise Lovewell 35,000 AF):							
Water Levels:			**1592.0**	**1592.0**	**1590.3**	**1583.2**	**1585.6**
Boat Ramps:							
• Concessions Area	1583	1578	***No***	***No***	***No***	No	***No***
• Marina	1583	1579	***No***	***No***	***No***	No	***No***
• Cabin Area	1583	1579	***No***	***No***	***No***	No	***No***
• Oak Hill	1586.6	1582.5	***No***	***No***	No	***Yes***	Yes
• Highway 14	1586.6	1582.6	***No***	***No***	No	***Yes***	Yes
Lovewell Marina	1583	1577	***No***	***No***	***No***	No	***No***
Lovewell Beach	1583	1573	***No***	***No***	***No***	No	***No***
Campgrounds:							
• Willow	1590	n/a	***No***	***No***	***No***	Yes	Yes
• Willow Utility	1595	n/a	Yes	Yes	Yes	Yes	Yes
• Cottonwood	1590	n/a	***No***	***No***	***No***	Yes	Yes
• Cottonwood Utility	1595	n/a	Yes	Yes	Yes	Yes	Yes
• Blue Bird	1590	n/a	***No***	***No***	***No***	Yes	Yes
• Cedar Point	1590	n/a	***No***	***No***	***No***	Yes	Yes
• Cedar Point Utility	1595	n/a	Yes	Yes	Yes	Yes	Yes
• Walleye Point	1590	n/a	***No***	***No***	***No***	Yes	Yes
• Walleye Pt. Utility	1595	n/a	Yes	Yes	Yes	Yes	Yes
Picnic Areas:							
• Covered Shelters	1590	n/a	***No***	***No***	***No***	Yes	Yes
Trailer Sites	1590	n/a	***No***	***No***	***No***	Yes	Yes
Cabin Area	1595	n/a	Yes	Yes	Yes	Yes	Yes

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
8) Alternative G (Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 AF):							
Water Levels:			**1592.0**	**1592.0**	**1591.4**	**1586.7**	**1588.3**
Boat Ramps:							
• Concessions	1583	1578	***No***	***No***	***No***	No	***No***
Area	1583	1579	***No***	***No***	***No***	No	***No***
• Marina	1583	1579	***No***	***No***	***No***	No	***No***
• Cabin Area	1586.6	1582.5	***No***	***No***	No	No	***No***
• Oak Hill	1586.6	1582.6	***No***	***No***	No	No	***No***
• Highway 14							
Lovewell Marina	1583	1577	***No***	***No***	***No***	No	***No***
Lovewell Beach	1583	1573	***No***	***No***	***No***	No	***No***
Campgrounds:							
• Willow	1590	n/a	***No***	***No***	***No***	Yes	Yes
• Willow Utility	1595	n/a	Yes	Yes	Yes	Yes	Yes
• Cottonwood	1590	n/a	***No***	***No***	***No***	Yes	Yes
• Cottonwood	1595	n/a	Yes	Yes	Yes	Yes	Yes
Utility	1590	n/a	***No***	***No***	***No***	Yes	Yes
• Blue Bird	1590	n/a	***No***	***No***	***No***	Yes	Yes
• Cedar Point	1595	n/a	Yes	Yes	Yes	Yes	Yes
• Cedar Point	1590	n/a	***No***	***No***	***No***	Yes	Yes
Utility	1595	n/a	Yes	Yes	Yes	Yes	Yes
• Walleye Point							
• Walleye Pt. Utility							
Picnic Areas:							
• Covered Shelters	1590	n/a	***No***	***No***	***No***	Yes	Yes
Trailer Sites	1590	n/a	***No***	***No***	***No***	Yes	Yes
Cabin Area	1595	n/a	Yes	Yes	Yes	Yes	Yes
9) Alternative H (Raise Lovewell 16,000 AF):							
Water Levels:			**1587.4**	**1587.4**	**1585.4**	**1575.9**	**1583.6**
Boat Ramps:							
• Concessions	1583	1578	***No***	***No***	***No***	No	***No***
Area	1583	1579	***No***	***No***	***No***	No	***No***
• Marina	1583	1579	***No***	***No***	***No***	No	***No***
• Cabin Area	1586.6	1582.5	***No***	***No***	***Yes***	No	Yes
• Oak Hill	1586.6	1582.6	***No***	***No***	***Yes***	No	Yes
• Highway 14							
Lovewell Marina	1583	1577	***No***	***No***	***No***	No	***No***
Lovewell Beach	1583	1573	***No***	***No***	***No***	***Yes***	***No***

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
10) Alternative I (Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF):							
Water Levels:			**1587.4**	**1587.4**	**1586.3**	**1581.1**	**1584.9**
Boat Ramps:							
• Concessions	1583	1578	***No***	***No***	***No***	***Yes***	***No***
Area	1583	1579	***No***	***No***	***No***	***Yes***	***No***
• Marina	1583	1579	***No***	***No***	***No***	***Yes***	***No***
• Cabin Area	1586.6	1582.5	***No***	***No***	***Yes***	No	Yes
• Oak Hill	1586.6	1582.6	***No***	***No***	***Yes***	No	Yes
• Highway 14							
Lovewell Marina	1583	1577	***No***	***No***	***No***	***Yes***	***No***
Lovewell Beach	1583	1573	***No***	***No***	***No***	***Yes***	***No***

Key: No = Facility Unavailable, Yes = Facility Available
Yes or No in Bold, Italics, and Centered in Cell = different from baseline

Baseline Alternative

Under wet conditions for the baseline alternative, all facilities are generally expected to be available except during the month of August where all water-based facilities are projected to be unavailable. In addition, the high water Oak Hill and Highway 14 ramps are also expected to be unavailable during July. Despite being high water conditions, the unavailability of these facilities is due to low water. Table E-4 generally presents facility availability only for the water-based facilities since the water-influenced facilities (i.e., campgrounds, picnic areas, trailer sites, and cabins) are available across most alternatives under wet conditions, including the baseline alternative. The only alternatives which include information on the water-influenced facilities are alternatives F and G.

Alternative A - Courtland Canal to Design Capacity, Winterize

Under wet conditions, this alternative is similar to the baseline alternative except that additional facility availability occurs in August at the beach.

Alternative B - Automate, Winterize Courtland Canal

Under wet conditions, this alternative is the same as the baseline alternative.

Alternative C - Automate, Winterize, Courtland Canal to Design Capacity

Under wet conditions, this alternative is similar to the baseline alternative except that additional facility availability occurs in August at the beach.

Alternative D - Automate, Winterize Courtland Canal; Raise Lovewell 16,000 ac-ft

Facilities are generally unavailable under wet conditions for this alternative. Only the high water Oak Hill and Highway 14 ramps are available during July and September, and the marina and beach in August. Facility unavailability in August is actually due to low water, whereas unavailability in other months is due to high water.

Compared to the baseline alternative, additional unavailability occurs for all facilities during May and June, and for the concessions area ramps, marina ramp, cabin area ramp, marina, and beach during July and September. Conversely, the only additional facility availability occurs in July for the high water Oak Hill and Highway 14 ramps, and in August for the marina and beach.

Alternative E - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft

Under wet conditions, this alternative is similar to alternative D except for additional facility availability for the concessions area ramps, marina ramp, and cabin area ramp during August. This additional facility availability during August also reflects a gain compared to the baseline alternative.

Alternative F - Automate, Winterize Courtland Canal; Raise Lovewell 35,000 ac-ft

Under wet conditions, all water-based facilities are generally unavailable for this alternative due to high water except for the high water Oak Hill and Highway 14 ramps during August and September. In addition, the following water-influenced facilities are expected to be unavailable in May through July: Willow campground, Cottonwood campground, Blue Bird group campground, Cedar Point campground, Walleye Point campground, some of the covered picnic shelters, and several of the trailer (RV) sites.

Compared to the baseline alternative, additional facility unavailability occurs across all water-based facilities during May and June and the concessions area ramps, marina ramp, cabin area ramp, marina, and beach during July and September. Conversely, the only additional facility availability occurs with the high water Oak Hill and Highway 14 ramps in August. For the water-influenced facilities, the facility unavailability noted above reflects a change from the baseline alternative.

Alternative G - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 ac-ft

Under wet conditions, all water-based facilities are expected to be unavailable across all months due to high water. Facility unavailability is the same as Alternative F for the water-influenced facilities.

Compared to the baseline alternative, additional facility unavailability occurs across all water-based facilities during May, June, and September and the concessions area ramps, marina ramp, cabin area ramp, marina, and beach during July. For the water-influenced facilities, the facility unavailability noted above reflects a change from the baseline alternative.

Alternative H - Raise Lovewell 16,000 ac-ft

Under wet conditions, the facilities are generally unavailable except for the high water Oak Hill and Highway 14 ramps during July and September, and the beach during August. Facility unavailability is generally due to high water except for low water effects in August.

Compared to the baseline alternative, additional facility unavailability occurs across all water-based facilities during May and June and the concessions area ramps, marina ramp, cabin area ramp, marina, and beach during July and September. Conversely, the only additional facility availability occurs with the high water Oak Hill and Highway 14 ramps in July and the beach in August.

Alternative I - Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft

Under wet conditions, all the water-based facilities are expected to be unavailable during May and June due to high water. In addition, the concessions area ramps, marina ramp, cabin area ramp, marina, and beach are expected to be unavailable during July and September. All facilities, except the high water Oak Hill and Highway 14 ramps, are expected to be available during August due to lower water levels.

Compared to the baseline alternative, additional facility unavailability occurs across all facilities in May and June and for the concessions area ramps, marina ramp, cabin area ramp, marina, and beach during July and September. Conversely, additional facility availability occurs in August for all water-based facilities except the high water Oak Hill and Highway 14 ramps, and in July at the Oak Hill and Highway 14 ramps.

Results – With Mitigation Analysis

This section presents the results of the with mitigation recreation facility availability analysis. By including the mitigation associated with moving or extending recreation facilities, problems of facility unavailability stemming from high water conditions are eliminated. Facility availability results were developed separately for the three hydrologic conditions – average, dry, and wet.

Average Hydrologic Conditions

Table E-5 presents the results of the analysis for all alternatives for the May to September high use recreation season. A “yes” implies the EOM water level falls within the facility’s usable range. Any differences in facility availability between the baseline alternative and the “action” alternatives are highlighted in bold and italics under each of the action alternatives.

TABLE E-5. FACILITY AVAILABILITY BY ALTERNATIVE UNDER AVERAGE HYDROLOGIC CONDITIONS

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
1) Baseline Alternative:							
Water Levels:			**1580.8**	**1580.9**	**1574.0**	**1572.2**	**1573.9**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	No	No	No
• Marina	1583	1579	Yes	Yes	No	No	No
• Cabin Area	1583	1579	Yes	Yes	No	No	No
• Oak Hill	1586.6	1582.5	No	No	No	No	No
• Highway 14	1586.6	1582.6	No	No	No	No	No
Lovewell Marina	1583	1577	Yes	Yes	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes
2) Alternative A (Courtland Canal to Design Capacity, Winterize):							
Water Levels:			**1581.3**	**1581.3**	**1574.8**	**1572.6**	**1574.1**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	No	No	No
• Marina	1583	1579	Yes	Yes	No	No	No
• Cabin Area	1583	1579	Yes	Yes	No	No	No
• Oak Hill	1586.6	1582.5	No	No	No	No	No
• Highway 14	1586.6	1582.6	No	No	No	No	No
Lovewell Marina	1583	1577	Yes	Yes	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes
3) Alternative B (Automate, Winterize Courtland Canal):							
Water Levels:			**1581.5**	**1581.5**	**1574.2**	**1572.2**	**1574.0**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	No	No	No
• Marina	1583	1579	Yes	Yes	No	No	No
• Cabin Area	1583	1579	Yes	Yes	No	No	No
• Oak Hill	1586.6	1582.5	No	No	No	No	No
• Highway 14	1586.6	1582.6	No	No	No	No	No
Lovewell Marina	1583	1577	Yes	Yes	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes
4) Alternative C (Automate, Winterize Courtland Canal to Design Capacity):							
Water Levels:			**1581.5**	**1581.5**	**1575.0**	**1572.7**	**1574.3**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	No	No	No
• Marina	1583	1579	Yes	Yes	No	No	No
• Cabin Area	1583	1579	Yes	Yes	No	No	No
• Oak Hill	1586.6	1582.5	No	No	No	No	No
• Highway 14	1586.6	1582.6	No	No	No	No	No
Lovewell Marina	1583	1577	Yes	Yes	No	No	No
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
5) Alternative D (Automate, Winterize Courtland Canal; Raise Lovewell 16,000 AF):							
Water Levels:			**1584.8**	**1584.9**	**1577.0**	**1573.0**	**1574.7**
Boat Ramps:							
• Concessions Area	NA	1578	Yes	Yes	No	No	No
• Marina	NA	1579	Yes	Yes	No	No	No
• Cabin Area	NA	1579	Yes	Yes	No	No	No
• Oak Hill	NA	1582.5	***Yes***	***Yes***	No	No	No
• Highway 14	NA	1582.6	***Yes***	***Yes***	No	No	No
Lovewell Marina	NA	1577	Yes	Yes	***Yes***	No	No
Lovewell Beach	NA	1573	Yes	Yes	Yes	***Yes***	Yes
6) Alternative E (Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF):							
Water Levels:			**1584.8**	**1584.9**	**1578.3**	**1573.7**	**1575.3**
Boat Ramps:							
• Concessions Area	NA	1578	Yes	Yes	***Yes***	No	No
• Marina	NA	1579	Yes	Yes	No	No	No
• Cabin Area	NA	1579	Yes	Yes	No	No	No
• Oak Hill	NA	1582.5	***Yes***	***Yes***	No	No	No
• Highway 14	NA	1582.6	***Yes***	***Yes***	No	No	No
Lovewell Marina	NA	1577	Yes	Yes	***Yes***	No	No
Lovewell Beach	NA	1573	Yes	Yes	Yes	***Yes***	Yes
7) Alternative F (Automate, Winterize Courtland Canal; Raise Lovewell 35,000 AF):							
Water Levels:			**1587.4**	**1587.6**	**1580.7**	**1574.5**	**1576.0**
Boat Ramps:							
• Concessions Area	NA	1578	Yes	Yes	***Yes***	No	No
• Marina	NA	1579	Yes	Yes	***Yes***	No	No
• Cabin Area	NA	1579	Yes	Yes	***Yes***	No	No
• Oak Hill	NA	1582.5	***Yes***	***Yes***	No	No	No
• Highway 14	NA	1582.6	***Yes***	***Yes***	No	No	No
Lovewell Marina	NA	1577	Yes	Yes	***Yes***	No	No
Lovewell Beach	NA	1573	Yes	Yes	Yes	***Yes***	Yes
8) Alternative G (Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 AF):							
Water Levels:			**1587.5**	**1587.8**	**1581.7**	**1575.6**	**1576.9**
Boat Ramps:							
• Concessions Area	NA	1578	Yes	Yes	***Yes***	No	No
• Marina	NA	1579	Yes	Yes	***Yes***	No	No
• Cabin Area	NA	1579	Yes	Yes	***Yes***	No	No
• Oak Hill	NA	1582.5	***Yes***	***Yes***	No	No	No
• Highway 14	NA	1582.6	***Yes***	***Yes***	No	No	No
Lovewell Marina	NA	1577	Yes	Yes	***Yes***	No	No
Lovewell Beach	NA	1573	Yes	Yes	Yes	***Yes***	Yes

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
9) Alternative H (Raise Lovewell 16,000 AF):							
Water Levels:			**1583.6**	**1583.8**	**1576.6**	**1572.9**	**1574.6**
Boat Ramps:							
• Concessions Area	NA	1578	Yes	Yes	No	No	No
• Marina	NA	1579	Yes	Yes	No	No	No
• Cabin Area	NA	1579	Yes	Yes	No	No	No
• Oak Hill	NA	1582.5	***Yes***	***Yes***	No	No	No
• Highway 14	NA	1582.6	***Yes***	***Yes***	No	No	No
Lovewell Marina	NA	1577	Yes	Yes	No	No	No
Lovewell Beach	NA	1573	Yes	Yes	Yes	No	Yes
10) Alternative I (Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF):							
Water Levels:			**1583.6**	**1583.9**	**1577.8**	**1573.5**	**1575.0**
Boat Ramps:							
• Concessions Area	NA	1578	Yes	Yes	No	No	No
• Marina	NA	1579	Yes	Yes	No	No	No
• Cabin Area	NA	1579	Yes	Yes	No	No	No
• Oak Hill	NA	1582.5	***Yes***	***Yes***	No	No	No
• Highway 14	NA	1582.6	***Yes***	***Yes***	No	No	No
Lovewell Marina	NA	1577	Yes	Yes	***Yes***	No	No
Lovewell Beach	NA	1573	Yes	Yes	Yes	***Yes***	Yes

Baseline

Based on the high and low end facility availability thresholds and the EOM water levels for the baseline alternative, none of the five boat ramps are projected to be available on average during the months of July through September. In addition, the high water ramps (Oak Hill and Highway 14) are projected to be unavailable on average during May and June. The Lovewell marina is projected to be unavailable on average during July through September and Lovewell beach is projected to be unavailable on average in August due to low water levels.

