EXECUTIVE SUMMARY

GENERAL

The study area for this appraisal report is the Lower Republican River Basin from below Harlan County Dam in south central Nebraska to Clay Center, Kansas just above the upper reaches of Milford Reservoir in north central Kansas. Included in this area is the Bostwick Division located in Nebraska and Kansas, a Reclamation project which includes Lovewell Dam and Reservoir. The Republican River Compact (Compact) provides for allocation and use of the waters in the basin above the Nebraska/Kansas stateline near Hardy, Nebraska to Colorado, Nebraska, and Kansas. The entire water supply originating downstream from Hardy is allocated to Kansas. Projects that divert water above Hardy must comply with provisions of the Republican River Compact. In 1984 Kansas established Minimum Desirable Streamflow (MDS) requirements at two locations in the study area on the Republican River at Concordia and Clay Center. Periodically, streamflows have been below established MDS target levels requiring administration of water rights in these areas. The purpose of this appraisal study is 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.

KS V. NE & CO LAWSUIT AND SETTLEMENT NEGOTIATIONS

In May, 1998, the State of Kansas filed a motion with the U.S. Supreme Court (Court) alleging the States of Nebraska and Colorado were violating the Republican River Compact. The case was given to a Special Master and Colorado, Kansas, and Nebraska (States) entered into negotiations for settlement. Representatives of the United States were involved in the negotiations. On May 19, 2003 the Court approved the Final Settlement Stipulation (FSS) entered into by the States. The Supreme Court accepted the Special Master's Final Report on October 20, 2003.

The FSS addressed the need for system improvements in the Republican River Basin. In Section IV.E of the FSS it states: "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." Also in Section V.A its states: "Kansas and Nebraska, in collaboration with the United States agree to take actions to minimize the bypass flows at Superior-Courtland diversion Dam."

During the negotiations for settlement, a Value Study Report was completed and the Republican River Compact Commissioners recommended the following proposals 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.

DEVELOPMENT OF ALTERNATIVES

The Lower Republican River Basin is subject to periodic flooding, periods of excess precipitation, and occasional droughts. The Bostwick Division includes two irrigation districts, the Bostwick Irrigation District in Nebraska with service available for 22,935 acres and Kansas Bostwick Irrigation District No. 2 with service available for 42,500 acres. Due to altered hydrologic conditions within the entire Republican Basin, these districts frequently experience water delivery shortages. The existing project facilities for the Bostwick Division in Nebraska and Kansas are approximately 50 years old. The problems associated with these aging facilities and the changed hydrologic conditions require better utilization of the available water supplies. There are opportunities to improve the efficient use and overall management of the Lower Republican River Basin's water resources in such a manner as to increase the water supplies for Bostwick Division lands and provide additional flexibility for the States to comply with the Compact settlement provisions or supply waters for supplementing flows to meet established MDS flows.

Nine alternatives were formulated 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. 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 or Jamestown Wildlife Management Area sites. Because of the operations model limitations, the hydrology analyses modeled the operation of the system for each alternative with the intent to maximize irrigation benefits. 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 have been quantitatively estimated. Allocation of water to provide MDS benefits would reduce the water available to provide irrigation benefits.

RESULTS FROM STUDY

The irrigation benefits accruing from the changes in operations associated with each alternative were estimated and the benefits were then compared to project costs. At this time, the alternatives which involve Lovewell Reservoir enlargements along with automating and winterizing the Courtland Canal appear to be the most viable. The enlargement alternatives could also, potentially, increase the recreational use at Lovewell Reservoir. There are environmental impacts 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 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. Four of the alternatives have benefits which exceed costs. The benefit-cost ratios for the alternatives ranged from 0.13 to 4.2.

FINDINGS

Reclamation has been involved in the Lower Republican Basin for over 60 years. Federal contracts to provide water service to the two irrigation districts have recently been renewed. 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. In addition, streamflows will periodically be less than the MDS established flows in Kansas. Presently some water supplies in the Lower Republican River 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. 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 feasibility study.

CHAPTER 1
INTRODUCTION

1.1 AUTHORITY

This report was authorized by the Federal Reclamation Laws (Act of June 17, 1902, 32 Stat. 388, and acts amendatory thereof and supplementary thereto).

1.2 PURPOSE AND SCOPE OF STUDY

The purpose of this appraisal study is to: (1) review existing data and information; (2) qualitatively identify some system improvement needs of the area; (3) and identify possible constraints, opportunities, and potential solutions to determine the advisability of proceeding to a feasibility study. This study will also describe the Bureau of Reclamation's (Reclamation) future role in the project, present a preliminary plan of study (POS) for the feasibility study, and summarize future environmental law compliance work. Environmental compliance activities will be addressed in conjunction with any subsequent feasibility study. This appraisal study is based for the most part on available data and information, and was completed with no field investigations.

The following purpose from the 1942 Republican River Compact[1] is quite similar to the purpose of this study "... 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 willingness to continue to work with the States to achieve the efficient use of the waters in the Republican River Basin.

1.3 OBJECTIVES

The Republican River Basin Litigation Negotiation Team endorsed as a Future Action, a System Improvement Feasibility Study, to be conducted from October 2004 to September 2007. The overall objective of this appraisal study is to determine if there is a Federal Interest in pursuing such a Feasibility Study in the Lower Republican River Basin and if so, prepare a POS for such study.

[1] Republican River Compact (Act of May 26, 1943, ch. 104, 57 Stat. 86.)

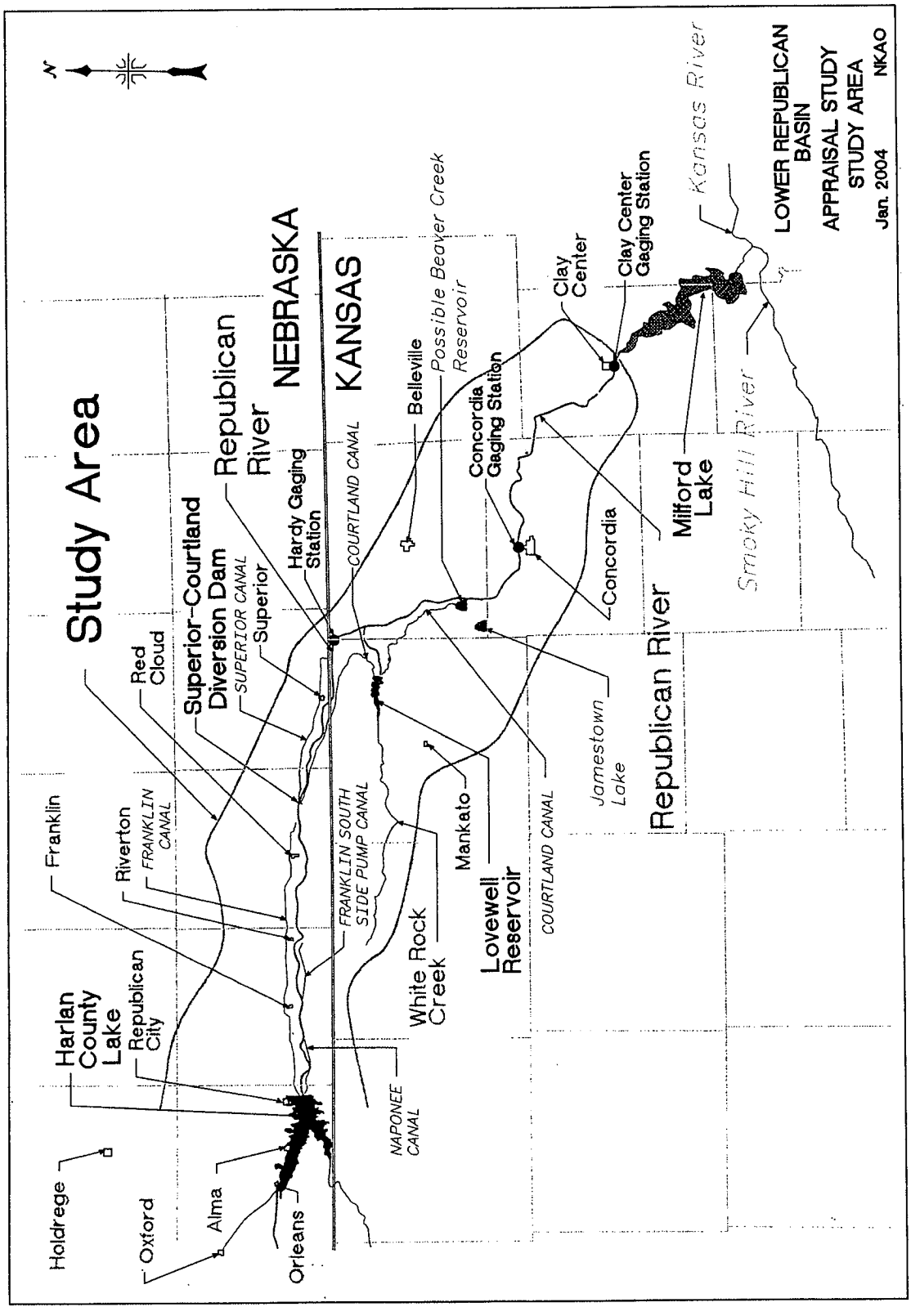


Figure 1.—Study Area.

1.4 PROJECT AREA AND DESCRIPTION

The study area lies in the Republican River Basin from below Harlan County Dam to Clay Center, Kansas just above the upper reaches of Milford Reservoir. See Figure 1. Included in this area is the Bostwick Division, Nebraska and Kansas, a Reclamation project. The irrigation systems are operated and maintained by two Irrigation Districts, the Bostwick Irrigation District in Nebraska and Kansas Bostwick Irrigation District No. 2. These districts began delivering water in the early 1950's. Service is currently available to 22,935 acres in Nebraska and 42,500 acres in Kansas. Storage water is provided to the Bostwick Division from the U.S. Army Corps of Engineer's (Corps) Harlan County Lake and Reclamation's Lovewell Reservoir. These facilities are operated and maintained by the Corps (Harlan County Lake) and Reclamation (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. The majority of the irrigation water is diverted at the Superior-Courtland Diversion Dam with some diverted directly out of Harlan County Lake and a small amount pumped from the river below Harlan County Dam.

There are about 3,722 square miles of surface drainage area in the Republican River 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 averages less than 2 miles in width and 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. Numerous small, entrenched tributaries, flowing nearly at right angles to the river, drain the upland areas.

The study area is considered subhumid and precipitation is normally poorly distributed and insufficient for optimum plant growth. The Bostwick project depends primarily upon surface inflows into the storage facilities. Due to increased groundwater and other increased water development in the basin the available surface water supplies into Harlan County Lake are generally declining with an occasional excess year or two that helps to replenish some of the storage water. Lovewell Reservoir and Harlan County Lake usually have a limited amount of carryover storage. There are competing needs for the limited available water so there is an urgent need to utilize the available water supplies as prudently and efficiently as possible. These competing needs are further discussed in Chapter 2 of this report.

1.5 PRIOR STUDIES, REPORTS, AND EXISTING WATER PROJECTS

The study area has had considerable project investigations and development of water resource facilities over the last sixty plus years. Only the studies and reports that have a significant importance to this study will be highlighted.

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). 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.

Other reports that have significance to the Bostwick Division and the Lower Republican River Basin are:

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

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

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

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

- 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, USBR, May 2002.

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

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

- Volume Analysis and Revised Flood Frequency Analysis for Comprehensive Facility Review, Lovewell Dam, USBR, 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, USBR, TSC, September 2003.

1.6 CONSULTATION AND MEETINGS

During the preparation of the Value Study Report and prior to the commencement of this Appraisal Study, a number of briefing meetings were conducted with the Republican River Lawsuit Settlement Negotiations Team. Each state assigned individuals to serve on the team in preparing the Value Study Report. During the meetings, the Compact Commissioners recommended specific proposals that should be considered for further study. The descriptions of these proposals are described in Section 2.

The consultation for this study consisted of providing the involved State agencies two written Status Reports and holding conference calls with them and Reclamation representatives. One meeting, conducted by representatives of Kansas and Nebraska State Agencies, was held on March 14, 2003 at Superior, Nebraska. In addition to interested State Agencies, involved local natural resource entities were invited and attended. A brief report 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.

Colorado has indicated that they would not likely be involved in any possible future feasibility study for the lower reaches of the river. Colorado is not directly involved with the existing features in the lower reaches of the Republican River (below Harlan County Dam) and did not attend the March 14, 2003 meeting held in Superior, however they were in attendance at other 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 MDS requirements, as described later in this Chapter, at two locations on the Republican River: Concordia and Clay Center. The instream flow requirements for these two locations established by the Kansas Legislature have a priority date of April 12, 1984. Water users that have a priority date after April 12, 1984 are closed when the MDS flows are less than the levels needed.