Alternative A – Courtland Canal to Design Capacity, Winterize

Based on average hydrologic conditions, facility availability for this alternative is the same as the Baseline Alternative.

Alternative B – Automate, Winterize Courtland Canal

Based on average hydrologic conditions, facility availability for this alternative is the same as the Baseline Alternative.

Alternative C – Automate, Winterize, Courtland Canal to Design Capacity

Based on average hydrologic conditions, facility availability for this alternative is the same as the Baseline Alternative.

Alternative D – Automate, Winterize Courtland Canal; Raise Lovewell 16,000 ac-ft
Compared to the Baseline Alternative, additional facility availability is expected to occur on average as follows: Oak Hill and Highway 14 ramps in May and June; marina in July; and the beach in August.

Alternative E - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft
This alternative follows essentially the same pattern of facility availability as Alternative D. The only difference lies in the additional availability of the concessions area ramp in July. This also reflects an additional gain in facility availability compared to the baseline alternative. Total gain in facility availability compared to the Baseline Alternative is as follows: concessions ramp in July; Oak Hill and Highway 14 ramps in May and June; marina in July; and the beach in August.

Alternative F - Automate, Winterize Courtland Canal; Raise Lovewell 35,000 ac-ft
In addition to the gains made from the Baseline Alternative by Alternative E, Alternative F also provides that the marina and cabin area boat ramps are available in August. The total gain in facility availability compared to the Baseline Alternative is as follows: concessions, marina, and cabin area ramps in July; Oak ill and Highway 14 ramps in May and June; marina in July; and the beach in August.

Alternative G - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 ac-ft
This alternative provides the same gains made as Alternative F.

Alternative H - Raise Lovewell 16,000 ac-ft
This alternative provides for the fewest gains relative to the Baseline Alternative, with the additional availability of only the Oak Hill and Highway 14 boat ramps during the months of May and June.

Alternative I - Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft
This alternative would provide the same gains over the Baseline Alternative as those identified for Alternative D, namely the Oak Hill and Highway 14 ramps in May and June, the marina in July, and the beach in August.

Dry Hydrologic Conditions

This section presents facility availability based on the with mitigation scenario for dry hydrologic conditions under each alternative. Results of this analysis should be given less weight than the average conditions analysis since dry conditions only occur about 10 percent of the time. Since the facility availability problems under dry hydrologic conditions are due to low water levels, and the mitigation addresses high water problems, the facility availability for the with mitigation

scenario mirrors that of the without mitigation scenario. See section B.2 above for a discussion of the impacts.

Wet Hydrologic Conditions

This section presents facility availability based on the with mitigation scenario for wet hydrologic conditions under each alternative. Results of this analysis should be given less weight than the average conditions analysis since wet conditions only occur about 10 percent of the time.

Table E-6 presents the results of the facility availability analysis. Information is only presented for the water-based facilities and not the land based water-influenced facilities. The land based water-influenced facilities would be available across all months and hydrologic conditions assuming facility mitigation. Low end thresholds are not relevant for these facilities since they are land based and the proposed mitigation would move or extend these facilities such that high water would no longer be a problem. Note that the changes in facility availability for each alternative compared to the Baseline Alternative are all positive, suggesting increases in facility availability. By pursuing the mitigation, under wet conditions, all of the additional facility unavailability compared to the Baseline Alternative seen under the without mitigation scenario is eliminated.

TABLE E-6.–FACILITY AVAILABILITY BY ALTERNATIVE UNDER WET HYDROLOGIC CONDITIONS

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
1) Baseline Alternative:							
Water Levels:			**1582.6**	**1582.6**	**1580.9**	**1572.0**	**1582.6**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	Yes	No	Yes
• Marina	1583	1579	Yes	Yes	Yes	No	Yes
• Cabin Area	1583	1579	Yes	Yes	Yes	No	Yes
• Oak Hill	1586.6	1582.5	Yes	Yes	No	No	Yes
• Highway 14	1586.6	1582.6	Yes	Yes	No	No	Yes
Lovewell Marina	1583	1577	Yes	Yes	Yes	No	Yes
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes
2) Alternative A (Courtland Canal to Design Capacity, Winterize):							
Water Levels:			**1582.6**	**1582.6**	**1582.0**	**1575.1**	**1582.6**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	Yes	No	Yes
• Marina	1583	1579	Yes	Yes	Yes	No	Yes
• Cabin Area	1583	1579	Yes	Yes	Yes	No	Yes
• Oak Hill	1586.6	1582.5	Yes	Yes	No	No	Yes
• Highway 14	1586.6	1582.6	Yes	Yes	No	No	Yes
Lovewell Marina	1583	1577	Yes	Yes	Yes	No	Yes
Lovewell Beach	1583	1573	Yes	Yes	Yes	***Yes***	Yes

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
3) Alternative B (Automate, Winterize Courtland Canal)							
Water Levels:			**1582.6**	**1582.6**	**1582.0**	**1572.0**	**1582.6**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	Yes	No	Yes
• Marina	1583	1579	Yes	Yes	Yes	No	Yes
• Cabin Area	1583	1579	Yes	Yes	Yes	No	Yes
• Oak Hill	1586.6	1582.5	Yes	Yes	No	No	Yes
• Highway 14	1586.6	1582.6	Yes	Yes	No	No	Yes
Lovewell Marina	1583	1577	Yes	Yes	Yes	No	Yes
Lovewell Beach	1583	1573	Yes	Yes	Yes	No	Yes
4) Alternative C (Automate, Winterize, Courtland Canal to Design Capacity)							
Water Levels:			**1582.6**	**1582.6**	**1582.1**	**1575.7**	**1582.6**
Boat Ramps:							
• Concessions Area	1583	1578	Yes	Yes	Yes	No	Yes
• Marina	1583	1579	Yes	Yes	Yes	No	Yes
• Cabin Area	1583	1579	Yes	Yes	Yes	No	Yes
• Oak Hill	1586.6	1582.5	Yes	Yes	No	No	Yes
• Highway 14	1586.6	1582.6	Yes	Yes	No	No	Yes
Lovewell Marina	1583	1577	Yes	Yes	Yes	No	Yes
Lovewell Beach	1583	1573	Yes	Yes	Yes	***Yes***	Yes
5) Alternative D (Automate, Winterize Courtland Canal; Raise Lovewell 16,000 AF)							
Water Levels:			**1587.4**	**1587.4**	**1585.4**	**1577.1**	**1583.6**
Boat Ramps:							
• Concessions Area	N/A	1578	Yes	Yes	Yes	No	Yes
• Marina	N/A	1579	Yes	Yes	Yes	No	Yes
• Cabin Area	N/A	1579	Yes	Yes	Yes	No	Yes
• Oak Hill	N/A	1582.5	Yes	Yes	***Yes***	No	Yes
• Highway 14	N/A	1582.6	Yes	Yes	***Yes***	No	Yes
Lovewell Marina	N/A	1577	Yes	Yes	Yes	***Yes***	Yes
Lovewell Beach	N/A	1573	Yes	Yes	Yes	***Yes***	Yes
6) Alternative E (Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF)							
Water Levels:			**1587.4**	**1587.4**	**1586.3**	**1581.5**	**1585.1**
Boat Ramps:							
• Concessions Area	N/A	1578	Yes	Yes	Yes	***Yes***	Yes
• Marina	N/A	1579	Yes	Yes	Yes	***Yes***	Yes
• Cabin Area	N/A	1579	Yes	Yes	Yes	***Yes***	Yes
• Oak Hill	N/A	1582.5	Yes	Yes	***Yes***	No	Yes
• Highway 14	N/A	1582.6	Yes	Yes	***Yes***	No	Yes
Lovewell Marina	N/A	1577	Yes	Yes	Yes	***Yes***	Yes
Lovewell Beach	N/A	1573	Yes	Yes	Yes	***Yes***	Yes

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
7) Alternative F (Automate, Winterize Courtland Canal; Raise Lovewell 35,000 AF)							
Water Levels:			**1592.0**	**1592.0**	**1590.3**	**1583.2**	**1585.6**
Boat Ramps:							
• Concessions Area	N/A	1578	Yes	Yes	Yes	***Yes***	Yes
• Marina	N/A	1579	Yes	Yes	Yes	***Yes***	Yes
• Cabin Area	N/A	1579	Yes	Yes	Yes	***Yes***	Yes
• Oak Hill	N/A	1582.5	Yes	Yes	***Yes***	***Yes***	Yes
• Highway 14	N/A	1582.6	Yes	Yes	***Yes***	***Yes***	Yes
Lovewell Marina	N/A	1577	Yes	Yes	Yes	***Yes***	Yes
Lovewell Beach	N/A	1573	Yes	Yes	Yes	***Yes***	Yes
8) Alternative G (Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 AF):							
Water Levels:			**1592.0**	**1592.0**	**1591.4**	**1586.7**	**1588.3**
Boat Ramps:							
• Concessions Area	N/A	1578	Yes	Yes	Yes	***Yes***	Yes
• Marina	N/A	1579	Yes	Yes	Yes	***Yes***	Yes
• Cabin Area	N/A	1579	Yes	Yes	Yes	***Yes***	Yes
• Oak Hill	N/A	1582.5	Yes	Yes	***Yes***	***Yes***	Yes
• Highway 14	N/A	1582.6	Yes	Yes	***Yes***	***Yes***	Yes
Lovewell Marina	N/A	1577	Yes	Yes	Yes	***Yes***	Yes
Lovewell Beach	N/A	1573	Yes	Yes	Yes	***Yes***	Yes
9) Alternative H (Raise Lovewell 16,000 AF):							
Water Levels:			**1587.4**	**1587.4**	**1585.4**	**1575.9**	**1583.6**
Boat Ramps:							
• Concessions Area	N/A	1578	Yes	Yes	Yes	No	Yes
• Marina	N/A	1579	Yes	Yes	Yes	No	Yes
• Cabin Area	N/A	1579	Yes	Yes	Yes	No	Yes
• Oak Hill	N/A	1582.5	Yes	Yes	***Yes***	No	Yes
• Highway 14	N/A	1582.6	Yes	Yes	***Yes***	No	Yes
Lovewell Marina	N/A	1577	Yes	Yes	Yes	No	Yes
Lovewell Beach	N/A	1573	Yes	Yes	Yes	***Yes***	Yes
10) Alternative I (Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF):							
Water Levels:			**1587.4**	**1587.4**	**1586.3**	**1581.1**	**1584.9**
Boat Ramps:							
• Concessions Area	N/A	1578	Yes	Yes	Yes	***Yes***	Yes
• Marina	N/A	1579	Yes	Yes	Yes	***Yes***	Yes
• Cabin Area	N/A	1579	Yes	Yes	Yes	***Yes***	Yes
• Oak Hill	N/A	1582.5	Yes	Yes	***Yes***	No	Yes
• Highway 14	N/A	1582.6	Yes	Yes	***Yes***	No	Yes
Lovewell Marina	N/A	1577	Yes	Yes	Yes	***Yes***	Yes
Lovewell Beach	N/A	1573	Yes	Yes	Yes	***Yes***	Yes

Key: No = Facility Unavailable, Yes = Facility Available

Yes or No in Bold, Italics, and Centered in Cell = different from baseline

N/A = Not Applicable as it is assumed that facility will be moved to above high water line

Baseline Alternative

Under wet conditions for the baseline alternative, all facilities are generally expected to be available except during the month of August where all water-based facilities are projected to be unavailable. In addition, the high water Oak Hill and Highway 14 ramps are also expected to be unavailable during July. Despite being high water conditions, the unavailability of these facilities is due to low water.

Alternative A - Courtland Canal to Design Capacity, Winterize

Under wet conditions, this alternative is similar to the baseline alternative except that additional facility availability occurs in August at the beach.

Alternative B - Automate, Winterize Courtland Canal

Under wet conditions, this alternative is the same as the baseline alternative.

Alternative C - Automate, Winterize, Courtland Canal to Design Capacity

Under wet conditions, this alternative is similar to the baseline alternative except that additional facility availability occurs in August at the beach (same as Alternative A).

Alternative D - Automate, Winterize Courtland Canal; Raise Lovewell 16,000 ac-ft

Compared to the Baseline Alternative, additional facility availability occurs in July for the high water Oak Hill and Highway 14 ramps, and in August for the marina and beach.

Alternative E - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft

Compared to the Baseline Alternative, additional facility availability occurs for the concessions area, marina, and cabin area ramps in August; the Oak Hill and Highway 14 ramps in July; and the marina and beach in August.

Alternative F - Automate, Winterize Courtland Canal; Raise Lovewell 35,000 ac-ft

Compared to the Baseline Alternative, additional facility availability occurs in August for all water-based facilities, and in July for the Oak Hill and Highway 14 ramps.

Alternative G - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 ac-ft

Compared to the Baseline Alternative, additional facility availability occurs in August for all water-based facilities, and in July for the Oak Hill and Highway 14 ramps (same as Alternative F).

Alternative H - Raise Lovewell 16,000 ac-ft

Compared to the Baseline Alternative, additional facility availability occurs for the Oak Hill and Highway 14 ramps in July; and the beach in August.

Alternative I - Courtland Canal to Design Capacity; Raise Lovewell 16,000 ac-ft

Compared to the Baseline Alternative, additional facility availability occurs for the concessions area, marina, and cabin area ramps in August; the Oak Hill and Highway 14 ramps in July; and the marina and beach in August (same as Alternative E).

Appendix F

Preliminary Plan of Study — Feasibility Study

Preliminary Plan of Study

Feasibility Study

Lower Republican River Basin

Nebraska and Kansas

January 2005

Table of Contents

Page

Enclosures

Tables

Chapter I – Purpose and Scope

I Definition

This plan of study (POS) for the feasibility study defines the planning approach, activities to be accomplished, schedule, and associated costs that the Federal Government and the local sponsor(s) will be supporting financially. The POS, therefore defines a "buy-in" between the Bureau of Reclamation (Reclamation) and the local sponsor(s) as well as those who will be performing and reviewing the activities involved in the feasibility study. The POS describes the tasks of the feasibility study and continues through the preparation of the final feasibility report and the National Environmental Policy Act (NEPA) compliance document called Planning Report/NEPA document (PR/NEPA document). Advance Planning activities such as project design and other implementation activities will be covered in a subsequent project management plan after construction authorization is received.

Feasibility studies are detailed investigations specifically authorized by law to determine the desirability of seeking Congressional authorization for implementation. Feasibility studies cannot begin until specifically authorized in accordance with the Federal Water Project Recreation Act (Public Law 89-72, Section 8; Stat. 217). While appraisal studies use existing data, feasibility studies include additional data collection and analyses to develop and consider a full and reasonable range of alternatives. Feasibility studies must be consistent with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, March 10, 1983, (*P&Gs).

Feasibility studies are normally prepared in compliance with the NEPA, Endangered Species Act (ESA), National Historic Preservation Act (NHPA), and other related environmental and cultural resource laws. These combined analyses culminate in an integrated PR/NEPA compliance document.

The POS is also a basis for change. Because planning is an iterative process without a predetermined outcome, more or fewer costs and time may be required to accomplish reformulation and evaluations of the alternatives. Changes in scope will occur as the technical picture unfolds. With clear descriptions of the scopes and assumptions outlined in the POS, deviations are easier to identify and manage.

The POS is a basis for the review and evaluation of the PR/NEPA document. It will be used as the basis to determine if the draft has been developed in accordance with established procedures and previous agreements and understandings of Reclamation and the sponsors into the scope, critical assumptions, methodologies, and level of detail. Review of the draft report will

be to ensure that the study has been developed consistent with these agreements and understandings with the objective of providing early assurance that a recommended project can be supported by higher authorities in the Administration, by the project sponsor, and by the Congress.

Lastly, the POS is a study management tool. It includes scopes of work that are used for allocating funds and managing the schedule by the study manager. It forms the basis for identifying commitments to the non-Federal sponsor and serves as a basis for performance measurement.

II Summary of POS Contents

This POS is comprised of the following chapters:

Chapter I – Purpose and Scope
This chapter includes the definition of the POS and a summary of the POS requirements.

Chapter II – Appraisal Study Summary
This chapter is an overview of the results of the appraisal study and the plan formulation rationale. The Lower Republican River Basin (Basin) Appraisal Study was completed in September 2004.

Chapter III – Feasibility Study Overview
This chapter provides an overview of the feasibility study, the processes to be followed and important assumptions.

Chapter IV – Summary Scopes of Work
This chapter contains a listing of the feasibility study milestones, a listing of the work tasks necessary to be accomplished during the study and summary scopes of work which are required to accomplish the tasks, in narrative form. The cost estimates consider all costs necessary to complete the study according to the schedule in Chapter V. This chapter provides a reference to the detailed scopes of work included as Enclosure C.

Chapter V – Schedule, Organizational Responsibility and Cost Summary
The schedule defines when key decision points and milestones will occur as well as the activities needed to be accomplished for each. The chapter also includes a table of organizational responsibilities for conducting the activities and a table of work task costs.

Chapter VI – Quality Management
This chapter addresses quality management.

III List of Enclosures

Enclosure A	Study Area Map
Enclosure B	Milestones
Enclosure C	Scopes of Work
Enclosure D	List of Acronyms
Enclosure E	Preliminary Table of Contents
Enclosure F	Review Checklist
Enclosure G	Letters of Intent from Kansas and Nebraska

Chapter II – Appraisal Study Summary

I Authority

The Appraisal Study (Study) of the Lower Republican River Basin (Basin) was authorized under Federal Reclamation Laws (Act of June 17, 1902, 32 Stat. 388, and acts amendatory thereof and supplementary thereto). The study was programmed and funded from Kansas Investigations.

II Purpose and Scope

The purpose of this Study, supported by Kansas and Nebraska, is to meet the requirements as stated in the U.S. Supreme Court's Final Settlement Stipulation (FSS), December 15, 2002:

> IV. E. *"The States agree to pursue in good faith, and in collaboration with the United States, system improvements in the Basin, including measures to improve the ability to utilize the water supply below Hardy, Nebraska on the main stem."*
>
> V.A. 4. *"Kansas and Nebraska, in collaboration with the United States agree to take actions to minimize the bypass flows at Superior-Courtland Diversion Dam."*

This Study also meets the States (Colorado, Kansas, and Nebraska) responsibilities of the 1942 Republican River Compact (Compact) "… to provide for the most efficient use of the water of the Basin for multiple purposes…"

III Project Area and Description

The appraisal study area lies in the Basin below Harlan County Dam in south-central Nebraska to Clay Center, Kansas just above the upper reaches of Milford Lake in north-central Kansas (Enclosure A). Included in this area is the Bostwick Division of the Pick-Sloan Missouri River Program (P-SMBP), a Reclamation project. There are two irrigation districts that operate and maintain the irrigation system: the Bostwick Irrigation District in Nebraska and the Kansas Bostwick Irrigation District No. 2 (KBID). These two districts began delivering water in the early 1950's. Current service is available to 22,935 acres in Nebraska and 42,500 acres in Kansas. Storage water is provided to the Bostwick Division from the Corps of Engineer's (Corps) Harlan County Lake and Reclamation's Lovewell Reservoir. The water supply for Harlan County Lake comes from the Republican River and Lovewell's water supply comes from diversions from the Republican

River at the Superior-Courtland Diversion Dam with some inflow from White Rock Creek. Irrigation water for the Bostwick Division is diverted directly from Harlan County Lake and Lovewell Reservoir, from the Republican River at the Superior-Courtland Diversion Dam, and a small amount pumped from the Republican River below Harlan County Dam.

There are about 3,722 square miles of surface drainage area in the Basin between Harlan County Dam and the river gaging station at Clay Center, Kansas. The Republican River is the predominant natural feature. Throughout its length, the river has eroded a valley mantled by alluvial sand and gravel deposits ranging to 60 feet in depth. The valley, averaging less than 2 miles wide, is now entrenched 100 to 200 feet below the adjacent uplands. The bordering loess-mantled prairie plains have been eroded into long tongues of rolling uplands. There are several small, entrenched tributaries, flowing nearly at right angles to the river that drain the upland areas.

This study area is considered subhumid. Precipitation in the area is normally poorly distributed and insufficient for optimum plant growth. The Bostwick Division depends primarily upon the storage water from Harlan County Lake and Lovewell Reservoir. Harlan County Lake inflows have been generally declining with an occasional year or two of excess inflows that helps to replenish some of the storage water. Harlan County Lake usually has a limited amount of carryover storage. Lovewell Reservoir carryover storage is supplemented by fall diversions from the Republican River through Courtland Canal. There are competing needs for the limited available water so there is an urgent need to use the available water supplies as prudently and efficiently as possible.

IV Problems and Needs

There are many competing needs for the limited available water supplies in the study area. The two project irrigation districts usually receive less than the full amount of water needed for a full irrigation water supply. Kansas has established Minimum Desirable Streamflow (MDS) requirements at two locations on the Republican River. The instream flow requirements for these two locations have a priority date of April 12, 1984, established by the Kansas Legislature. Water users that have a priority date after April 12, 1984 are closed when the flows are less than the MDS levels established.

V Objectives and Constraints

Input on planning objectives and constraints was sought for the Appraisal Study from the involved States and interested parties such as the Bostwick Irrigation Districts, Natural Resources Districts (NRD) in the Basin, and the Lower Republican Water Users. This resulted in Reclamation identifying the following

planning objectives for the appraisal study and which also will apply to the Feasibility Study, subject to modifications as the study progresses:

1. Minimize bypass at Superior-Courtland Diversion Dam.
2. Provide augmentation storage water for MDS.
3. Develop cost effective solutions.
4. Provide additional water supply to Bostwick Division lands.
5. Provide additional recreation benefits.
6. Recognize possible environmental and cultural impacts.

Planning constraints on the development of these plans include the following:

- Republican River Compact
- State Water Rights
- Harlan County Consensus Plan
- Physical limitations of existing facilities, including Courtland Canal, Lovewell Reservoir, and other storage facilities
- Environmental and Cultural Considerations

VI Development of Alternatives

During the negotiations for settlement, a Value Study Report, Proposals for More Efficient Management of Lower Republican River Water Supplies, was completed by Reclamation on December 17, 2002, and the Compact Commissioners recommended the following proposals from that report be studied and analyzed:

1. Courtland Canal Automation, Reshape Canal Prism, and provide for Winter Operation.
2. Increase Lovewell Capacity – 16,000 acre-feet (ac-ft).
3. Increase Lovewell Capacity – 35,000 ac-ft.
4. Off-stream Storage, Kansas Tributaries, Beaver Creek.

The appraisal study formulated nine alternatives using the recommended proposals provided by the Compact Commissioners. An operation study simulating reservoir conditions and streamflow at different locations in the Basin was completed for the baseline condition and each alternative. Because of the operations model limitations, the hydrology analyses modeled the operation of the system for each alternative with the intent to maximize Bostwick irrigation benefits. Additional hydrological analyses to model system operation which emphasized other potential resource needs, such as MDS, were not performed. As a result, only irrigation benefits were quantitatively estimated. Allocation of water to provide MDS benefits would reduce the water available to provide irrigation benefits. The study also briefly investigated three other alternatives for supplying water to meet MDS-related needs in Kansas, which could include private irrigators who are junior to the MDS.

VII Results from the Study

The study results indicate additional water can be made available for storage in Lovewell Reservoir. The storage of this additional water could also be considered for other possible downstream facilities such as Beaver Creek site or Jamestown Wildlife Management Area site. The irrigation benefits accruing from the changes in operations associated with each alternative were estimated and the benefits were then compared to project costs. The alternatives which involve Lovewell Reservoir enlargements along with automating and winterizing the Courtland Canal appear to be the most viable, as shown in Table 1 and Table 2. The enlargement alternatives could potentially increase the recreational use at Lovewell Reservoir. Environmental impacts are associated with each alternative. If further studies are conducted, the NEPA documents will identify the full scope of the environmental impacts associated with each alternative.

The estimated implementation cost for the alternatives ranged from $1,650,000 to $25,000,000. Benefits do not exceed costs for all of the alternatives. Four of the alternatives have benefits which exceed costs. The benefit-cost ratios for the alternatives ranged from 0.13 to 4.2.

TABLE 1. SUMMARY OF ALTERNATIVE EVALUATIONS–IRRIGATION BENEFITS ONLY

Alternative	Implementation Cost	Benefits (Irrigation Only)	Objective 1	Objective 2		Cost Ratio	Objective 4 (inches)	(Average Hydrologic Conditions) (vs. Baseline)
A	$13,000,000	$1,640,000	-	NE	Smallest Increase	0.13	0.2	No Change
B	$2,000,000	$3,990,000	+	NE	Moderate Increase	2.00	0.5	No Change
C	$15,000,000	$5,500,000	+	NE	Moderate Increase	0.37	0.7	No Change
D	$3,600,000	$11,000,000	+	NE	Moderate Increase	3.06	1.5	Moderate Increase
E	$16,500,000	$11,700,000	+	NE	Largest Increase	0.71	1.6	Moderate Increase
F	$12,000,000	$15,200,000	+	NE	Largest Increase	1.27	2.2	Largest Increase
G	$25,000,000	$15,700,000	+	NE	Largest Increase	0.63	2.3	Largest Increase
H	$1,650,000	$6,960,000	-	NE	Smallest Increase	4.22	0.9	Smallest Increase
I	$14,500,000	$6,960,000	-	NE	Smallest Increase	0.48	0.9	Moderate Increase
J	$14,490,000	NE	NE	NE	Likely Decrease	NE	NE	NE
K	$6,720,000	NE	NE	NE	Likely Decrease	NE	NE	NE
L	$12,600,000	NE	NE	NE	Likely Decrease	NE	NE	NE

Objectives

Objective 1 – Minimize bypass at Superior-Courtland Diversion Dam
Objective 2 – Provide augmentation storage water for MDS
Objective 3 – Develop cost-effective solutions
Objective 4 - Provide additional water supply to Bostwick Division lands – (additional inches of water)
Objective 5 – Provide additional recreation benefits

+ = highly complies with objective
- = does not comply with objective
NE = Not Estimated or Evaluated

Alternatives

A – Courtland Canal to Design Capacity, Winterize
B – Automate, Winterize
C – Automate, Winterize, Courtland Canal to Design Capacity
D - Automate, Winterize, Raise Lovewell 16,000 ac-ft
E - Automate, Winterize, Raise Lovewell 16,000 ac-ft, Courtland Canal to Design Capacity
F – Automate, Winterize, Raise Lovewell 35,000 ac-ft.
G – Automate, Winterize, Raise Lovewell 35,000 ac-ft, Courtland Canal to Design Capacity
H - Raise Lovewell 16,000 ac-ft
I – Raise Lovewell 16,000 ac-ft, Courtland Canal to Design Capacity
J – Off-Stream Storage, Jamestown Waterfowl Management Area South Dam
K - Off-Stream Storage, Jamestown Waterfowl Management Area North Dam
L – Off-Stream Storage, Beaver Creek

TABLE 2.–SUMMARY OF ALTERNATIVE EVALUATIONS–MDS ENHANCEMENT ONLY

Alternative	*Implementation Cost*	*Benefits*	*Objective 1*	*Objective 2*	*(in MDS violations)*		*(vs. Baseline)*	*(Average Hydrologic Conditions) (vs. Baseline)*
A	*$13,000,000*	*NE*	*-*	*-*	*Small Decrease*	*NE*	*No Change*	*No Change*
B	*$2,000,000*	*NE*	*+*	*-*	*Small Decrease*	*NE*	*No Change*	*No Change*
C	*$15,000,000*	*NE*	*+*	*-*	*Small Decrease*	*NE*	*No Change*	*No Change*
D	*$3,600,000*	*NE*	*+*	*0*	*Moderate Decrease*	*NE*	*No Change*	*Moderate Increase*
E	*$16,500,000*	*NE*	*+*	*0*	*Moderate Decrease*	*NE*	*No Change*	*Moderate Increase*
F	*$12,000,000*	*NE*	*+*	*+*	*Largest Decrease*	*NE*	*No Change*	*Largest Increase*
G	*$25,000,000*	*NE*	*+*	*+*	*Largest Decrease*	*NE*	*No Change*	*Largest Increase*
H	*$1,650,000*	*NE*	*-*	*0*	*Moderate Decrease*	*NE*	*No Change*	*Smallest Increase*
I	*$14,500,000*	*NE*	*-*	*0*	*Moderate Decrease*	*NE*	*No Change*	*Moderate Increase*
J	*$14,490,000*	*NE*	*NE*	*+*	*Largest Decrease*	*NE*	*NE*	*NE*
K	*$6,720,000*	*NE*	*NE*	*+*	*Largest Decrease*	*NE*	*NE*	*NE*
L	*$12,600,000*	*NE*	*NE*	*+*	*Largest Decrease*	*NE*	*NE*	*NE*

Objectives

Objective 1 – Minimize bypass at Superior-Courtland Diversion Dam
Objective 2 – Provide augmentation storage water for MDS
Objective 3 – Develop cost-effective solutions
Objective 4 - Provide additional water supply to Bostwick Division lands – (additional inches of water)
Objective 5 – Provide additional recreation benefits

+ = highly complies with objective
0 = complies with objective
- = does not comply with objective
NE = Not Estimated or Evaluated

Alternatives

A – Courtland Canal to Design Capacity, Winterize
B – Automate, Winterize
C – Automate, Winterize, Courtland Canal to Design Capacity
D - Automate, Winterize, Raise Lovewell 16,000 ac-ft
E - Automate, Winterize, Raise Lovewell 16,000 ac-ft, Courtland Canal to Design Capacity
F - Automate, Winterize, Raise Lovewell 35,000 ac-ft.
G – Automate, Winterize, Raise Lovewell 35,000 ac-ft, Courtland Canal to Design Capacity
H – Raise Lovewell 16,000 ac-ft
I – Raise Lovewell 16,000 ac-ft, Courtland Canal to Design Capacity
J – Off-Stream Storage, Jamestown Waterfowl Management Area South Dam
K- Off-Stream Storage, Jamestown Waterfowl Management Area North Dam
L – Off-Stream Storage, Beaver Creek

Chapter III – Feasibility Study Overview

I Authority

The POS assumes that Reclamation is authorized by Congress to conduct the study and enter into a feasibility study cost-share agreement with non-Federal partners for providing water supply improvements in the Basin area. On October 2, 2003, Congressman Tom Osborne (NE) introduced H.R. 3241 which was referred to the Committee on Resources, "To authorize the Secretary of Interior to conduct a study to determine the feasibility of implementing a water supply and conservation project to improve water supply reliability, increase the capacity of water storage, and improve water management efficiency in the Basin between Harlan County Lake in Nebraska and Milford Lake in Kansas". The final legislation will be listed and described in this section when received from the Congress.

II Location of Study, Non-Federal Sponsor, and Congressional Districts

Based on the draft authorizing legislation, the study area is assumed to be located in the Basin between Harlan County Lake in Nebraska and Milford Lake in Kansas.

The non-Federal sponsors for the feasibility of the study are the States of Kansas and Nebraska.

The study area lies within the jurisdiction of the following Congressional Districts:

- 3rd District, NE – Tom Osborne
- 1st District, KS – Jerry Moran

III Prior Reports

Many reports and studies were completed during the development of the Basin over the last 60 years. Some of the more significant reports are listed below. These reports will be reviewed as a part of the initial stages of the feasibility study. The goal will be to draw key information critical in directing the feasibility study, such as problems and opportunities, planning objectives and constraints, public concerns, measures to address identified planning objectives, preliminary plans, conclusions from the preliminary screening and establishment of plan

formulation rationale. In addition, the reviews will analyze preliminary plans as well as the screening criteria used for eliminating plans, provide a rationale for the likely array of alternatives to be studied in the feasibility study and will include an analysis of resource agency views and concerns.

The Bostwick Division was authorized for construction by the Flood Control Act of 1944, Public Law 534 as part of the Missouri River Basin Project (now the Pick-Sloan Missouri Basin Program [P-SMBP]). The plan was outlined in Senate Document No. 191, and revised in Senate document No. 247, as a coordinated plan of Reclamation and the Corps.

Reports having significance to the Bostwick Division and the Basin are:

- Bostwick Division, Nebraska-Kansas, Volume 1, Parts 1, 2, 3, and 4, Definite Plan Report (DPR), Bureau of Reclamation, Region 7, Denver, Colorado, June 1953.

- Bostwick Division, Nebraska-Kansas, Volume 1, Supplement, General Plan of Development, Definite Plan Report (DPR), Bureau of Reclamation, Region 7, Denver, Colorado, April 1956.

- Republican River Basin, Water Management Study, Special Report, Bureau of Reclamation, February 1985.

- Republican River Basin Flows; Flows Adjusted to 1993 Level Basin Development, prepared by Lane, Norval, and Weghorst in the Flood Hydrology Group, Bureau of Reclamation, Technical Service Center, Denver, Colorado, October 1995.

- Resource Management Assessment (RMA), Republican River Basin, Water Service Contract Renewal, Bureau of Reclamation, Great Plains Region, July 1996.

- Repayment and Long-Term Water Service Contract Renewals for the Republican River Basin, Nebraska and Kansas, July 2000.

- Technical Assistance to States (TATS) Study, Lower Republican River, Kansas, Water Augmentation Analysis, Bureau of Reclamation, May 2002.

- Final Settlement Stipulation (FSS), Supreme Court of the United States, Kansas vs. Nebraska and Colorado, December 15, 2002.

- Value Study Report, Proposals for More Efficient Management of Lower Republican River Water Supplies, Bureau of Reclamation, Technical Service Center, Denver, Colorado, December 17, 2002.

- Volume Analysis and Revised Flood Frequency Analysis for Comprehensive Facility Review, Lovewell Dam, Bureau of Reclamation, Technical Service Center, Denver, Colorado, May 2003.

- Republican River Basin Report of Preliminary Findings, Nebraska Department of Natural Resources, May 20, 2003.