2.1 REPUBLICAN RIVER COMPACT

The compact allocates waters of the Republican River Basin above Hardy, Nebraska to Colorado, Nebraska and Kansas. The entire water supply originating below Hardy, Nebraska is allocated to Kansas. The water supply available for allocation and the Beneficial Consumptive Use (BCU) is calculated annually. Through these calculations, each state receives a water supply for BCU. BCU is defined in the FSS 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 it would be included in the water supply and BCU calculations. Non-consumptive uses such as diversions for MDS storage use would not be considered a BCU according to the definitions currently being used for accounting purposes.

2.2 REPUBLICAN RIVER COMPACT LITIGATION

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 Republican River compact.[2] After briefing by all the States and the United States, the Court referred the matter to a Special Master in November 1999.

After several hearings and reports the issues to be resolved were defined in rulings by the Special Master in May 2001. After these rulings, 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 Corps also participated. These negotiations culminated in a settlement package that was subsequently approved and entered into by the Governors and Attorneys General of the States, and on April 15, 2003, the Special Master formally recommended to the Court approval of this settlement

[2] The states of Colorado, Kansas and Nebraska are hereafter referred to as "the States" in this report.

agreement. On May 19, 2003, the Court approved the FSS entered into by the States. As one of the tools to the Settlement Agreement a groundwater model was developed by the States. This groundwater model has been accepted by the States and the Court accepted the Special Master's final report on October 20, 2003. According to an order issued by the Court in May, this means that the Lawsuit has been dismissed.

2.3 SETTLEMENT PROVISIONS

Provisions excerpted from the Settlement Stipulation that pertain directly to this study include:

> "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."
>
> "Kansas and Nebraska, in collaboration with the United States, agree to take actions to minimize bypass flows at Superior-Courtland Diversion Dam."

Reclamation published a Value Study Report concerning management of the Lower Republican River water supplies on December 17, 2002. This report was entitled: "Proposals for More Efficient Management of Lower Republican River Water Supplies". In this report the States 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.

The potential for improved use of the water supply below Hardy was not analyzed due to Reclamation's budget and time constraints. Because of the limitations associated with 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 Lower Republican River Basin, which is the reach downstream of Harlan County Dam, is subject to occasional flooding, some periods of excess precipitation, and occasional droughts. The existing project facilities for the Bostwick Division in Nebraska and Kansas are around 50 years old. There are typical ongoing maintenance and operational problems associated with these facilities and changed hydrologic conditions, all of which could lend to opportunities for better utilization of the available water supplies.

The Bostwick Division consists of two irrigation districts. The Bostwick Irrigation District in Nebraska has service available for 22,935 acres. The Kansas Bostwick Irrigation District No. 2 has service available for 42,500 acres. The first irrigation service was available in Nebraska in 1954 and in Kansas in 1955, and Lovewell Dam and Reservoir was completed in 1957. Due to changed hydrologic conditions in the entire Republican Basin, these districts frequently experience water delivery shortages. For example, according to Reclamation's Resource Management Assessment (RMA) of the Republican River Basin, the mean annual historic (1931-93) 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. Almost all of these are junior to the Bostwick Division's rights. Below the Diversion Dam and above the Nebraska-Kansas stateline there are surface water rights totaling about 25 cfs, and almost all of those rights are junior to the Bostwick Division. Nebraska has recently taken action to adjudicate water rights in this area and some rights may be cancelled.

In Kansas there are surface water rights totaling about 210 cfs in the reach below the Nebraska-Kansas stateline and above Clay Center, Kansas with about 17 cfs being vested. A vested right continues the beneficial use of water that began prior to June 28, 1945. All of the Kansas priority dates are treated as junior to the earliest Nebraska direct flow right for the Bostwick Division of April 3, 1946.

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 (NRD) 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 Republican River Basin above Guide Rock as part of the settlement provisions. In December 2002, in compliance with the Final Stipulation, the Lower Republican NRD approved a moratorium for the upcoming three years on all wells pumping more than 50 gallon per minute in the part of the Lower Republican Basin that is in Nebraska. The District is also phasing in a well-metering requirement to track water usage.

The opportunities for obtaining new groundwater rights for irrigation in the Lower Republican Basin in Kansas are more limited, especially due to the MDS standards. These rights would be junior to MDS. Much of the bottom lands of the river valley are irrigated from the alluvial aquifer. There are about 385 registered irrigation wells in this portion of the basin above Clay Center.

The Kansas Water Office 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. The administration of MDS resulted in the suspension of approximately 150 junior water right groundwater irrigators in the alluvial valley of the Republican River in Kansas. 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.

2.4.2 EXPECTED FUTURE CONDITIONS

The conditions as used for the Hydrology Baseline Conditions, as described in Chapter 3.3, are considered to be the Expected Future Conditions of the Lower Republican River Basin from Harlan County Dam to Clay Center, Kansas. Actions will likely be required by the States to come into compliance with the Republican River Compact. However, there have been no discussions as to what actions the States may take to control their consumptive uses, if these requirements arise. In addition, the 2000 renewal contracts with the irrigation districts in the Republican River Basin mandated distribution system and on-farm delivery system efficiency improvements. The irrigation districts committed to implement improvements that would achieve on-farm efficiency improvements of 5% and delivery system efficiency improvements between 2% and 8% (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 system improvements 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 District contracts. The Baseline Conditions assumed for this study are the 1993 level of development for streamflow conditions and 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 Lower Basin's water resources. This can be done in such a manner as to increase the water supplies available for Bostwick Division lands and provide additional flexibility for the States to comply with the settlement provisions associated with the Republican River Compact and MDS flow augmentation in Kansas.

The two irrigation districts in the Lower Basin, the Bostwick Irrigation District in Nebraska and the Kansas Bostwick Irrigation District No. 2, frequently experience water delivery shortages. There are opportunities to provide these districts with improved water deliveries in such a manner as to reduce the frequency and severity of the shortages.

If adequate water is available there could also be opportunities in the Lower Basin to provide Kansas with water to help meet their MDS at the two designated locations on the Republican River below the Nebraska-Kansas stateline at Concordia, Kansas and above Milford Lake at Clay Center, Kansas. Use of a storage facility at locations such as Beaver Creek or Jamestown could provide additional fish and wildlife benefits, supplement flows to meet MDS, and would improve the utilization of the water supply below Hardy.