- Analysis Addressing Hydrologic/Hydraulic Issues, Lovewell Dam, Bureau of Reclamation, Technical Service Center, Denver, Colorado, September 2003.

IV Financial Considerations

After the study is authorized and funds appropriated by the Congress, a cost-share agreement with the non-Federal sponsors must be executed before the study can commence. As the non-Federal sponsors, the States of Nebraska and Kansas will be required to provide funding or in-kind services for 50 percent of the cost of the feasibility study. Cost-sharing requirements for project implementation will be discussed with the sponsors as the study progresses. Letters of intent from the local sponsors stating a willingness to pursue the feasibility study and to share in the cost and an understanding of the cost sharing are included as Enclosure G.

V The Planning Process in the Feasibility Study

The feasibility study should be responsive to the authorizing legislation, and should identify, evaluate and recommend an appropriate, coordinated and implementable solution to the identified problems and opportunities. The report should:

1. Be a complete decision document and should present the results of the appraisal and feasibility studies;

2. Provide a complete presentation of study results and findings, including those developed in the appraisal report;

3. Comprehensively evaluate those methods and alternative plans requiring additional authority;

4. Document the non-Federal sponsor cost-sharing requirements;

5. Demonstrate that sufficient alternatives were formulated and evaluated to maximize net benefits per the Principles and Guidelines and meet the requirements of NEPA; and

6. Indicate compliance with local, State, and national laws, regulations, executive orders and public policies.

- Principles and Guidelines (P & G). The feasibility study will be conducted according to the P&G. Formulation and evaluation of alternatives will follow Reclamation policy and procedures for implementing NEPA and other applicable Federal rules and regulations. The overall Federal objective for such planning is to contribute to national economic development consistent with protecting the Nation's environment. The preliminary Table of Contents for the Basin Feasibility Study is provided as Enclosure E.

- Plan Formulation. Planning objectives will be refined from those identified in the Appraisal Study based on the study authorizing language, public input and other factors. Alternatives, including potentially viable alternatives identified in the Appraisal Study and other studies, will be formulated in a systematic manner to ensure that a full range of reasonable alternatives is identified and evaluated to address problems, take advantage of opportunities, meet planning objectives and avoid constraints. If newer technology or experiences are available they will be applied in reformulation and modifying previously developed alternatives. Under the P&G, at least one alternative will be developed that maximizes net economic development benefits to the Nation (national economic benefits exceed costs). This plan is called the National Economic Development (NED) Plan. Plans that address State and local concerns or emphasize other functions such as environmental quality and other social effects may also be formulated.

- Evaluation and Comparison. Each identified alternative plan will be tested against **four criteria** to determine viability. The criteria are **completeness** (the extent to which a plan accounts for all investments or action to ensure realization of planned effects); **effectiveness** (the extent to which a plan alleviates specified problems); **efficiency** (the extent to which a plan is responsive to the most cost-effective means of alleviating specified problems while being consistent with protecting the Nation's environment); and **acceptability** (the plan is workable with respect to State, Tribal, and local entities and the public and is compatible with existing laws, regulations, and public policies). After viable alternatives are formulated they will be evaluated, compared, and displayed in up to four accounts, e.g. national economic development (NED), environmental quality (EQ), regional economic development (RED) and other social effects (OSE).

- Level of Detail. The engineering and related technical aspects of the feasibility study will be developed to the level that will provide a reliable project schedule and cost estimate which will support the appropriation ceiling to be established by the authorizing legislation. The data gathered to develop feasibility estimates, e.g., implementation costs, is therefore confined to the minimum reasonably required to support this level of detail with reasonable contingency factors and is not of sufficient detail to support specifications for construction designs.

- These implementation costs include the post authorization planning and design costs, construction costs, construction contingency costs, and operations, maintenance and replacement (OM&R) costs. They also include costs for all fish and wildlife habitat mitigation, historic and archaeological mitigation and data recovery, lands, easements, relocations, rights-of-way, disposal/borrow areas and water and mineral rights necessary to implement the project.

Existing data prepared by Reclamation or by other agencies will be sought out and used in lieu of obtaining new data whenever possible. The most economical methods of obtaining the necessary design and related data will be emphasized, consistent with a reasonable degree of accuracy and the objectives of the feasibility study. If field testing is deemed necessary, it will be confined to the recommended plan whenever possible because of cost. Any additional analyses or tests planned for the later phases of design (e.g., post authorization) for the recommended plan will be described and costs included in the project cost estimate and schedule.

VI Assumptions and Exceptions

The following assumptions provide a basis for the feasibility study which will be revisited at the initiation of the study:

- Future Without Project/No Action Condition. The No Action or Future Without condition will describe conditions that would exist in the future if no Federal solution were implemented to meet the needs in the study area. The No Action plan will serve as a base from which to measure the benefits and impacts of the various alternative plans. The planning horizon is anticipated to be year 2050. Since the primary focus of the study is water supply, the study team will review and verify previous analyses and reports such as surface and ground water studies conducted by the States and others. Activities by the States which are underway or likely to proceed in response to the FSS will be incorporated in the No Action as will possible operation and maintenance (O&M) type activities such as restoring Courtland Canal capacity and automating and

winterizing the Superior-Courtland Diversion Dam and Courtland Canal. The No Action hydrology will consider the agreement by the States that future water supply conditions and corresponding shortages to the Bostwick Divisions and flows in Kansas should not be worse than the Present Conditions (approximate year 2000).

- Study Area. It is assumed that the authorizing legislation identifies the study area as the Lower Republic Basin between Harlan County Lake in Nebraska and Milford Lake in Kansas.

- Safety of Dams (SOD) Activities. Potential dam safety issues associated with the Lovewell Dam enlargement proposals were analyzed during the Appraisal Study. A Flood Frequency Analysis was completed to determine flood peaks and volumes for floods up to a 10,000 year event. The floods were routed for the existing reservoir conditions and for the two enlarged reservoir conditions. Routings of the 10,000 year event indicate very little difference in available freeboard for the existing and modified reservoir conditions. A risk analysis to document existing versus modified reservoir dam safety risks will be performed by the Technical Service Center (TSC).

The specific changes in risk scenarios associated with an enlargement proposal will be documented. The risk analysis will address all failure modes that would be impacted by the enlargement, including risks associated with seepage and piping failure modes associated with higher reservoir water surfaces as well as risks associated with overtopping failure modes. Reclamation will pursue reasonable actions to mitigate increased risks associated with the modifications, even when the increased risks are below Reclamation guidelines for pursuing Dam Safety risk reduction actions.

- Plan Formulation. For cost estimating purposes, the feasibility study will initially consider the nine alternatives identified in the Appraisal Study plus two additional storage reservoir sites referred to as Beaver Creek and Jamestown sites.

- Start Date. A start date of 10/01/2005 is assumed.

- Cost Estimates. Costs are current through FY 2004.

- Policy Exceptions. The study will be conducted in compliance with the feasibility study authorizing legislation, the P&G, local, State and national laws, regulations, executive orders and public policies. No exceptions to established guidance and policy have been identified.

VII Potential Issues Affecting Initiation of a Feasibility Study

Continuation of this study into the cost-shared feasibility study is contingent upon an authorization and appropriation from Congress and an executed Feasibility Study Cooperative Agreement (cooperative agreement).

Some alternatives outlined in the Appraisal Study may be eligible for completion under existing Reclamation programs, such as the O&M Program, Water Conservation Field Services Program (WCFSP), or the Water 2025 Challenge Grant Program. The WCFSP provides technical and financial assistance for implementing water conservation activities through cooperative agreements or grants. The Water 2025 Challenge Grant Program is administered by Reclamation and provides local irrigation districts throughout the West with matching funds to support a variety of projects to make more efficient use of existing water supplies through water conservation.

If the sponsors successfully garner a WCFSP or Water 2025 grant from Reclamation, they and Reclamation will revisit the area's resultant needs and determine whether or not to continue with the feasibility study and/or whether an appropriate modification in scope is required.

VIII Project Area Map

A map of the study area is provided as Enclosure A.

Chapter IV – Summary Scopes of Work

I Milestones

Seven milestones are identified for the feasibility study, as follows:

F1 Initiate Study
F2 Complete Public Workshops/Scoping
F3 Preliminary Formulation Scoping Meeting
F4 Alternative Formulation Meeting (Completes Plan Formulation)
F5 Complete Public Review
F6 Final PR/NEPA document to Regional Director
F7 Commissioner Approval

II Work Tasks

Parent tasks are identified below as separate products that go into the feasibility documentation and appendices. They are the major separable elements of the activities that are keyed to separately identifiable products developed for the major feasibility study milestones above. Sub-tasks will be developed during the initial phases of the feasibility study. The parent task listing follows:

A. Hydrology Studies and Report
B. Safety of Dams and Report
C. Engineering and Design Analysis and Report
D. Reservoir Mapping
E. Socioeconomic Studies & Recreation Studies and Report
F. Fish and Wildlife Studies and Report
G. Real Property Studies and Report
H. Environmental Studies and Report
I. Fish and Wildlife Coordination Act Report
J. Cultural Resource Studies and Report
K. Public Involvement Process
L. Project Management
M. Policy, Legal and Institutional Review

III Summarized Scopes of Work

For each parent task a scope of work was developed that describes the work that is to be performed. Each scope of work describes the activities to be accomplished in narrative form and includes estimated costs. The detailed scopes of work are in Enclosure C. It should be noted that prior to completion of

Milestone F2, the study team will review all existing reports identified in Chapter III as well as other reports discovered during study start-up. See Enclosure B for more information on milestones.

In addition to review of existing information, analyses will be performed under each parent task to define the Future Without condition and develop statements of problems, opportunities, planning objectives and constraints.

The POS assumes that activities will be undertaken during plan formulation to assess alternatives for the enlargements at Lovewell Reservoir and for two downstream sites at Beaver Creek and Jamestown. The level of detail is as indicated in Chapter III, Section V e.g., to perform the minimum engineering and related technical analyses to develop a reliable cost estimate and schedule for the recommended plan with reasonable contingency factors. Cost estimates are based on fiscal year 2004 salary rates.

A. Hydrology Studies and Report $206,000

There are several other hydrology activities ongoing as the results of the Basin Negotiated Settlement of the Compact litigation. This study effort is a separate effort from the Republican River Compact Administration (RRCA) Groundwater Model, the 5-Year Running Average System Operation Study, Compact Accounting, and the Soil and Water Conservation Evaluation. If data and information are available from these efforts and they are deemed important for this study, then all efforts will be made to incorporate such data and information.

1. Future Without (No Action) ─ Hydrology studies will be performed to consider net space available in reservoirs after sediment accumulation, conversion of agricultural supplies to other demands, and water conservation and its impact on future needs. The States agree that the Future Without water supply conditions should not be worse than the Present Condition (approximate year 2000).

2. Future With ─ Alternatives will be evaluated to include coverage of such items as:

    a. Operation studies considering reservoir yield, storage allocations, diversion requirements for present and anticipated future cropping patterns, return flows, storage, instream flows, and improvements to the diversion facilities to better utilize natural flows, and fish and wildlife enhancements will be conducted in order to quantify possible benefits for alternatives being evaluated.

    b. The operation studies conducted will be limited to quantifying possible benefits and impacts for identified alternatives and are not the operation studies being conducted for the Compact Settlement that are reviewing 5-year averages for Compact accounting.

c. Water Rights. The Compact annually allocates, the entire water supply for beneficial consumptive use (BCU) in Kansas originating in the Basin downstream from the lowest crossing of the river at the Nebraska-Kansas state line. If alternatives are identified that require new state water rights the States will need to resolve these issues.

d. Compacts. The Hydrology studies will conform to the U.S. Supreme Court's May 19, 2003 approval of the December 16, 2002 Final Settlement Stipulation.

e. Fish and Wildlife impacts, including enhancements, will be evaluated.

f. Environmental and Recreation (water quality, instream flows, flat water recreation) impacts will be evaluated.

B. Safety of Dams $35,400

A risk analysis will be performed on Lovewell Dam assessing the existing condition and the incremental risk associated with raising the embankments. Studies will be completed in accordance with Reclamation's *Guidelines for Achieving Public Protection in Dam Safety Decision Making,* June 15, 2003.

C. Engineering and Design Analysis and Report $247,000

1. Future Without (No Action) –No anticipated work is required.

2. Future With – Engineering involvement in support of the feasibility study includes designs and cost estimates for plan formulation, planning/VE studies for alternative sites and for the recommended plan. Engineering and design will be conducted to determine reasonable and comparable costs for the alternatives. When a recommended plan is identified, additional work will be conducted to improve the design and accuracy of the feasibility cost estimate and schedule. Data collection, mapping and field work will be accomplished as necessary for the comparable evaluations of the identified alternatives.

D. Reservoir Mapping $50,000

Aerial photogrammetry of Lovewell Reservoir to produce 2 foot contour interval drawings. Work includes photo acquisition (1:7200 scale B&W photographs), ground control, photogrammetric mapping, production of 2 foot contour interval drawings, contact prints, and digital data on DVDs. The area involved is about 9,000 acres. Current mapping efforts being completed by the State of Kansas for the Jamestown site will be utilized to study the Jamestown alternative.

E. Socioeconomic Studies and Report $199,000

1. Future Without (No Action) – In addition to review of existing information and reports, an analysis of recreation (flat-water and in-stream) will be completed.
2. Future With – Alternatives will be developed and evaluated to meet identified needs and will include coverage of the Principles and Guidelines (P&G) items such as NED, RED, EQ and OSE. The Social-economic team members will participate in the process to identify the recommended alternative.

F. Fish and Wildlife Studies $30,000

Studies relating to fish and wildlife impacts, water and land requirements, water operations, benefits, etc. will be required.

G. Real Property Studies and Report $5,000

1. Future Without (No Action) – In addition to review of existing information and reports, an analysis of the existing publicly owned property boundaries and flowage easement lines for Lovewell Reservoir and the Jamestown site will be performed.
2. Future With – Activities will be undertaken in support of alternatives requiring real property acquisitions or flowage easements.

H. Environmental Studies and Report $110,000

1. Future Without (No Action) – In addition to review of existing information and reports, the No Action condition will be prepared to include consideration of the riverine environment, streamflows, and descriptions from other parent tasks such as T&E species, cultural resources, wildlife, wetlands and water quality.
2. Future With – Studies and analyses of environmental issues associated with alternatives will be undertaken and documented. This will also include activities relating to public involvement and NEPA document preparation.

I. Fish and Wildlife Coordination Act Report $50,000

1. Future Without (No Action) – In addition to review of existing information and reports, the USFWS will identify issues relating to wetland habitat, associated riparian and upland wildlife values at Lovewell Reservoir, and the downstream reservoir sites and overall water quality in the study area.
2. Future With – Activities will be undertaken relating to the study's recommended alternative, which will include loss of wetlands habitats, loss of associated riparian and upland wildlife habitats, effects on fisheries and effects on water quality.

J. Cultural Resource Studies and Report $20,000

1. Future Without (No Action) – In addition to review of existing information and reports, a description of the No Action condition will be prepared from a cultural resources perspective at Lovewell Reservoir and the downstream reservoir sites.

2. Future With – During plan formulation, literature searches will be conducted at all of the sites to determine reasonable and comparable cultural resource impacts and costs for the alternatives. This will include potential construction and operational impacts of alternatives including land acquisition and utility, road and recreation area relocation, borrow areas, etc. When a recommended plan is identified, fieldwork will be conducted and a resource inventory developed which will be important for signing a MOA or Programmatic Agreement with the State Historic Preservation Office (SHPO) and Indian tribes. The feasibility report will also describe activities and indicate the cost for additional surveys, mitigation and related activities to be conducted in the "advance planning/final design" phase for the recommended plan.

K. Public Involvement Process $35,000

The public involvement specialist will plan, develop and implement a process to involve the various publics that have an interest in addressing the water supply needs in the study area in compliance with NEPA regulations. This will include developing a flexible public involvement strategy to include key events such as public meetings and/or workshops, identifying important contacts, developing a process for tracking public contacts, collecting public comments, implementing and maintaining public communications (media releases, informational e-mails, telephone trees, and media management), preparing executive summaries and other reports necessary for public distribution and information, and other assistance to the study team leader and members as requested. The process will provide assurance that interested publics are identified and invited to participate in a meaningful way.

L. Project Management $79,600

This includes study management responsibilities and cost for the study team leader over a 3-year period.

M. Policy, Legal and Institutional Review $20,000

This item includes policy, legal and institutional input and review by the Regional Office at key junctures of the study. It may include a representative of the Field Solicitor's Office in Billings. This task also includes review and/or input from the States of a policy, institutional or legal nature.

Chapter V – Schedule, Organizational Responsibilities, and Cost Summary

I Study Schedule

The parent tasks and subtasks and milestones will be entered into Microsoft Project and a Gantt chart for the feasibility study.

II Organizational Responsibilities

The scopes of work represent understandings between the Area Manager and first line supervisors of functional organizations in the Area Office in Grand Island NE, Regional Office in Billings MT, Technical Service Center in Denver, CO, and the sponsors. The primary responsible organization for each parent task is identified by organization codes in Table 3, keeping in mind that Reclamation and the sponsor could likely each have responsibilities with any given parent task.

TABLE 3. ORGANIZATION RESPONSIBILITIES

Parent Task	Reclamation	Sponsor	Other
A. Hydrology Studies and Report	GPRO	NE/KS	
B. Safety of Dams	D-8300		
C. Engineering and Design Analysis and Report	D-8100		
D. Reservoir Mapping	GPRO		
E. Socioeconomic Studies and Report	D-8500		
F. Fish and Wildlife Studies	NKAO		USFWS
G. Real Property Studies and Report	NKAO		
H. Environmental Studies and Report	NKAO D-8500		
I. Fish and Wildlife Coordination Act Report	NKAO		USFWS
J. Cultural Resource Studies and Report	NKAO		
K. Public Involvement Process	NKAO	NE/KS	
L. Project Management	NKAO		
M. Policy, Legal & Institutional Review	GPRO SOL	NE/KS	

Codes

NKAO – Nebraska-Kansas Area Office
GPRO – Great Plains Regional Office (Billings)
D-8100 – Technical Service Center, Civil Engineering Services Division
D-8300 – Technical Service Center, GeoTechnical Services Division
D-8500 – Technical Service Center, Water Resources Division
SOL – Field Solicitor's Office (Billings)
NE/KS – State of Nebraska/State of Kansas
USFWS – U.S. Fish and Wildlife Service

III Funding Constraints

Funding for the first and subsequent years of the feasibility study is assumed to be unconstrained. The schedule indicates an optimum schedule based upon unconstrained funding.

IV Uncertainties in the Schedule

The study plan assumes a start date of October 1, 2005 with a 36 month study period. Assuming adequate funding is available, there appear to be no known scheduling uncertainties.

V Basis for the Cost Estimate

The feasibility cost estimate is based upon a summation of the costs that were identified for the individual parent tasks in the detailed scopes of work that are included in Enclosure C. The current year study cost without contingencies is $1,087,000.

Salary rates for current year 2004 were utilized. Assuming the major study effort will not commence until 2006, the cost estimates were adjusted to include 10 percent allowance for inflation. Appropriate contingencies are also included to deal with the uncertainty in the elements of the study. A contingency in the amount of 10 percent of the study costs is applied to the above estimate to arrive at the final estimate. The resulting total study cost including contingencies and inflation adjustment is $1,305,000.

VI Costs for Federal and Non-Federal Activities

The non-Federal sponsor must contribute 50 percent of the cost of the study and the distribution of the Federal and non-Federal costs is as shown in Table 4.

Nebraska and Kansas have agreed to equally share the non-Federal cost share portion with either cash or in-kind services.

TABLE 4. COST FOR FEDERAL AND NON-FEDERAL ACTIVITIES ($1,000'S)

	Total Cost	Federal Cost	States' Cash*	States' In-Kind*
A. Hydrology Studies and Report	206.0	103.0	48.0	55.0
B. Safety of Dams and Report	35.4	17.7	17.7	0.0
C. Engineering and Design Analysis and Report	247.0	123.5	93.5	30.0
D. Reservoir Mapping	50.0	25.0	25.0	0.0
E. Socio-economic & Recreation Studies and Report	199.0	99.5	62.0	37.5
F. Fish and Wildlife Studies	30.0	15.0	0.0	15.0
G. Real Property Studies and Report	5.0	2.5	2.5	0.0
H. Environmental Studies and Report	110.0	55.0	40.0	15.0
I FWCA** Report	50.0	25.0	25.0	0.0
J Cultural Resource Studies and Report	20.0	10.0	5.0	5.0
K. Public Involvement Documents	35.0	17.5	5.0	12.5
L. Project Management	79.6	39.8	39.8	0.0
M. Policy, Legal & Institutional Review	20.0	10.0	2.0	8.0
SUBTOTAL	1087.0	543.5	365.5	178.0
10% for Inflation	109.0	54.5	36.7	17.8
10% for Contingencies	109.0	54.5	36.7	17.8
TOTAL (rounded)	**1305.0**	**652.5**	**438.9**	**213.6**

* States' share of in-kind services and cash are proposals only and have not been finalized.
** Fish and Wildlife Coordination Act

Chapter VI – Quality Management

I Quality Management Objective

The quality management objective is to ensure that a high-quality feasibility study is undertaken encompassing all aspects of its development, including planning, engineering, hydrology, environmental compliance and other technical as well as policy and legal considerations. Quality management will be undertaken via a multi-tier quality control (QC) process and a quality assurance (QA) process to achieve a defensible PR/NEPA document that meet or exceed customer requirements and consistent with Reclamation policies, rules and regulations.

For QC, the interdisciplinary planning team will undertake the study and at key junctures functional supervisors will perform a technical check. All work will be further reviewed by qualified and disinterested peer reviewers at appropriate stages. For TSC-performed activities, the existing TSC "peer review" process will be used. Written documentation of all reviews will be developed and included in the transmittal of the draft report to the Regional Office. The Nebraska-Kansas Area Office (NKAO) Area Manager will transmit the draft report and supporting QC documentation to the Regional Office.

For QA, the Regional Planning Coordinator will ensure that QC has been adequately incorporated into the study process and that technical and peer review documentation has been developed for the study and transmitted with the draft report to the Regional Office.

II Documents to be Reviewed and Schedule for Review Activities

The process for accomplishing policy and technical review will begin with study initiation and will proceed throughout the study. Appropriate reviews will be accomplished prior to the release of materials to other study team members or integrated into the overall study process. All of the products of the tasks listed in the detailed scopes of work will be subject to review. Costs for performing technical and related peer reviews are included in the task cost estimates. Costs for Regional Office policy, legal and institutional review are included in Work Task M.

Review and comment will occur prior to two major milestone meetings in the planning process, e.g., milestones F3 and F4, so that the results can be relied upon in setting the course for further study. Policy, legal and institutional reviewers will participate as appropriate at these milestone meetings. Since this quality

control will have occurred prior to each milestone meeting, meetings are free to address critical outstanding issues and set direction for the next step of the study since a firm technical and policy basis for making decisions will have already been established.

III Process and Schedule

A. Technical and Peer Review Protocol

Functional supervisors in the TSC, Area Office and Regional Office will check work products throughout the study to confirm the proper selection and application of established criteria, regulations, laws, codes, principles and professional procedures to ensure a quality product. Review will also confirm the constructability and effectiveness of the product and the utilization of clearly justified and valid assumptions and methodologies. All work products will undergo a peer review process similar to that developed and implemented by TSC.

B. Policy, Legal and Institutional Review Team

A review team from the Regional Office and the Field Solicitor's Office will provide input and/or review comments on policy, legal and institutional considerations at key junctures of the study. The States are also assumed to be represented on this team. Reviews will be performed and comments furnished in advance of milestone F3 (Preliminary Formulation Scoping Meeting) and milestone F4 (Alternative Formulation Meeting) as well as at an intermediate point between F3 and F4 if necessary. The team will also review the Draft PR/NEPA document during the public review process.

The review team will document the comments and guidance in memoranda and transmit to the team via the Area Manager. The memoranda will be used to revise or incorporate changes to the study, to complete all required detailed analyses and prepare the draft PR/NEPA document for Regional Director signature and transmittal to the Commissioner. The Area Manager, acting through the study team leader, will be responsible for ensuring that comments and guidance identified in the memoranda are fully addressed.

IV Review Checklist

The technical, peer, policy, legal and institutional reviews conducted during the study will ensure that there is a uniform application of clearly established Reclamation-wide procedures and policy. It will also identify issues that must be resolved in the absence of clearly established criteria, guidance, regulations, laws principles and procedures or where judgment plays a substantial role. Lastly, it will minimize the time that the report is in the Regional Office before transmittal to the Commissioner.

To aid functional supervisors and other reviewers, a checklist is provided as Enclosure F.

V Roster of the Feasibility Study Team

(To be completed prior to study initiation)

Organization/Function	Name/Title	Address	Phone/e-mail
D-8000			
GPRO			
NKAO			
KANSAS			
NEBRASKA			

VI Roster of the Review Team

(To be completed prior to study initiation, including State representation)

Organization/Function	Name/Title	Address	Phone/e-mail
GPRO			
SOL			
KANSAS			
NEBRASKA			

VII Feasibility Study Quality Certification

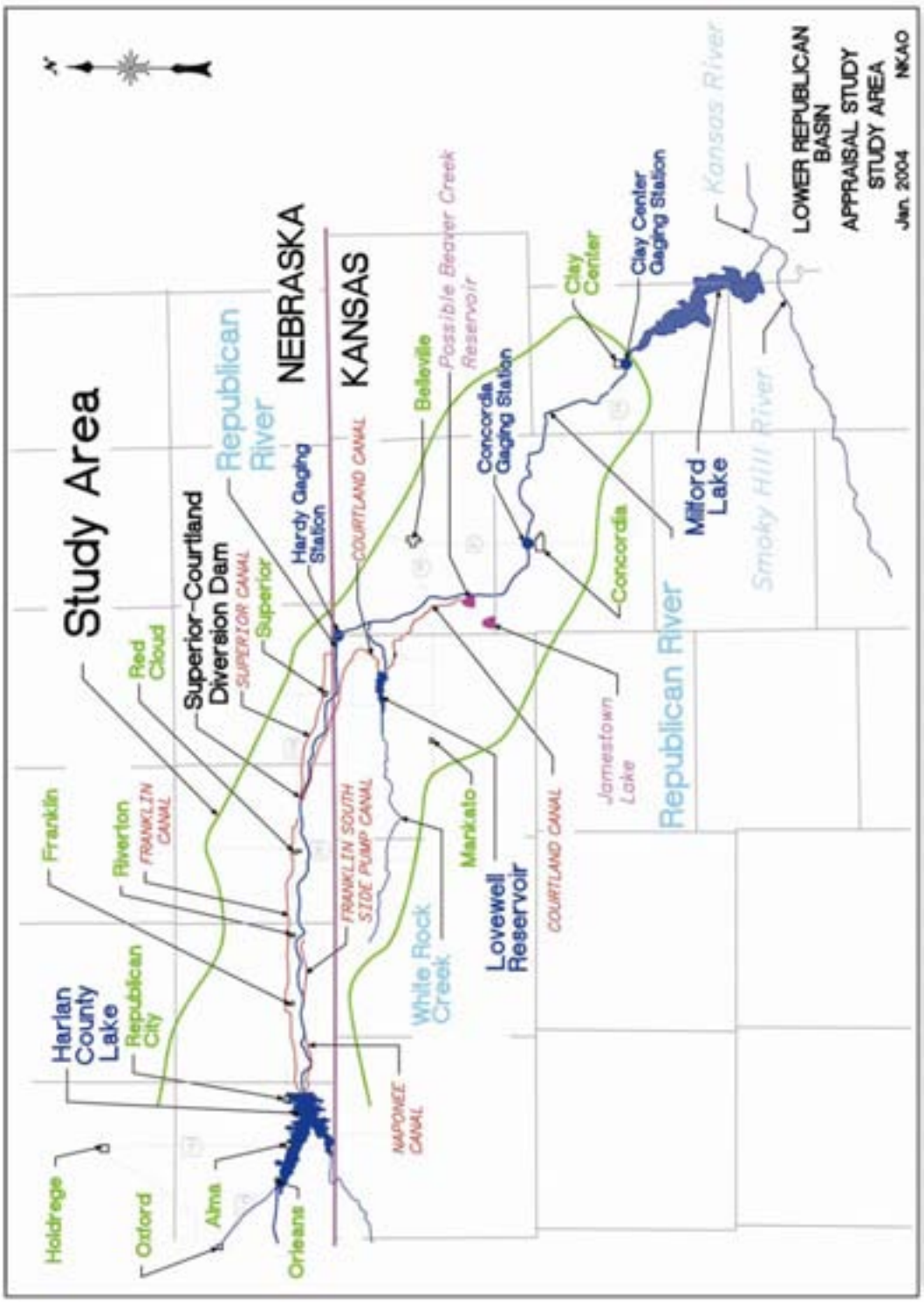
The documentation produced during the review process (technical, policy, legal and institutional) will be included with the submission of the draft PR/NEPA document to the Regional Director. The documentation will be accompanied by a certification signed by the Area Manager indicating that the review process has been completed according to the POS and that all technical, policy and legal issues have been addressed.

VIII List of Enclosures

Enclosure A	Study Area Map
Enclosure B	Milestones
Enclosure C	Scopes of Work
Enclosure D	List of Acronyms
Enclosure E	Preliminary Table of Contents
Enclosure F	Review Checklist
Enclosure G	Letters of Intent from Kansas and Nebraska

Enclosure A

Study Area Map


Study Area
NEBRASKA
KANSAS
Republican River
Harlan County Lake
Republican City
Franklin
Riverton
FRANKLIN CANAL
Red Cloud
Superior-Courtland Diversion Dam
SUPERIOR CANAL
Superior
Hardy Gaging Station
COURTLAND CANAL
Holdrege
Oxford
Alma
Orleans
NAPONEE CANAL
FRANKLIN SOUTH SIDE PUMP CANAL
White Rock Creek
Lovewell Reservoir
Mankato
COURTLAND CANAL
Jamestown Lake
Republican River
Concordia
Clay Center
Clay Center Gaging Station
Belleville
Possible Beaver Creek Reservoir
Concordia Gaging Station
Milford Lake
Smoky Hill River
Kansas River
LOWER REPUBLICAN BASIN
APPRAISAL STUDY
STUDY AREA
Jan. 2004
NKAO

Enclosure B

Feasibility Study Milestones

Milestone	Name	Description
F1	Initiate Study	This is the date Reclamation receives study funds. Assume to begin October 1, 2005
F2	Final Public Workshop/ Scoping Meeting	This is the final public workshop/scoping meeting to inform the public and obtain input, public opinions and fulfill scoping requirements for NEPA purposes. March 31, 2006
F3	Preliminary Formulation Scoping Meeting	The scoping meeting is with the study team and the policy, legal and institutional team to address potential changes in the POS, to finalize future without (No Action) project conditions, screen preliminary alternatives and ensure that the study is focused and tailored to meet the specific objectives and constraints. June 30, 2006
F4	Alternative Formulation Meeting	The Alternative Formulation Meeting (AFM) completes plan formulation. At this meeting among the study team and the Regional Office team, final plans will be evaluated and consensus reached that the evaluations are adequate to recommend a plan. The primary goal is to identify and resolve any concerns that would otherwise delay the approval of the draft report. The meeting will also address actions required to prepare and release the draft report. March 31, 2007
F5	Public Review	This milestone is the conclusion of field level coordination of the draft PR/NEPA document including review by the public and the Regional Office team. March 31, 2008
F6	Draft PR/NEPA document to RD	Date of submittal of final report package to GPRO including technical and legal certifications, compliance memoranda and other required documentation. June 30, 2008
F7	Commissioner Approval	Date of the signature. This milestone is used as the completion of the feasibility study. September 30, 2008

Enclosure C

Scopes of Work

Task A – Hydrology Studies and Report

Issues and Concerns to be Addressed

Determine extent of the existing hydrologic studies and address additional model development requirements.

Technical Service Center

Description: A yield study will be performed by personnel representing the Great Plains regional office. Output from the study will include the normal water surface elevation associated with the proposed raised embankment and dike sections. Some technical support will be provided by the TSC. Only costs associated with the technical support by the TSC are included herein.

Cost: The estimated number of staff days for this task is 8 days at skill level 3 or $6,500.

Great Plains Region

Description:

Task 1: Up-Date Data Sets for OPSTUDY Hydrologic Model

There is a need to develop hydrology data sets for the OPSTUDY model to represent future-without-project conditions. The starting point for this data set will be the 1993 level-of-development data set used for the appraisal study. That data set was developed from historic recorded monthly flows that were adjusted to reflect the impacts of development in the basin through 1993. This data set will be brought up to the most recent level using historic recorded flow data after 1993. This is based on the assumption that reduced stream flows in the basin have already resulted in the states' curtailment of additional development that may significantly reduce flows.

This data set may need further refinement for the feasibility study to reflect hydrologic impacts from any physical or administrative processes in the basin that are probable and reasonable to anticipate at the future planning horizon. This could include the effects of future sedimentation in reservoirs, and impacts from the administration of water usage to meet the Compact allocations.