2.4.4 PROBLEMS WARRANTING FEDERAL PARTICIPATION

Federal water resources agencies, Reclamation and the Corps, have had major involvement in the Lower Republican Basin for over 60 years, with project development being initiated in the 1940s. The project construction included Reclamation's Bostwick Division in Nebraska and Kansas which utilizes most of the storage space in Harlan County Lake in Nebraska and Lovewell Reservoir. Federal water supply contracts with the two irrigation districts were renewed in 2000. The districts experience significant water delivery shortages and it is anticipated that shortages will continue to occur. Available water supplies for the Lower Republican Basin have decreased over the years. This and the perception that Nebraska and Colorado were using more than their Compact water allocation, contributed to Kansas's decision to file a complaint against Nebraska and Colorado in the Court. 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. There is also Federal interest in that the Bostwick Districts still have repayment obligations on their project. The Federal government, although not a named

defendant in the litigation among the three states, was a participant in the negotiated settlement and has agreed to study, and if possible, develop system improvements to make more efficient use of the water that is available. These circumstances involve the three States and the United States and therefore lend merit to warranting Federal participation.

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, NRDs in the Republican Basin, the Lower Republican Water Users, and the Governor's Water Task Force. This resulted in Reclamation identifying the following planning objectives for the appraisal study with the overriding objective being to determine the Federal interest to conduct a feasibility study:

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 – (additional inches of water).
5. Provide additional recreation benefits.
6. Recognize possible environmental and cultural impacts.

The primary planning objective, for which alternatives were developed, is to conform to the Final Settlement Stipulation as agreed upon by the States and approved by the Court.

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

There are several management methods available to enhance the use of the water supply in the section of the Republican River below Harlan County Dam. Combinations of the management methods were developed into alternatives.

A number of the management methods that are being considered involve the enhancement and rehabilitation of existing Reclamation owned facilities. It is recognized that the work on these existing facilities may or may not require additional construction authority to implement. These methods were included in this appraisal study effort to ensure that all of the possible methods be considered and compared in order to determine the most economical and viable alternative.

3.1.1 WINTERIZE SUPERIOR – COURTLAND DIVERSION DAM AND COURTLAND CANAL

Currently there is flow at Superior-Courtland Diversion Dam that cannot be diverted into Lovewell Reservoir during the winter months due to periods of icing conditions at the diversion dam and in the canal. Winterizing[3] the diversion dam and Courtland Canal check structures would allow for canal diversions whenever water is needed and available for diversion. This could potentially increase the water available in Lovewell Reservoir or some other storage structure near the canal that could be utilized. This improvement would result in Lovewell reservoir filling earlier in the spring and thereby allow additional time for maintenance of the diversion 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 minimize bypass flows at the diversion dam. By automating the gates at the diversion dam and the check structures and placing a more reliable flow measurement structure on the canal, some of these fluctuations could be diverted, minimizing bypass flows. This would result in a decrease in 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. The implementation of an alternative involving this method would

[3] "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.

address the stipulation as detailed in the settlement agreement to minimize the by-pass flows at Superior-Courtland Diversion Dam.

3.1.3 RENOVATE COURTLAND CANAL (RESTORE THE COURTLAND CANAL TO DESIGN CAPACITY)

This management method is to restore the Courtland Canal to its design capacity between the Superior-Courtland Diversion Dam and Lovewell Reservoir. The design capacity at the diversion dam is 751 cfs and the current capacity is estimated to be approximately 580 cfs. The reduced flow capacity is 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 along the canal system. These smaller in-line structures were installed by the District as a cost savings measure when county road bridges required replacement. The pipe structures would be removed and replaced by bridges that will allow the additional flow capacity. 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. See Figure 2. Proposals include raising this conservation storage by 16,000 ac-ft (Figure 3) or 35,000 ac-ft (Figure 4). These 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).

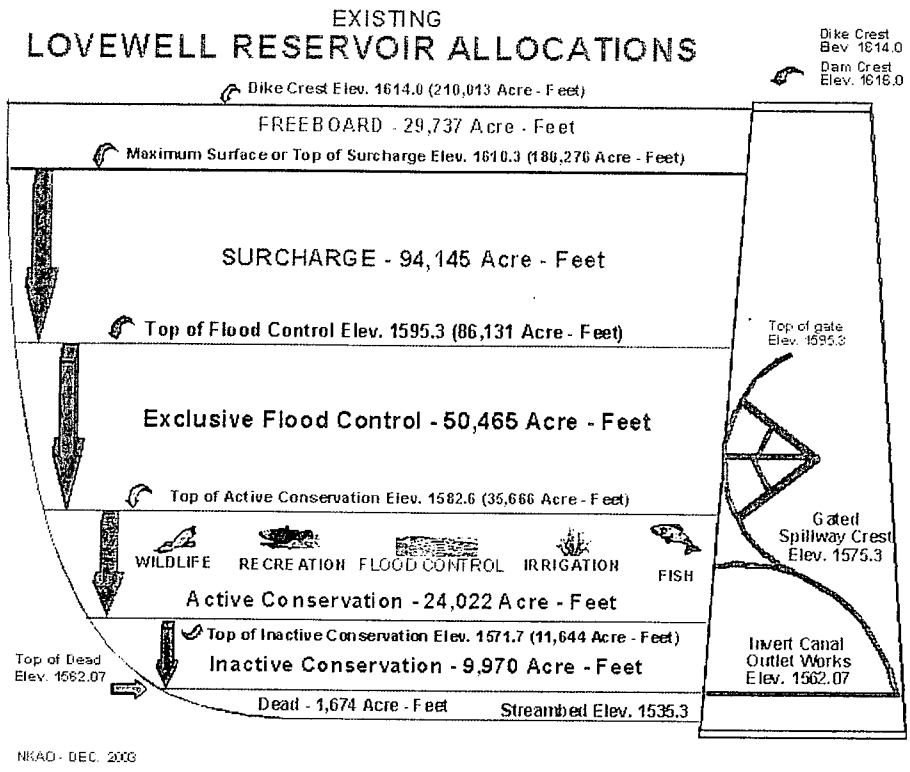


Figure 2.–Lovewell Reservoir Existing Allocations.