- Streamflow data used in appraisal level study were based on 1931-2000 recorded data adjusted to the 1993 level-of-development in the basin. Streamflow records for the entire Basin will be extended based on most recent available data.
    - 2 staff days

- There is a need to incorporate the simulation of Federal project irrigation return flows into hydrologic model. This will require re-adjusting the previous OPSTUDY hydrology to remove the impacts of historical return flows. Hypothetical return flow patterns will need to be developed for the projects and reach gains will need to be reduced accordingly. Discussions with study partner hydrologists will be needed for methods to calculate conveyance and application losses, what percentage of those losses are anticipated to return to streams, and the pattern to distribute the return flows to the stream over time.
    - 10 staff days

- Historic trends will be reviewed to assess if the 1993 level-of-development is acceptable for usage as future level. Some of the Republican sub-basins may be showing a continued downward trend in flows from the ’93 level. If trend is still declining, then there is a need to perform a re-evaluation of regression analyses used to develop ’93 levels.
    - 5 staff days

- It is anticipated that a potential exists for future changes to the streamflow regime if States (Nebraska) administer consumptive use in the basin to meet compact allocations. The States will be contacted to provide their best estimates as to what impacts their administration procedures may have on flows. For example, Nebraska may need to run the compact’s ground-water model to provide impacts to streamflow.
    - 5 staff days

- Future sediment rates in all Basin reservoirs will need to be reviewed. Pool capacities in reservoirs will be adjusted for estimated sediment rates at designated future planning horizon.
    - 8 staff days

- The OPSTUDY model will need to be rerun with the changed pool capacities and new future level streamflow to arrive at the simulated inflows to Harlan County Lake.
    - 4 staff days

Task 2: Develop MODSIM and Inputs

There is a need to develop the MODSIM monthly time step hydrology model of the river basin for the entire Basin down to and including Milford Lake. The existing OPSTUDY model contains much of the data needed for developing a new model. Output from the present version of MODSIM needs additional processing for presenting results. MODSIM results can be imported into another program, like Excel, for processing into tables and graphs for usage in reports.

- Develop MODSIM Model from OPSTUDY Data: Multiple ownership accounts will be developed for the enlarged Lovewell Reservoir. Incorporate priority dates for various diversions and storage rights. Develop Visual Basic module code in Excel for importing MODSIM output to produce tables and graphs. Write up of model description and data sources.
    - 20 staff days

- Update Monthly Irrigation Demands to Match New Period of Record: This involves collecting climatological data and calculating CIRs. Need to determine the method that will be used for CIR calculations. The same method that was used for the contract renewal model could be used, or we could utilize CIR data developed for the RRCA settlement GW model. Irrigation demands are also a function of conveyance losses and on-farm efficiencies. There is a need to examine and determine: conveyance losses and on-farm efficiencies; demand amounts (percentages or quantities); and adjustments for water short periods.
    - 10 staff days

- Develop Demands for Flow Augmentation Releases from Non-Irrigation Pools: If there is an alternative to replace flow depletions in Kansas by groundwater pumpers, then a groundwater model will be needed to calculate these depletions. The existing groundwater model for the Lower Republican in Kansas will be reviewed to determine if it is capable to supply these depletion calculations. A determination will have to be made if Kansas can run the model and supply the demands? If a new model is needed, then considerable more time for model development can be expected.
    - 5 staff days

- Write Script for MODSIM to Simulate Harlan Consensus Operations, Simulate Milford Lake Operations, and Test: The algorithm for OPSTUY in the Appraisal Study has been developed in FORTRAN and needs to be converted to script for MODSIM. Assistance from Reclamation's Technical Service Center staff who have written script for MODSIM may be utilized in order to minimize time expended on a learning curve. There is also a need to develop Harlan County Lake 5-year running average inflows for the Consensus algorithm. These 5-year averages may come

from simulated inflows to Harlan County Lake from the OPSTUDY model. These flows will need to reflect the impacts of present and/or future level development in the basin.
  - 8 staff days

- Develop Demand Curve and write script for MODSIM to simulate Milford Lake operations. This is proposed to be a Kansas task.

- A procedure to equalize shortages to districts during periods of water supply shortages in the Basin will be needed. This will probably require writing script in MODSIM to determine the available supply at the beginning of the irrigation season and set deliveries to individual districts to maintain a balanced delivery to the farm. This is so that a uniform delivery per acre can be maintained.
  - 8 staff days

- Additional nodes will need to be added to the model as necessary in order to simulate private diversions, off-stream storage structures and conveyance systems to the storage structures. The area-capacity relationships will need to be developed for new storage structures.
  - 10 staff days

- There will be a need to develop and incorporate ground-water response functions into model to simulate groundwater-surface water interaction. This will need KS and NE assistance to provide groundwater modeling data, including depletions by alluvial well pumpers.
  - 20 staff days

Task 3: Calculate Available Natural Water Supply

The available natural water supply for flow augmentation at off-stream storage sites will need to be calculated.

- Previous studies identified potential locations for off-stream storage sites in tributaries to the Republican River in Kansas which could provide augmentation water in Kansas. However, those studies did not quantify the potential available supply or look at sizing of structures. Several of the proposed sites have some recorded flow measurements, although they may not be current. Other sites have streams with no past flow measurements. Methodologies to develop streamflow available for storage to augment streamflow will be evaluated. Methods to transpose measured flows, including drainage area ratios, basin characteristics comparisons, and correlation of flows with nearby measurement sites will be considered. Concurrent flow measurements at potential storage sites may be needed to correlate with measured data at nearby sites. In addition to water supply

for storage, flood flows will need to be assessed for design of storage structures.

- 15 staff days

Task 4: Develop Future Without Hydrology Scenario

- The affected environment will be described and the future-without-project scenario developed for the hydrology sections of feasibility/planning report. The hydrologic model simulations for future-without-project and alternatives will be performed. Results from the model will be extracted and report sections prepared describing hydrologic impacts by future-without and study alternatives. Various stages of the feasibility/planning report will be reviewed. (This estimate does not include running the model to develop project impacts for present-level conditions)
  - 35 staff days

Target Milestones (assuming that Plan Formulation is completed by 3/31/07.

	Start	Completion
Task 1 -	October 1, 2005	December 31, 2005
Task 2 -	January 1, 2006	June 30, 2006
Task 3 -	July 1, 2006	July 30, 2006
Task 4 -	Aug 1, 2006	September 30, 2006

Costs:

Task	Overall Time For Task	Resources	Unit (Days)	Cost
Task 1 – Up-Date Data Sets for OPSTUDY Hydrologic Model	10/1/05 to 12/31/05	GP-4500	34	$25,500
Task 2 – Develop MODSIM and Inputs	1/01/06 to 6/30/06	GP-4500	82	$61,500
Task 3 – Calculate Available Natural Water Supply	7/01/06 to 7/30/06	GP-4500	15	$11,250
Task 4 – Develop Future Without Hydrology Scenario	8/01/06 to 9/30/06	GP-4500	35	$26,250
Rerun Model				
Evaluate Results				
Totals				$124,500

$357,000*can be concurrent

Nebraska-Kansas Area Office

Description: NKAO would be responsible for providing input data, verifying model runs, determining that the model is working correctly and analyzing results from model runs.

Cost: The total costs are estimated to be $20,000.

States

Description: Nebraska and Kansas are responsible for providing data as indicated in the Great Plains Regional Office task descriptions as well as verifying the model and analyzing results from model runs.

Cost: Nebraska and Kansas would each provide $27,500 of in-kind services for this task.

Total Cost Task A – Hydrology **$206,000**

Task B – Safety of Dams and Report
Lovewell Reservoir Enlargements – Risk Analysis

Technical Service Center

Description: A risk analysis will be preformed to assess the existing baseline risk conditions prevailing for Lovewell Dam. Once the yield study has been completed, the results will be utilized with the existing area-capacity curves to quantify the magnitude of the embankment and dike raise required to provide approximately equal flood protection as the baseline conditions. These raise heights (on the order of 3 to 6 feet) will be utilized in conjunction with construction, geology, and performance data to assess the incremental static risk associated with raising the embankments, dikes, and spillway crest. If the risks associated with the selected raise heights are outside of Reclamation guidelines the risk analysis team will determine the likely raise configuration to establish compliance.

Factors contributing to risk at Lovewell Dam include: (i) landslides; (ii) hydrologic loading; and (iii) others. The interplay between these factors necessitates a thorough risk analysis to include personnel representing Geotechnical Engineering, Geology, and Waterways and Concrete Dams. In addition, personnel representing the regional office, area office, and O&M should attend. A risk analysis report documenting the findings and conclusions of the risk analysis team will be drafted and peer reviewed.

Cost: The estimated number of staff days for this task is presented below. The estimated cost to perform a risk analysis as described above is approximately $35,400.

Subtask Description	SD SL2	SL2 Rate (FY04)	SD SL3	SL3 Rate (FY04)
Data Collection				
Geotech	3	$696		$816
Geology			1	
Risk Analysis				
Geotech	5		5	
Geology			5	
WWCD			6	
Facilitator			5	
At-Risk Op	6			
RA Report				
Geotech	7		2	
Geology			1.5	

Great Plains Regional Office

Description: No work under this task.

Cost: NA

Nebraska-Kansas Area Office

Description: No work under this task.

Cost: NA

States

Description: No work under this task.

Cost: NA

Total Cost Task B – Safety of Dams and Report $35,400

Task C – Engineering and Design Analysis and Report

Technical Service Center

Task 1: Geotechnical Engineering and Geology

Description: Geotechnical engineering and geology will collect and perform a review of the available construction, geologic, and performance data relevant to Lovewell Dam. The collected data will be made available to the risk analysis team. The geotechnical engineer will estimate the modified embankment/dike heights and cross sections based on the results of the yield study and completed appraisal level study.

Once the available data have been reviewed and the risk analysis completed, geotechnical engineering and geology personnel will visit the dam site to evaluate likely exploration locations. Geology personnel then will draft a field exploration request (FER) to collect additional embankment, foundation, and borrow soils data required to facilitate a feasibility level design. The anticipated field exploration includes two drill holes (assumed 80-feet-deep) and up to two test pits to be logged by regional personnel.

The geotechnical engineer will utilize the results of the risk analysis to evaluate the final feasibility level top of dam elevation and develop approximately two alternatives for the raise of the embankment and dikes. Stability of a limited number of cross sections will be analyzed based on the alternatives developed. Feasibility level cost estimates for each raise alternative in compliance with Reclamation's safety of dams guidelines will be prepared.

The geologist will perform a review of available borrow sources likely to be utilized during modification work. The geologist will review and organize field exploration data and laboratory test results as they become available.

Cost: The estimated number of staff days for Task 1 is presented below. The estimated total cost to perform geotechnical and geologic analyses as described above is approximately $76,100.

Subtask Description	SD SL2	SL2 Rate (FY04)	SD SL3	SL3 Rate (FY04)
Data Collection and Review				
Geotech	10	$696		$816
Geology			4	
Site Visit (1)				
Geotech	3			
Geology			3	
Prepare FER				
Geotech	1			
Geology			5	
Establish Top of Dam Elevations				
Geotech	10		5	
Develop Raise Cross Sections				
Geotech	15		2	
Geology			5	
Slope Stability				
Geotech	10		4	
CADD Support				
Geocats	10			
Cost Estimates				
Geotech	10		4	

(1) Assumes $1,000 non-labor cost for each individual (i.e., $2,000 total)

Task 2: Hydrologic and Hydraulic Analyses

Description: An initial data review will be performed to assess studies performed to date. Personnel from the Waterways and Concrete Dams Group will participate in the feasibility study by performing a hydrologic assessment of the existing (i.e., baseline) condition in support of the risk analysis. In addition, these personnel will be performing flood routings to assist the geotechnical engineer in locating the top of dam for the raised sections to maintain the existing level of downstream flood protection during the probable maximum flood (PMF).

Modifications to the existing spillway crest structure and chute will be evaluated as necessary to accommodate the embankment raise and new water surface elevations. Personnel assigned to Task 2 will work closely with personnel from the Mechanical Branch to allow for the necessary feasibility estimate for required modifications to the existing radial gates. The cost of modifying the existing

spillway and chute will be developed for each alternative. In addition, diversion requirements during construction would be assessed.

Cost: The estimated number of staff days for Task 2 is presented below. The estimated total cost to perform hydrologic and hydraulic analyses as described above is approximately $38,400.

Subtask Description	SD SL2	SL2 Rate (FY04)	SD SL3	SL3 Rate (FY04)
Data Collection and Review / Project Management				
WWCD		$696	2.5	$816
Hydraulic Design				
WWCD	18		4	
Structural Design				
WWCD	14		1	
Optimize Layouts				
WWCD	2		1	
Cost Estimate				
WWCD	3			
Drawings/Documentation				
WWCD	7		1	

Task 3: Mechanical Systems Analyses

Description: Personnel from the Mechanical Systems Group will determine the necessity for modifications to the existing radial gates due to the proposed modifications to the existing spillway crest structure and anticipated reservoir water surface elevations. Previous analyses indicated that for a 3-foot-high crest raise a minor amount of gate modifications would be necessary. However, for a 6-foot-high spillway crest raise more significant mechanical modifications would be necessary. The personnel assigned to Task 3 would reassess the mechanical modifications necessary due to more refined modifications to the spillway crest elevations obtained during the hydraulic analyses performed during Task 2.

The necessity of mechanical modifications to the radial gates will be evaluated for each alternative developed. Construction cost estimates for this work will be developed for each alternative.

Cost: The estimated number of staff days for Task 3 is presented below. The estimated total cost to perform mechanical analyses as described above is approximately $2,800.

Subtask Description	SD SL2	SL2 Rate (FY04)	SD SL3	SL3 Rate (FY04)
Mechanical Assessment				
MEG	3	$696		$816
Cost Estimate				
MEG	1			

Task 4: Cost Estimating

Description: Feasibility level cost estimates will be developed for each alternative developed.

Cost: The estimated number of staff days and for Task 4 is presented below. The estimated total cost to develop feasibility level cost estimates as described above is approximately $4,300.

Subtask Description	SD SL2	SL2 Rate (FY04)	SD SL3	SL3 Rate (FY04)
Cost Estimating				
Estimating Group	5	$696	1	$816

Task 5: Laboratory Soils Testing

Description: A limited amount of laboratory soils testing will be included during the feasibility study. Relatively undisturbed samples will be collected during the field exploration work and borrow site investigations. Soils testing for the identified fine-grained borrow areas and anticipated embankment materials would consist of: (i) compaction; (ii) gradations; and (iii) CU' triaxial tests. Soils testing for the identified coarse-grained borrow areas would consist of: (i) compaction; (ii) gradations; (iii) index testing; and (iv) relative density.

The estimated (FY04) cost for laboratory soils testing is approximately $8,300. The estimated cost for drilling and test pit excavation is approximately $59,200.

Summary of Cost: The total Technical Service Center cost for Tasks 1 through Task 5 is $189,100.

Great Plains Regional Office

Description: The Great Plains Regional Office would provide peer review and consultation services for the design data package and engineering report, along with the technical review of the reservoir mapping contract.

Cost: The total estimated cost is $12,000.

Nebraska-Kansas Area Office

Description: The Nebraska-Kansas Area Office would provide design data for feasibility level design and cost estimate, including the assembly of the required field data, preliminary design criteria, the work requirements, and other required information and data.

Cost: The total estimated cost is $15,900.

States

Description: The states would provide support for technical review and analysis of the results.

Cost: Nebraska and Kansas are each to provide $15,000 of in-kind services.

Total Cost Task C – Engineering Design and Analysis $247,000

Task D – Reservoir Mapping

Technical Service Center

Description: No work on this task is to be performed by TSC.

Cost: NA

Great Plains Regional Office

Description: Aerial photogrammetry of Lovewell Reservoir to produce 2 foot contour interval topography. Work includes photo acquisition (1:7200 scale B&W photographs), ground control, photogrammetric mapping, production of 2 foot contour interval drawings, contact prints, and digital data on DVDs. The area involved is about 9,000 acres. The cost estimate includes support for the contracting officer. For the downstream Reservoir Sites, it is assumed there is no requirement for additional mapping.

Cost: The total cost is estimated to be $49,000.

Nebraska-Kansas Area Office

Description: Nebraska-Kansas Area Office would provide the statement of work, field data, and technical review of the map product.

Cost: The total cost is $1,000.

States

Description: No work will be performed by the States under this item.

Cost: NA

Total Cost Task D – Reservoir Mapping **$50,000**

Task E – Socioeconomic Studies and Report

Technical Service Center

Description: Economics

Task	Staff Days		Labor	Non Labor	Total
	SL2	SL3			
1. Agriculture	40		$27,840		$27,840
2. Recreation		75	$61,200		$61,200
3. Regional		50	$40,800		$40,800
TOTAL	**40**	**125**	**$129,840**		**$129,840**

Social And Environmental Justice

Identify and analyze significant social and environmental justice impacts associated with a range of alternatives for improving water supply for the Basin.

Task Detail:

- Describe existing and future social and environmental justice conditions for the immediate study area and any other identified impact areas for the period of analysis. Initial social and environmental justice issues and concerns will be identified during scoping. Additional issues and concerns may be identified as the study progresses.

- Prepare social and environmental justice impact analysis (environmental consequences) of alternatives (comparison of action alternatives to the no action alternative). Assist in preparation of the Other Social Effects Account (OSE), i.e., analyses prepared by others may also be included in the OSE. Results of scoping, public involvement activities and regional economic analyses will be used to identify additional social and environmental justice impacts. Social and environmental justice impacts may also occur outside the immediate study area. Work will be coordinated with Economics and other disciplines to avoid duplication of effort.

- Participate in team meetings and plan formulation and evaluation activities. Review draft reports and respond to comments.

- Prepare information for inclusion in the PR/NEPA compliance document. No formal appendix will be prepared.

Task	Staff Days		Labor	Non Labor	Total
	SL2	SL3			
1. Affected Environment/Existing Conditions	10		$6,960		$6,960
2. Environmental Consequences/Impact Analysis	10		$6,960		$6,960
3. Team meetings, plan formulation, and evaluation activities	10		$6,960	$3,000	$9,960
4. Peer review, review drafts, respond to comments	10		$6,960		$6,960
TOTAL	**40**		**$27,840**	**$3,000**	**$30,840**

Great Plains Regional Office

Description: No work is anticipated by GPRO.

Cost: NA

Nebraska-Kansas Area Office

Description: The Nebraska-Kansas Area Office will provide field and office data support and consultation.

Cost: The estimated cost is $800.

States

Description: The State will provide technical review and analysis of the report.

Cost: Nebraska is expected to provide $18,700 of in-kind services and Kansas is to provide $18,800 of in-kind services.

Total Cost Task E – Socioeconomic Studies and Report $199,000

Task F – Fish and Wildlife Studies

This task is in addition to the Fish and Wildlife Coordination Report as detailed under Task I.

Technical Service Center

Description: No work for this task is expected by TSC.

Cost: NA

Great Plains Regional Office

Description: Provide technical support and report review.

Cost: The total cost is estimated to be $5,000.

Nebraska-Kansas Area Office

Description: Future Without (No Action) ─ In addition to review of existing information and reports, identify issues relating to wetland habitat, associated riparian and upland wildlife values at Lovewell Reservoir, and the Jamestown site and overall water quality in the study area.

Future With ─ Activities will be undertaken relating to the study's alternatives, which will include loss of wetlands habitats, loss of associated riparian and upland wildlife habitats, effects on fisheries and effects on water quality

Cost: The total cost is estimated to be $10,000.

States

Description: The State will provide data and information support, technical analysis, and peer review.

Cost: Nebraska and Kansas are expected to each supply $7,500 in in-kind services.

Total Cost Task F ─ Fish and Wildlife Studies $30,000

Task G ─ Real Property Studies and Report

Issues/Concerns

Work involves reservoir enlargements and/or downstream reservoirs. Verify the need for real property land acquisitions including boundary line adjustments and determine need for flowage easements.

Technical Service Center

Description: No work is expected from TSC.

Cost: NA

Great Plains Regional Office

Description: Provide technical support and report review.
Cost: The GPRO cost is estimated to be $2,000.

Nebraska-Kansas Area Office

Description: The Nebraska-Kansas Area Office will perform record searches and determine acquisition boundaries, and prepare report section.

Cost: The NKAO cost is estimated to be $3,000.

States

Description: No work is expected by the States.

Cost: NA

Total Cost Task G – Real Property Studies and Report $5,000

Task H – Environmental Studies and Report

Issues/Concerns

1. Cultural Resources: Effects of increased water elevations and bank cutting on cultural resources

2. Lands/Real Property Interests: Determine the need to acquire additional lands interest, including flood easements, as a result of enlargements and higher water surfaces at storage or impoundment facilities.

3. Recreation: Changes in Points of Diversion and stream flows that affect fishery habitat, recreation, water quality, and impact to existing facilities due to dam enlargements.

4. Socioeconomic impacts: Effects on downstream agricultural interests and growth.

5. Streamflow changes: Streamflow changes as they affect other resources.

6. Threatened and Endangered Species: If the FWS determines that there are listed threatened and/or endangered species or critical habitat that could potentially occur in the project area, the action agency must then prepare a biological assessment (BA) to determine whether the proposed action may affect a listed species. The BA will state whether there is a "no affect" or "may affect" for each species on the list. After the Service reviews the BA, they must determine whether they concur with the action agency's conclusion. A "may affect" determination results in the action agency consulting with the Service.

7. Wildlife: effects on avian nesting species and other species that are affected by changes in operation and enlargements. Determine this thru Fish and Wildlife Coordination Act (FWCA).

8. Wetlands: Effects on wetlands as a result of decreased flows and wetlands in and adjacent to enlarged reservoirs as a result of flooding.

9. Water Quality: Effects on water quality in the river as a result of altered flow regimes.

Technical Service Center

Description: The Resource Manager for this effort will be responsible for the preparation of the Draft and Final Feasibility Report and NEPA Compliance Document and all associated coordination activities of those providing input into that process. Work activities and associated expenditures will be monitored and controlled to the extent possible to ensure that the products are provided on time and within budget. All work commitments and products will receive the proper review and peer review. Specific tasks include the development of a schedule and major milestones for completion of the NEPA document, development of the Purpose and Need statement, the identification of issues for evaluation in the NEPA document, and development of a reasonable range of alternatives.

Task Detail:

- Service agreements between the TSC and the NKAO will be developed and modified as needed in accordance with the needs of the study.

- Work accomplishments of individual technical disciplines will be tracked in relation to expenditures to ensure that study progress is being achieved efficiently. Problem areas will be identified early and discussed with TSC staff and NKAO staff as necessary to develop an acceptable solution.

- Coordination with NKAO staff and other participants will occur on a periodic basis through e-mail, phone calls, conference calls, and meetings when needed to monitor study progress and discuss study accomplishments and problems or concerns.

- The development of a final purpose and need statement, goals and objectives, criteria for alternative development, and alternatives for the proposes project will be coordinated with NKAO and TSC staff as well as other participants as appropriate.

- All documents produced as part of this study will be reviewed to ensure that they meet all requirements in accordance with purpose and need, goals, and objectives of the project.

Task	Staff Days		Labor	Non Labor	Total
	SL2	SL3			
1. Develop service agreements and modify as needed.	1	2	$2,328		$2,328
2. Track work accomplishments and expenditures.	2	1	$2,208		$2,208
3. Coordinate with NKAO and other participants.	2	4	$4,656		$4,656
4. Coordinate and participates in the development of a final purpose and need statement, goals and objectives, and alternative formulation for the project.	3	7	$7,800		$7,800
5. Ensure that all documents meet project requirements in accordance with purpose and need, goals, and objectives of the project.	2	4	$4,656		$4,656
TOTAL	**10**	**18**	**$21,648**		**$21,648**

Cost: The estimated cost is $21,600.

Great Plains Regional Office

Description: The Great Plains Regional Office will provide staff technical support and review of the NEPA document.

Cost: The estimated cost is $30,000.

Nebraska-Kansas Area Office

Description:

Task
Complete draft study reports to address issues identified, but not addressed in the PR Technical Reports
Preliminary Draft NEPA document/Feasibility Study (FS) for internal agency review
Preliminary NEPA document/FS - agency comments/revisions
Distribute NEPA document/FS for public review/comment, public hearings
Incorporate/respond to NEPA document/FS comments (finalize documents)
Prepare and sign NEPA document - Distribute copies

Cost: The estimated cost is $43,400.

States

Description: Kansas will provide technical support and assist FWS in performing some of the activities and review report.

Cost: Kansas is expected to provide $15,000 of in-kind services

Total Cost Task H – Environmental Studies and Report $110,000

Task I – Fish and Wildlife Coordination Act Report

Anticipated Fish and Wildlife Related Issues

Certain plant and animal surveys can only be accomplished during certain times of the year. It is assumed the activities listed below will be performed for the recommended alternative only.

	Activity
1.	Mapping and quantifying riparian, wetland, and other wildlife habitat types that would be affected by the new maximum water surface elevations The Jamestown area will be provided by Kansas.
2.	Modeling necessary to predict frequency of flooding of additional areas that will be affected by re-operation and increased elevations. (Accomplished under Task A)
3.	Models to show changes in stream flow regime of the River and other tributaries affected by enlargement.(Accomplished under Task A)
4.	Analysis of increased fishing demand as a result of enlarged reservoirs and development of mitigation. Kansas will provide assistance.
5.	Survey new areas for listed or sensitive species- Data partially available through contract renewal process.
6.	Transfer funding to FWS for FWCA work (includes accomplishment of above work)

Description: The above listed work and preparation of the report would be completed by FWS.

Cost: This report is expected to cost $50,000. Cost is reflected under Nebraska-Kansas Area Office's portion of the work.

Total Cost Task I – FWCA Report **$50,000**

Task J – Cultural Resource Studies and Report

Technical Service Center

Description: No work is expected by TSC.

Cost: NA

Great Plains Regional Office

Description: No work is expected by GPRO. Technical support provided by Regional Office is addressed under Task H.
Cost: NA

Nebraska-Kansas Area Office

Description:

Task
Inventory of affected resources
Research and write NEPA Cultural Resources sections
Write agreement on effects of project
Consultation on NEPA, Section 106 with State Historic Preservation Officer, Advisory Council on Historic Preservation and Tribes
Inventory of affected resources
Research and write NEPA Cultural Resources sections
Write programmatic agreement on effects of project
Consultation on NEPA, Section 106 with State Historic Preservation Officer, Advisory Council on Historic Preservation and Tribes

Cost: The expected cost is $15,000.

States

Description: Provide technical support and report review.

Cost: Kansas is expected to provide $5,000 of in-kind services.

Total Cost Task J – Cultural Resource Studies and Report $20,000

Task K – Public Involvement

The public involvement specialist would plan, develop and implement a process to involve the various publics that have an interest in the water supply needs in the study area. Public involvement action will be in compliance with NEPA regulations.

Technical Service Center

Description: No work by TSC is anticipated.

Cost: NA

Great Plains Regional Office

Description: The Great Plains Regional Office will provide technical staff support and assistance.

Cost: The estimated costs are $5,000.

Nebraska-Kansas Area Office

Description:

Task Detail

1. Develop a flexible, evolving public involvement strategy. Identify key events, e.g., public meetings, workshops, promotional opportunities; identify important contacts; develop process for tracking public contacts, etc. Provide assistance, strategies, etc., to team leader and members as requested.

2. Establish and maintain ongoing rapport with local communities to include responding to day-to-day inquiries in support of NEPA

3. Identify publics to assure all probable interested publics are identified, informed and invited to participate in the study. Develop and maintain a mailing list.

4. Plan public meetings.

5. Conduct public meetings.

6. Collect public comments.

7. Prepare public involvement and public comments summaries.

PUBLIC INVOLVEMENT	Staff Days			Labor	Non-Labor	Fees	Total
	L1	L2	L3				
Develop and revise public involvement strategy.							
Establish and maintain rapport							
1. Identify publics; develop and maintain mailing list.							
2. Plan public meetings							
3. Conduct public meetings							
4. Process public comments							
5. Prepare public involvement and public comments summaries							
Paid public notices							
Court reporter							
Facility rental fees							
TOTALS							

Public Involvement Documents

As required under the NEPA, Reclamation will make a diligent effort to inform and involve the public as it conducts the feasibility study.

The first step in the process will be to make a good-faith effort to identify interested and affected publics. Reclamation's public involvement plan can be built upon previous public relations work already undertaken in the area. Reclamation will also continue its cooperative working relationship with the States in public involvement.

The first step in the public involvement process will be scoping. Scoping is the process used to ask interested publics to help identify significant issues related to the proposal. It may include purchased public notices via the media, news releases, e-mail notifications, website development, public meetings and/or workshops and other public involvement techniques. This process will also help further identify interested and affected publics and how to keep them informed.

As alternatives are developed and evaluated, there will be other opportunities to seek public input. This may come through soliciting comments on environmental documents and additional public forums at which the public may seek information and make comments. The level and type of public involvement at this stage is normally a function of public interest in the study and the level of controversy associated with the issues.

Another step in the public involvement process will occur as environmental documents are released in draft. News releases and media management, public notices through the media, public meetings, and other public involvement methods may be used to assure sufficient opportunity is provided to make comments.

Cost: The estimated costs are $17,500.

States

Description: The State will provide support and assistance in coordination and conduct public involvement activities, especially public meetings.

Cost: Nebraska is expected to provide $6,300 of in-kind services and Kansas is expected to provide $6,200.

Total Cost Task K – Public Involvement **$35,000**

Task L – Project Management

Technical Service Center

Project Coordination

Description: Technical project coordination will be performed by the assigned principal engineer. Project coordination will include meetings, conference calls, and providing guidance to personnel assigned to each task. In addition project coordination will include drafting a service agreement and tracking progress.

Cost: The estimated number of staff days for project coordination is 40 SD at SL2 is $27,840. The estimated cost for project coordination does not include funding for travel to meetings held outside the Technical Service Center in Denver. Some of the TSC costs of project management are described and included in Items E and H.

Great Plains Regional Office

Description: The Great Plains Regional Office will provide technical support and policy guidance to the Area Office and study team.

Cost: The estimated cost is $24,000.

Nebraska-Kansas Area Office

Description: The Nebraska-Kansas Area Office will provide team leader for overall project coordination and administration activities.

Cost: The estimated cost is $27,800.

States

Description: No work is expected.

Cost: NA

Total Cost Task L – Project Management **$79,600**

Task M – Policy, Legal and Institutional Review

The team will provide input and/or reviews at key junctures of the study. The makeup of the team is envisioned to include representatives from the Regional Office, from the Field Solicitor's Office in Billings and from each of the States. This team will help insure that the policy, legal and institutional aspects of the study are adequately incorporated. The work is likely to include conformance with P&G, NEPA, Administration and Reclamation policy and Reclamation Law.

The team will insure that alternatives, including potentially viable alternatives identified in the appraisal study, are formulated in a systematic manner to ensure that a full range of reasonable alternatives are identified and evaluated. They will also insure that at least one alternative is developed that maximizes net economic development benefits to the Nation (national economic benefits exceed costs), e.g., the NED Plan. They will also insure that plans that address State and local concerns or emphasize other functions such as environmental quality and other social effects are also formulated as appropriate. They will review, provide input to and concur in the No Action/ Future Without condition A as described in milestone F3

The team will also insure that each identified alternative plan will be tested against four criteria to determine viability. The four criteria are: completeness (the extent to which a plan accounts for all investments or action to ensure realization of planned effects); effectiveness (the extent to which a plan alleviates specified problems); efficiency (the extent to which a plan is responsive to the most cost-effective means of alleviating specified problems while being consistent with protecting the Nation's environment); and acceptability (the plan is workable with respect to State, Tribal, and local entities and the public and is compatible with existing laws, regulations, and public policies).

After viable alternatives are formulated the team will insure that they are evaluated, compared, and displayed. While only the national economic development (NED) account display is required to indicate changes in the economic value of the national output of goods and services, the environmental quality (EQ) account, the regional economic development (RED) account and the other social effects (OSE) account may also be displayed if doing so will better illuminate the decision process.

Great Plains Regional Office and Field Solicitor's Office

Description: The Great Plains Regional Office will provide representatives to serve on the policy, legal and institutional team.
Cost: The estimated cost is $10,000.

Nebraska-Kansas Area Office

Description: The Nebraska-Kansas Area Office will provide project coordination and support.

Cost: The estimated cost is $2,000.

States

Description: It is assumed that the States will each provide a representative to serve on the team.

Cost: Nebraska and Kansas are each expected to provide $4,000 of in-kind services and $1,000 in cash.