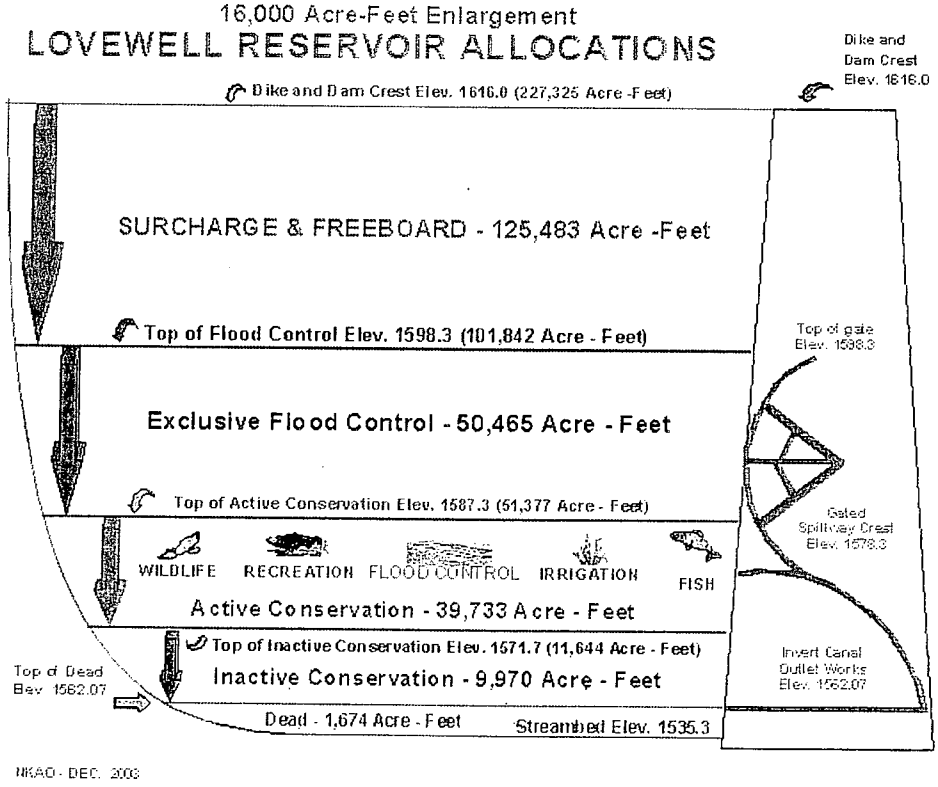


Figure 3.–Lovewell Reservoir allocations for 16,000 ac-ft enlargement.

3.2 RIVER SYSTEM OPERATION MODEL

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 computer model simulates the streamflow and reservoir conditions for the entire Republican River Basin. 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.

This study was done at the appraisal level of detail so the results are usable to determine the benefits for increased water supplies for irrigation to the Bostwick Division. 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.

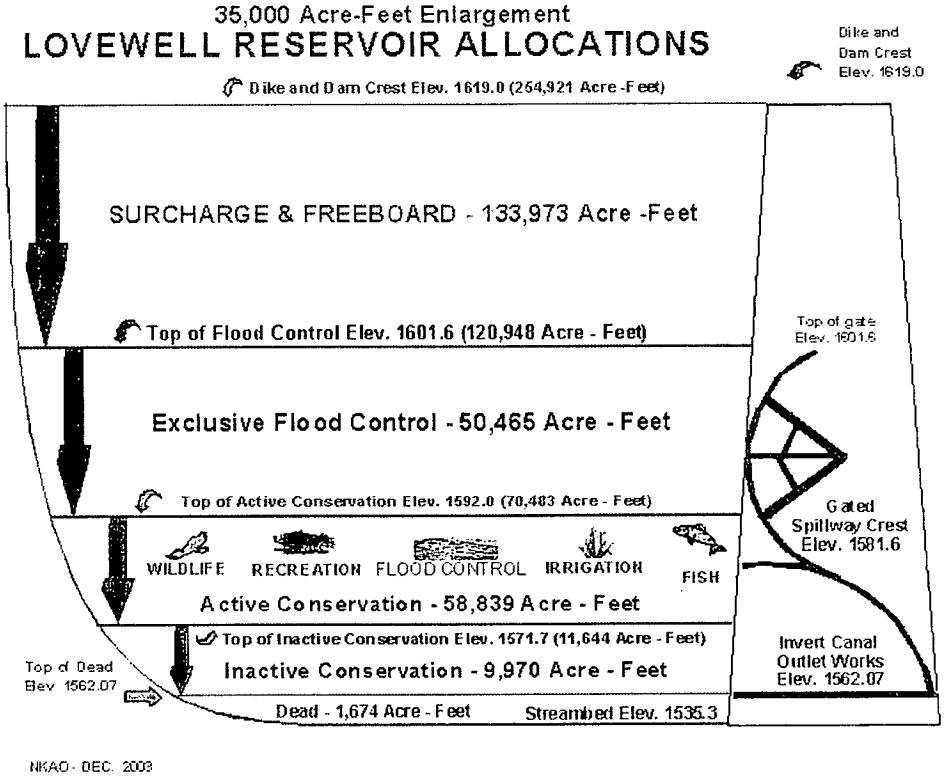


Figure 4.–Lovewell Reservoir allocations for 35,000 ac-ft enlargement.

Since this appraisal study concentrates on improving the use of 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 5. The model was modified to incorporate Harlan County 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.

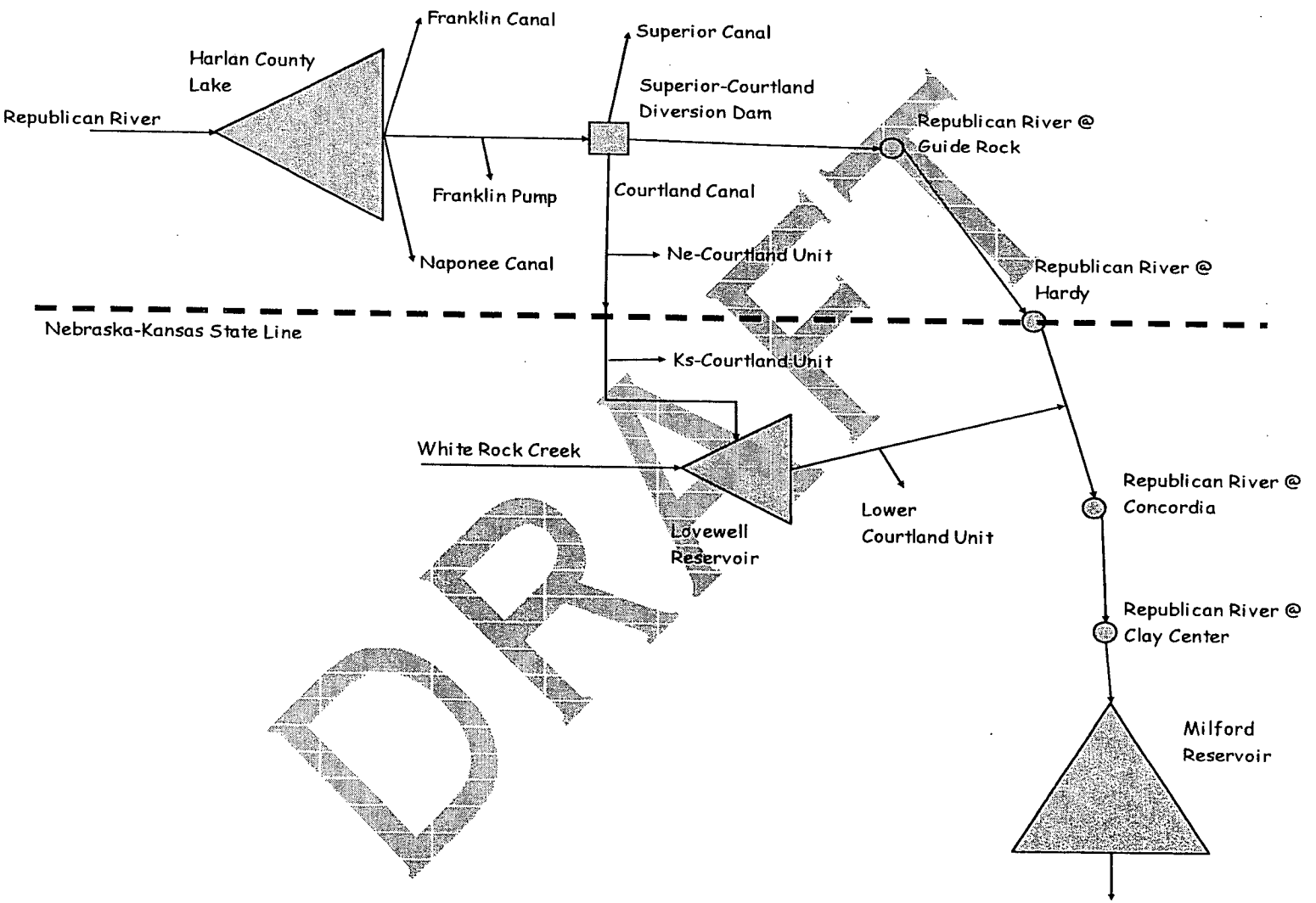


Figure 5.–Schematic Diagram of Lower Republic River Basin

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.

Further details concerning these items can be found in Appendix A.

3.3 DESCRIPTION OF BASELINE AND ALTERNATIVES

The baseline condition, which is considered the future without condition, included the simulation of the streamflows and reservoir operations of the basin. The streamflow conditions were as described above and the delivery efficiency associated with the contract renewals for irrigation districts were 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:

Table 1.–Summary of Model Runs

		Alternatives								
Component	Baseline	A	B	C	D	E	F	G	H	I
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 AF)	35.7	35.7	35.7	35.7	51.7	51.7	70.7	70.7	51.7	51.7
Lovewell BOC[2] (1000 AF)	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

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

3.3.1 ALTERNATIVE A — COURTLAND CANAL TO DESIGN CAPACITY, WINTERIZE

This alternative 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 Reservoire storage.

3.3.2 ALTERNATIVE B — AUTOMATE, WINTERIZE COURTLAND CANAL

This alternative 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

This alternative 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 AF

This alternative 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 AF

This alternative includes all of the provisions of Alternative C and adds the additional conservation storage of 16,000 ac-ft in Lovewell Reservoir.

3.3.6 ALTERNATIVE F — AUTOMATE, WINTERIZE COURTLAND CANAL; RAISE LOVEWELL 35,000 AF

This alternative 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 AF

This alternative 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 AF

This alternative continues the current operations and provides additional storage space of 16,000 ac-ft in Lovewell Reservoir.

3.3.9 ALTERNATIVE I — COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 16,000 AF

This alternative would return Courtland Canal to design capacity and provide additional storage space of 16,000 ac-ft in Lovewell Reservoir.

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 level study because significant revisions to the OPSTUDY model would be required. These alternatives could be examined further if additional studies are undertaken at the feasibility level. The additional waters delivered to Lovewell Reservoir in the alternatives studied could be delivered to these other storage facilities if it was determined that uses such as supplementing flows to meet MDS was desirable. 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-Irr. 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 the above table the increase in average water supply for the non-irrigation season varies from 2,600 acre-feet to 15,500 acre-feet and the annual variance is 4,200 acre-feet to 17,300 acre-feet, (e.g., 17,300 = 42,500 – 25,200)

3.4.1.2 MINIMUM DAILY STREAMFLOW ANALYSIS

As stated in Chapter 2, Kansas has established MDS requirements in the Republican River Basin. The MDS 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. 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 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. Tables summarizing the results of this analysis are included in the 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 Irrigation Districts that were used as an input to the analysis:

Table 3.—Weighted 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 weighted farm delivery compared to the baseline. The weighted 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 for the current existing flow condition or the original design flow of 751 cfs. The current flow for the Courtland Canal is approximately 580 cfs due to the degradation of the existing canal prism and restrictions at several locations. Additionally, the flow of 580 cfs represents the maximum flow allowable given the current condition of Courtland Canal. When the canal was originally constructed in the 1950's, the original design flow for the Courtland Canal was 751 cfs.

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 fifty 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 unreinforced concrete lined canal. Over the years, the concrete lined sections were subjected to extensive damage. 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 lining 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 utilizing undersized railroad tanker cars that restrict canal flows. The crossings are to be replaced with new county road bridges in order to 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 and canal headworks at the Diversion Dam in order to provide for winter operations. The bubbler system would prevent the build up 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[4]. 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 primarily from diversions from 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 feet, and an additional 50,460 ac-ft of flood control space between reservoir elevations 1582.6 and 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 on White Rock Creek 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 1614 feet. Near the left 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 feet, and 14,600 ft^3/s at the top of flood control pool elevation 1595.3 feet.

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 approximately

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

elevation 1603. The State of Kansas has provided a flood easement to the United States up to 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 an inlet channel, trash-racked inlet, gate chamber, stilling basin, wasteway, and canal entrance. The design capacity of the outlet works is 635 cfs at reservoir elevation 1571.7 feet.

For the Republican River Appraisal 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 total reservoir capacity, and revisions to the Reservoir Capacity Allocations to increase the active conservation 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. 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 revising the top of active capacity from elevation 1582.6 feet to 1587.3 feet. To maintain the existing flood control capacity, the top of flood control pool would be revised from 1595.3 to 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 of 1616.0 feet.

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 feet, 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 feet. 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 feet 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 revising the top of active capacity from elevation 1582.6 feet to 1592.0 feet. To maintain the existing flood control capacity, the top of the flood control pool would be revised from 1595.3 to 1601.6. The original reservoir surcharge capacity would remain at about 94,000 ac-ft with the dam and dike crest elevations raised to 1619 feet.