Total Cost Task M- Policy, Legal, and Institutional Rev. $20,000

Summary

The following table shows the summary of task costs:

SUMMARY OF TASK COSTS
LOWER REPUBLICAN RIVER BASIN FEASIBILITY STUDY
(UNIT – $1,000)

Task	Total Cost	Federal Cash	Nebraska Cash	Kansas Cash	Nebraska In Kind	Kansas In Kind	Total Cash	NKAO	GPRO	TSC
A – Hydrology	206.0	103.0	24.0	24.0	27.5	27.5	151.0	20.0	124.0	6.5
B – Safety of Dams	35.4	17.7	8.8	8.9	0.0	0.0	35.4	0.0	0.0	35.4
C – Engineering and Design	247.0	123.5	46.8	46.7	15.0	15.0	217.0	15.9	12.0	189.1
D – Reservoir Mapping	50.0	25.0	12.5	12.5	0.0	0.0	50.0	1.0	49.0	0.0
E – Socioeconomic Studies and Report	199.0	99.5	31.0	31.0	18.7	18.8	161.5	.0.8	0.0	160.7
F – Fish and Wildlife Studies	30.0	15.0	0.0	0.0	7.5	7.5	15.0	10.0	5.0	0.0
G – Real Property Studies and Report	5.0	2.5	1.2	1.3	0.0	0.0	5.0	3.0	2.0	0.0
H – Environmental Studies and Report	110.0	55.0	27.5	12.5	0.0	15.0	95.0	43.4	30.0	21.6
I – Fish and Wildlife Coordination Act Report	50.0	25.0	12.5	12.5	0.0	0.0	50.0	50.0	0.0	0.0
J – Cultural Resource Studies and Report	20.0	10.0	5.0	0.0	0.0	5.0	15.0	15.0	0.0	0.0
K – Public Involvement	35.0	17.5	2.5	2.5	6.3	6.2	22.5	17.5	5.0	0.0
L – Project Management	79.6	39.8	19.9	19.9	0.0	0.0	79.6	27.8	24.0	27.8
M – Policy, Legal and Institutional Review	20.0	10.0	1.0	1.0	4.0	4.0	12.0	2.0	10.0	0.0
Subtotal	1087.0	543.5	192.7	172.8	79.0	99.0	909.0	206.4	261.5	441.1
+/-10% for Inflation	109	54.5	19.4	17.3	7.9	9.9	91.2	20.7	26.3	44.2
+/-10% for Contengencies	109	54.5	19.3	17.4	7.9	9.9	91.2	20.7	26.3	44.2
Total	1305	652.5	231.4	207.5	94.8	118.8	1091.4	247.8	314.1	529.5

Notes: NKAO costs include FWCA Report; Estimates are based on FY 04 Salary Rates; States shares of in-kind services and cash are preliminary proposals. Sept. 22, 2004

Enclosure D

List of Acronyms

List of Acronyms

ac-ft	acre-feet
AFM	Alternative Formulation Meeting
BA	Biological Assessment
the Basin	Lower Republican River Basin
BCU	Beneficial Consumptive Use
the Compact	Republican River Compact
Corps	U.S. Army Corp of Engineers
DPR	Definite Plan Report
EA	Environmental Assessment
ESA	Endangered Species Act
EQ	environmental quality
FS	Feasibility Study
FSCA	Feasibility Study Cooperative Agreement
FSS	Final Settlement Stipulation
FWCA	Fish and Wildlife Coordination Act of 1958
FWS	Fish and Wildlife Service
FWS/USFWS	U.S. Fish and Wildlife Service
FY	Federal Fiscal Year
GPRO	Great Plains Regional Office, Billings Montana
KBID	Kansas Bostwick Irrigation District No. 2
MDS	Minimum Desirable Streamflow
NA	Not Applicable
NED	National Economic Development
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NKAO	Nebraska-Kansas Area Office

NRD	Natural Resources District
O&M	operation and maintenance
OM&R	operation, maintenance and replacement
OSE	other social effects
P&G	Economic and Environmental Principles and Guidelines for Water Related Land Resources Implementation Studies
PMF	Probable Maximum Flood
POS	plan of study
P-SMBP	Pick-Sloan Missouri Basin Program
PR	Planning Report
PR/NEPA	Planning Report / National Environmental Policy Act
QA	Quality Assurance
QC	Quality Control
RD	Regional Director
Reclamation	Bureau of Reclamation
RED	regional economic development
RMA	Resource Management Assessment
RRCA	Republican River Compact Administration
SHPO	State Historic Preservation Office
SOL	Field Solicitor's Office, Billings, Montana
the States	Colorado, Kansas, and Nebraska
Study	Appraisal Study
TATS	Technical Assistance to States
TSC	Technical Service Center

Enclosure E

Preliminary
Table of Contents

Suggested Content: PR/NEPA document (assuming EA/FONSI)

Feasibility studies are detailed investigations specifically authorized by law to determine the desirability of seeking congressional authorization for implementation. Feasibility studies cannot begin until specifically authorized in accordance with the Federal Water Project Recreation Act (Public Law 89-72, Section 8; Stat. 217). While appraisal studies use existing data, feasibility studies include additional data collection and analyses to develop and consider a full and reasonable range of alternatives. Feasibility studies must be consistent with the P&G and NEPA.

Feasibility studies are normally integrated with National Environmental Policy Act (NEPA), Endangered Species Act (ESA), National Historic Preservation Act (NHPA), and other related environmental and cultural resource laws and compliance requirements. These combined analyses culminate in an integrated Planning Report/NEPA compliance document. Also see <http://www.usbr.gov/recman/cmp/cmp05-02.htm>.

Table of Contents
Summary

Chapter 1. Introduction

Location of potential project
Study purpose, scope, and objectives
Study authority
Public involvement/scoping (include cooperating agencies)
Previous studies of the project area by Reclamation or others
Relationship of other water and related resources activities to our study

Chapter 2. Need for Action

This chapter defines the problems, needs, and opportunities and resulting planning objectives and constraints toward which plan formulation is directed. This chapter also addresses needs associated with National, State, and local concerns and clearly defines the problem in each category and the resource needs to solve the problem.

This chapter should state problems, needs, and opportunities for both current and future conditions.

Chapter 3. Resources, Opportunities, and Constraints

This chapter provides a general discussion of present and future conditions in those resource categories that have a bearing on the formulation of plans to address the identified needs. This chapter should cite physical, statutory, social, institutional, and environmental opportunities and constraints that limit the capability of the resources to meet needs.

Chapter 4. Alternatives

Alternative formulation

Recommended plan

- Overview of plan concept
- Plan accomplishments
- Plan description
- Project costs
- Economic and financial analysis
  - Discuss National Economic Development evaluation, cost allocation, and cost sharing. Also describe non-Federal interest and participation in project funding.
- Environmental acceptability
  - Briefly discuss, since supporting analyses are included in the Environmental Quality Account and Environmental consequences discussion.
- Social acceptability
  - Briefly discuss, since supporting analyses are included in the Social Account and environmental consequences discussions.
- Actions and permits

Other viable alternatives

No Action Alternative

- Explain that this alternative serves as the basis for determining the effects of all viable alternatives.

Comparative evaluation and plan selection (include Recommended Plan, other viable alternatives, and No Action Alternative). Evaluate each alternative on a number of parameters, e.g., economic, environmental, social, legal, institutional, and technical.

1. Include a comparative four-account display consisting of the National Economic Development, Environmental Quality, Regional Economic Development, and Social evaluations, as appropriate. The NED account is the only mandatory display. The evaluations must be consistent with and supported by the environmental consequences analysis.

2. Include a comparative discussion of responsiveness of alternatives (tests of viability) in instances where these factors influence plan selection. The tests of viability are acceptability, effectiveness, efficiency and completeness.

3. Provide the rationale for selecting the Recommended Plan.

Other Plans Considered (eliminated as viable alternatives)

Chapter 5. Affected Environment and Environmental Consequences

Note: For a Feasibility Report, note only the Potential Effects of Alternatives
Setting
Water resources
Fish and wildlife
Recreation
Other resources, if they are issues
Endangered species
Economics
Social environment
Cultural resources
Indian trust assets
Environmental justice

Chapter 6. Consultation and Coordination

Public involvement
- Scoping process
- Public meetings

Fish and wildlife consultation
- Endangered Species Act, Section 7
- Fish and Wildlife Coordination Act

Cultural resources consultation
Issues to be resolved and areas of controversy
Other agency consultation
Executive Orders

Distribution List

List of Preparers

Environmental Commitments

Glossary

Bibliography

Acronyms and Abbreviations

Index

Attachments

Fish and Wildlife Coordination Act Report and Responses to Recommendations
Others as appropriate

Lists of Figures and Tables

Enclosure F

Review Checklist

Review Checklist

Items that will be considered during the reviews include the following:

A. Formulation

1. Will alternatives function safely, reliably, and efficiently, and are they engineeringly sound?

2. What is the future without-project (No Action) condition and what are the assumptions upon which it is based?

3. Are the key assumptions underlying the predicted with-project conditions documented and justified as the most likely parameters?

4. What alternatives, including different performance levels, have been considered?

5. What is the rationale for screening out the alternatives that were not selected for implementation?

6. What beneficial and adverse effects have been evaluated for the alternative plans studied in detail?

7. Does risk and/or uncertainty inherent in the data or in the various assumptions of future economic, demographic, social, and environmental trends, have a significant effect on plan formulation?

8. What coordination has occurred with State, local, and Federal agencies and how have their views been considered in formulating the recommended plan?

B. Recommended Plan

1. Is the recommended plan the NED (or most cost effective) plan?

2. If a departure from the NED (or most cost effective) plan is being recommended, what is the rationale to support the recommended departure?

3. How do the benefits and costs of the NED (or most cost effective) plan compare to other candidate plans?

4. Are there any interstate implications of the project, and if so, how have they been addressed?

5. Are there any legal or institutional obstacles to project implementation, and if so, how have they been addressed?

6. Does the Federal Power Marketing Agency indicate the marketability of the power produced for the recommended plan?

C. Economic Feasibility

1. What discount rate, price level, and amortization period were used to determine annual benefits and costs?

2. What procedures were used to evaluate NED benefits?

3. What are the bases for the economic projections?

4. What separable features have been incrementally economically evaluated, and what are the separable B/C ratios?

5. Have all anticipated project outputs, monetary and non-monetary, positive and negative, been included in the economic evaluation? If not, what outputs were omitted and why?

6. What is the B/C ratio of the project and separable elements based on existing benefits?

7. What contingency allowances were used for major cost items and what is the basis for them?

8. What engineering and design, and supervision and administration charges were included in the estimate, and what is the basis for them?

9. What items are included in annual OM&R costs, and how were they developed?

10. Was interest during construction documented?

D. Environmental Evaluation

1. What studies and coordination were conducted in accordance with NEPA and other applicable environmental laws?

2. What studies were conducted to determine if there are potential or actual contaminated lands (hazardous and toxic wastes, pollutants, etc.) included in the land requirements?

3. What preservation, conservation, historical, and scientific agencies and interests were consulted, what were their views, and how were their views considered during plan formulation?

4. What incremental analysis was performed to determine the scope of the fish and wildlife mitigation plan?

E. Environmental Design Considerations

1. Is the project designed to be in concert with the environment and the sponsor and public's views concerning the environment?

2. Overall, is this project environmentally sound? To what degree does this project add or detract from the environment?

F. Engineering

1. Is there an engineering appendix to the planning report?

2. Does the report document that the cost estimate will remain relatively stable based on the engineering effort in the appendix?

3. Does the report document the design with clear references and assumptions?

4. Have design criteria for the project been established and do they include functional requirements, local sponsor requirements, technical design, and environmental engineering considerations?

5. If appropriate, has the Corps been contacted to determine requirements for permits for any structures to be constructed or relocated over a navigable waterway?

6. Does the engineering appendix provide a comprehensive discussion and complete documentation of the envisioned design?

G. Hydrology and Hydraulics

1. Is the analysis based on current hydraulic, hydrologic, and climatic data?

2. Does the report provide the hydraulic and hydrologic studies necessary to establish channel capacities, structure configurations, freeboard, ability to safely pass the PMF, etc?

3. Have physical and/or numerical modeling been performed? If modeling or other studies are not to be performed, is the rationale for omitting these efforts documented and has the appropriate approval been obtained?

H. Surveying and Mapping

1. Does the report provide topographic or other maps to support the level of detail required to eliminate possibility of large quantity errors?

2. Has the report met Reclamation's requirements for Geospatial Data and Systems?

I. Geotechnical.

1. Does the report document that a site investigation, subsurface explorations testing and have analysis been accomplished and present geotechnical information to support the type of project, foundation design, structural components and availability of construction materials?

2. Does the report address any special construction features or procedures (dewatering, stage construction, etc.) and are they included in the estimate?

3. Does the report provide the level of design necessary to document the cost estimate?

J. Structural Design

1. Does the report clearly present the results of alternatives needed to support the selected project site, configuration, and features, including main structures and major appurtenances?

2. Does the report document the comparison of alternatives in sufficient detail to establish a realistic comparison of costs?

3. Have appropriate additional studies or tests planned for later phases of the design been identified?

K. Hazardous and Toxic Waste

1. Have hazardous and toxic wastes areas been identified and the project designed to avoid problems?

L. Construction Materials and Procedures

1. Have potential sources and suitability of construction material for concrete, earth and rock borrow, stone slope protection; and for disposal sites been identified?

2. Have preliminary construction procedures, construction sequence and duration, and a water control plan for each step of the proposed plan, been developed?

3. Have construction equipment and production rates been determined for major items, in support of the work schedule and cost estimate?

M. Operation, Maintenance, and Replacement (OM&R)

1. Has an OM&R plan been developed for the project, and does it include detailed estimates of the Federal and non-Federal costs?

N. Cost Estimate and Schedule

1. Is the baseline estimate the fully funded project cost estimate and is it developed for the recommended scope and schedule established in the report?

2. Does the estimate include all Federal and non-Federal costs for lands and damages, all construction features, planning, engineering and design and supervision and administration along with the appropriate contingencies and inflation associated with each of these activities through project completion?

3. Do the contingencies reflect the risks related to the uncertainties or unanticipated conditions identified by the data and design detail available at the time the estimate was prepared?

4. Is the final product a reliable, accurate cost estimate that defines the local sponsors obligations and supports project authorization within the established laws and regulations?

O. Value Engineering (VE)

1. For projects with estimated cost of $2,000,000 or greater, has a Value Engineering Study been completed or is there a cost estimate and schedule for the study?

2. If a VE study is not recommended, has a formal waiver request been approved by the Regional Office?

P. Real Estate.

1. Does the Planning Report contain a comprehensive real estate plan that describes the real estate requirements needed to support all project purposes?

2. Does the report provide a complete real estate cost estimate?

3. Does the report document the thorough investigation of facility/utility relocations?

4. Does the report provide a suitable acquisition and related real estate schedule?

Q. Cost Sharing Requirements

1. What project purposes are addressed by the recommended plan and how have costs been allocated to them?

2. If recreation or fish and wildlife enhancement are included in multiple-purpose projects, has the appropriate letter of intent from the non-Federal sponsor been obtained in accordance with Public Law 89-72?

3. What documentation is available to assure that the sponsors fully understand and are willing and capable of furnishing the local cost sharing specified?

4. How was the apportionment of cost to sponsors calculated?

5. Who are the beneficiaries of the project and are there special circumstances associated with the project that warrant consideration of increased non-Federal cost sharing?

6. If the non-Federal sponsor is relying on non-guaranteed debt (e.g. a particular revenue source or limited tax, or bonds backed by such a source) to obtain remaining funds, what information is available to demonstrate the financial capability of the non-Federal sponsor and that the projected revenues or proceeds are reasonably certain and are sufficient to cover the sponsor's stream of costs through time?

7. If the non-Federal sponsor is relying on third party contributions, is data available from the third party to insure financial capability and its legal commitment to the sponsor?

R. Project Authorization

1. Have all elements necessary for Congressional authorization been included in the report?

S. Technical and Legal Review

1. Has documentation of significant issues and possible impact and their resolution been provided?

2. Has certification of technical / legal review been provided?

Enclosure G

Letters of Intent from Kansas and Nebraska

WTR-4 on Rep

AD ASTRA PER ASPERA

KANSAS

RECEIVED

DEPARTMENT OF AGRICULTURE
ADRIAN J. POLANSKY, SECRETARY

KATHLEEN SEBELIUS, GOVERNOR

REMARKS

March 17, 2004

Mr Steve Ronshaugen
Acting Area Manager
U.S. Bureau of Reclamation
PO Box 1607
Grand Island, NE 68802-1607

RE: LOWER REPUBLICAN RIVER AUGMENTATION FEASIBILITY STUDY

Dear Mr. Ronshaugen:

This letter is to express Kansas' support for the proposed feasibility study in the Lower Republican River basin to be conducted by the Bureau of Reclamation in cooperation with the states of Kansas and Nebraska.

In the December 15, 2002, Settlement Stipulation in the Kansas v. Nebraska and Colorado case (Supreme Court Original No. 126), the "States agree[d] to pursue in good faith, and in collaboration with the United States, system improvements in the Basin, including measures to improve the ability to utilize the water supply below Hardy, Nebraska on the main stem." In accordance with that agreement, Kansas has participated in value engineering and appraisal studies that explored a number of alternative projects. The projects under consideration for this feasibility study are a result of those earlier studies and initial evaluations.

Kansas is interested in pursuing the feasibility study to further assess possible system improvements. We understand this pursuit involves participation by Kansas and Nebraska to the extent that each provides 25 percent cost-share. Kansas anticipates its involvement to include both in-kind services and fiscal participation. Fiscal participation hinges funding being made available by the Kansas Legislature, as well as on the participation of Nebraska and the Bureau of Reclamation.

109 SW 9th St., Topeka, KS 66612-1283
Voice (785) 296-3556 Fax (785) 296-8389 http://www.accesskansas.org/kda

040264

We appreciate the bureau's work in the appraisal study and look forward to continued collaboration with the bureau and the state of Nebraska.

Sincerely,

Adrian J. Polansky
Kansas Secretary of Agriculture

c: David L. Pope, Chief Engineer, Division of Water Resources
Joe Harkins, Director, Kansas Water Office

AJP/DLP/gaa/dlm

ADM-13.00

STATE OF NEBRASKA

DEPARTMENT OF NATURAL RESOURCES
Roger K. Patterson
Director

MAR 2004
RECEIVED

March 9, 2004

IN REPLY REFER TO:

Mike Johanns
Governor

NAME	INITIAL	ACTION	DATE
Steve			
Sean			
Mizek			
McCook			
400			
David			

REMARKS:

Michael Kube
Bureau of Reclamation – Great Plains Region
Nebraska-Kansas Area Office
PO Box 1607
Grand Island, NE 68802

RE: Lower Republican Feasibility Study

Dear ~~Mr. Kube~~ Mike:

The Nebraska Department of Natural Resources would like to support the further study of the Lower Republican River Basin by participating in the feasibility study.

We understand that by participating in this study, we will be responsible for a portion of the associated costs of the study. As the State of Nebraska is currently in the middle of a prolonged period of budget cuts, we would like to maximize the portion of our contributions as in-kind services.

Our representative and contact for the study will continue to be Jeff Shafer. Please direct all correspondence and requests to him. Jeff can be reached at (402) 471-0586 or jshafer@dnr.state.ne.us.

Sincerely,

Roger K. Patterson
Director

js

040215