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 feet. 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[5] "Analyses Addressing Hydrologic/Hydraulic Issues for Lovewell Dam," which included flood routings for the proposed modifications to increase the capacity of Lovewell Reservoir were completed in September 2003[6]. 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 also 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. Considering the potential loss of life due to dam failure from a flood event, diminishing justification to take action to reduce risk is indicated for the existing dam. The same conclusion would apply if the dam were modified, as proposed, to increase storage capacity since the hydrologic risks of dam failure are essentially the same for the modified structures and operation.

Additionally, 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 modification to increase reservoir capacity are expected to have little, if any, impacts on the estimated piping/internal erosion or landslide failure risks because of the relatively small increases in the normal reservoir operating levels. Any additional work that may be required to assure that increasing the reservoir storage capacity does not increase risk to the downstream public would be minimal, and within the scope of work required for the modification.

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

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

3.4.2.3 OTHER STORAGE ALTERNATIVES

Other storage alternatives in the Kansas portion of the study area were evaluated by the Value Engineering (VE) study referenced in Section 1.5, above. These alternatives included[7]:

- 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 VE study are considered comparable to the cost-estimates included for Alternatives A through I outlined in this report. The findings of the VE study 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 & 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.

[7] The Alternative J, K, and L designations are for this Appraisal Report. In the VE Report, these alternatives were designated as Proposal F1, F2, and G respectively.

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 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.

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

The VE Study 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[8]. These estimates were developed

[8] 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.

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 or Feasibility level 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 8 was used[9]. 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.

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 1992.0')	$1,900,000	$250,000	$2,150,000

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

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 include10 percent for mobilization, 25 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[10]	5.0
Right-of-Way (ROW)	2.0
TOTAL	25

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 updating the costs identified for those alternatives in the VE Study by 5 percent to account for cost of inflation.

[10] The Environmental Permitting multiplier includes the cost for activities such as environmental mitigation and cultural resource mitigation.

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
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

[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)
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
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 appraisal level 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 appraisal 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 will 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 to provide irrigation benefits and would reduce the level of irrigation benefits identified but would increase potential benefits related to MDS. 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.[11]

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

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

Nebraska[12]. The only cost which was expected to change with yield was the harvesting cost[13]. 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.

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 Applied	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

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

[13] 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.

Based on the above estimated yields, gross revenues under each Alternative were calculated using the 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.[14] After subtracting all the costs of production, the 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 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[15] expected to receive benefits. The estimated baseline total annual benefits were $12,559,172[16]. 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.

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

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

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

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*

For the alternatives which include either of the two options for raising the conservation pool in Lovewell Reservoir, it is likely that recreational use of the reservoir would increase if the existing recreational facilities inundated by higher water levels were replaced or extended[17]. 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 first iteration analysis are included in the first half of Appendix E. That analysis considered the effect of all the alternatives relative to facility availability

[17] For the purposes of this study, it is assumed that inundated facilities would be replaced and the alternative cost estimates include the cost of this mitigation.

thresholds. The results of the second iteration analysis, for all hydrologic conditions, are presented in the second-half of Appendix E.

The results of the second iteration analysis, which would occur for each alternative under average hydrologic conditions are discussed below[18]. For the alternatives which include one of the two Lovewell Dam enlargement options, most of the projected benefits (relative to the baseline) would not be realized unless the investment was made to relocate the recreational facilities which would be affected by higher water levels. The cost associated with this mitigation was discussed in Section 3.4.2.4 above. This cost estimate assumed 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 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 the second iteration facility availability analysis, 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. 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. For these alternatives 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 they would 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-1in Appendix E shows the availability thresholds used in both the first and second iteration analysis.

[18] The second iteration analyses for the "dry" and "wet" hydrologic conditions are included in Appendix E.

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 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 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 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 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 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 Alternative 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 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 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 a Lovewell Dam raises, this alternative provides for the fewest gains relative to the Baseline Alternative. 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 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.

3.4.3.3 BENEFIT-COST ANALYSIS

A benefit-cost ratio analysis provides a discounted measure of a projects' 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[19].

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. 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

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

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 affects 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. It is possible that state agencies in both Nebraska and Kansas would have to be consulted.

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 National Pollutant Discharge Elimination System (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.

Reclamation will contact the Service for a current list of threatened and/or endangered species that might occur within the proposed project area. The Service was consulted during the preparation of the Republican River Basin environmental impact statement for contract renewal; however, that was in 2000.

As previously mentioned, possible permits required might include NPDES from the States of 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 Republican River 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.

Selenium, a naturally occurring trace element, was found by recent Reclamation studies to be at elevated levels within the Basin. 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.

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 bioloaccumulation of selenium in aquatic invertebrates and fish, no obvious indications of reproductive impairments have been reported.

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 Jewel 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"[20] and can be seen in its entirety in that publication.

[20] Resource Management Assessment, Republican River Basin: Water Service Contract Renewal, 1966, U.S. Department of Interior, Bureau of Reclamation, Great Plains Region, July 1996.

3.4.5.1 OVERVIEW

The socioeconomic structure in the Lower Republican River 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.

The agricultural industry has traditionally dominated the economic base and land use in the Lower Republican River 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 crop production for the five counties in the study area was about $420.4 million in 1992. These averages were obtained from the 1992 Census of Agriculture.

The annual value of agricultural production for the two irrigation districts (Bostwick Irrigation District and Kansas Bostwick Irrigation District) increased from $12,513,503 in 1978 to $14,258,274 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.

3.4.5.2 AGRICULTURAL PRODUCTION AND VALUE

The agricultural industry has traditionally dominated the economic base and land use in the Lower Republican River 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. These averages were obtained from the 1992 Census of Agriculture. The annual value of agricultural production for the two irrigation districts (Bostwick Irrigation District and Kansas Bostwick Irrigation District) increased from $12,513,503 in 1978 to $14,258,274 in 1992. 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 proposals to increase storage capacities of Lovewell Reservoir would require considerable Cultural Resources Investigations. Additional lands currently outside Federal Property boundaries will be a directly impacted resulting from increased pool

elevations. There are approximately fifteen "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 1583 feet and/or extending to an elevation of about 1600 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 five feet and require additional National Register testing. Seven (7) sites are located at the five to ten feet about 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 a feasibility investigation.

The Kansas State Historic Preservation Office (SHPO) is viewing "Normal" reservoir operations as a Section 106 process. 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.

The removed 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.

3.4.7 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 Kansas Bostwick Irrigation No. 2 and is for use for irrigation of Bostwick Division lands. If a permanent right to store additional water is desired, an additional storage right is necessary. If water is stored for some other purpose besides irrigation in any storage facility, a water right designating storage of water for that purpose would be necessary. It is possible that a natural flow right would be necessary. The reach of the Republican River between Harlan County Dam and Hardy, Nebraska is closed to appropriations 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 or 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 irrigators and surface water irrigators. Nebraska does not require water right permits for ground water users and the administration of ground water users is by the natural resource district while administration of surface water users is at the state level.

A. Nebraska Surface Water Rights below Harlan County Dam and above Stateline

- 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 4/3/46.

- There are 94.04 cfs direct flow water rights in the Republican 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 mainstem on the Republican River below the Diversion Dam and above the Stateline 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 mainstem of the Republican River below the Diversion Dam and above the Stateline 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.

B. Kansas Water Rights, Stateline 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 minimum desirable streamflows (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 a 5 vested rights in the Republican River Basin from the Stateline to Clay Center. The authorized quantity is 342.5 ac-ft, the authorized rate is 17.18 cfs, and the authorized total acres is 766.

C. 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. Kansas Bostwick Irrigation District No. 2 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. Almost 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 Republican 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.

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 and appropriations would also 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 specific Congressional Authority for those alternatives involving improving operational efficiencies such as system automation or O&M improvements on existing Reclamation facilities would not be required. Such legislation could also clarify how much of the costs of modification would be assigned for repayment by the Kansas Bostwick Irrigation District No. 2, the Bostwick Irrigation District in Nebraska, power users of P-SMBP and other beneficiaries. Legislation could also clarify Reclamation's authority to provide benefits for MDS and to store and convey non-project water to the extent necessary to meet desired outcomes in the Lower Republican River Basin.

3.4.7.2 INSTITUTIONAL

A. General:

The study area in this appraisal study is the reach of the Lower Republican River 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 Pick-Sloan Missouri Basin Program (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. For discussion of the Consensus Plan see Section 3.2.2. 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
- Kansas – Lower Republican Basin Advisory Committee in Kansas

B. Republican River Compact:

There is a Republican River Compact among the States of Colorado, Kansas, and Nebraska that 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 with 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.

C. Republican River Basin Lawsuit:

There was a disagreement on the utilization 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 seventeen months of intense negotiations an out-of-court settlement was reached and which was approved by the Court in May 2003.

D. Final Settlement Stipulation (FSS):

The litigation resulted in a Final Settlement 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.
- The settlement also provides that the States and the United States will jointly study and, if possible, develop 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.

E. Repayment Contracts:

Reclamation has repayment contracts with two entities, the Bostwick Irrigation District in Nebraska and the Kansas-Bostwick Irrigation District No. 2 in Kansas. 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. As previously discussed, the volume of additional water varies from between 4,200 to 17,300 acre-feet per year. It should be noted that this was just an assumption made for the purposes of this study and this evaluation. 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.

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 maybe 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 know 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	Incremental Net Benefits (Irrigation Only)	Objective 1	Objective 2	MDS Impacts	Objective 3 Benefit/ Cost Ratio	Objective 4 (inches)	Objective 5 Recreation Benefits (Average Hydrologic Conditions)
A	$13,000,000	$1,640,000	-	NE	-	0.13	0.2	Same as Baseline
B	$2,000,000	$3,990,000	+	NE	--	2.00	0.5	Same as Baseline
C	$15,000,000	$5,500,000	+	NE	--	0.37	0.7	Same as Baseline
D	$3,600,000	$11,000,000	+	NE	--	3.06	1.5	Moderate Increase Over Baseline
E	$16,500,000	$11,700,000	+	NE	---	0.71	1.6	Moderate Increase Over Baseline
F	$12,000,000	$15,200,000	+	NE	---	1.27	2.2	Largest Increase Over Baseline
G	$25,000,000	$15,700,000	+	NE	---	0.63	2.3	Largest Increase Over Baseline
H	$1,650,000	$6,960,000	-	NE	-	4.22	0.9	Smallest Increase Over Baseline
I	$14,500,000	$6,960,000	-	NE	-	0.48	0.9	Moderate Increase Over Baseline
J	$14,490,000	NE	NE	NE	+	NE	NE	NE
K	$6,720,000	NE	NE	NE	+	NE	NE	NE
L	$12,600,000	NE	NE	NE	+	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 to 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	Incremental Net Benefits	Objective 1	Objective 2	MDS Impacts	Objective 3 B/C Ratio	Objective 4	Objective 5 Recreation Benefits (Average Hydrologic Conditions)
A	$13,000,000	NE	-	-	-	NE	Same as Baseline	Same as Baseline
B	$2,000,000	NE	+	-	-	NE	Same as Baseline	Same as Baseline
C	$15,000,000	NE	+	-	-	NE	Same as Baseline	Same as Baseline
D	$3,600,000	NE	+	0	+	NE	Same as Baseline	Moderate Increase Over Baseline
E	$16,500,000	NE	+	0	+	NE	Same as Baseline	Moderate Increase Over Baseline
F	$12,000,000	NE	+	+	+	NE	Same as Baseline	Largest Increase Over Baseline
G	$25,000,000	NE	+	+	+	NE	Same as Baseline	Largest Increase Over Baseline
H	$1,650,000	NE	-	0	+	NE	Same as Baseline	Smallest Increase Over Baseline
I	$14,500,000	NE	-	0	+	NE	Same as Baseline	Moderate Increase Over Baseline
J	$14,490,000	NE	NE	+	+	NE	NE	NE
K	$6,720,000	NE	NE	+	+	NE	NE	NE
L	$12,600,000	NE	NE	+	+	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 to 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 4
FINDINGS

4.1 FEDERAL INTEREST TO PURSUE A FEASIBILITY STUDY

The Lower Republican River Basin has an extensive history of Federal involvement. Extensive 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.

4.1.1 FINDINGS

Reclamation has been involved in the Lower Republican Basin for over 60 years. Federal water supply contracts with the two irrigation districts have recently been renewed. 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. In addition, streamflows will periodically be less than the MDS established flows in Kansas. Presently some water supplies in the Lower Republican River 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. 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 Feasibility Study.

4.2 FEASIBILITY STUDY — DRAFT PLAN OF STUDY AND PRELIMINARY COST ESTIMATE

The 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 defines a "buy-in" between Reclamation and the local sponsor(s) as well as those who will be performing and reviewing the activities involved in the Feasibility Study. The study cost estimate and detailed work schedule will not be fully developed and finalized until there is specific Congressional authorization for a Feasibility Study. The preliminary draft POS is provided as Appendix F.

APPENDIX A

HYDROLOGY REPORT

LOWER REPUBLICAN APPRAISAL 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 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

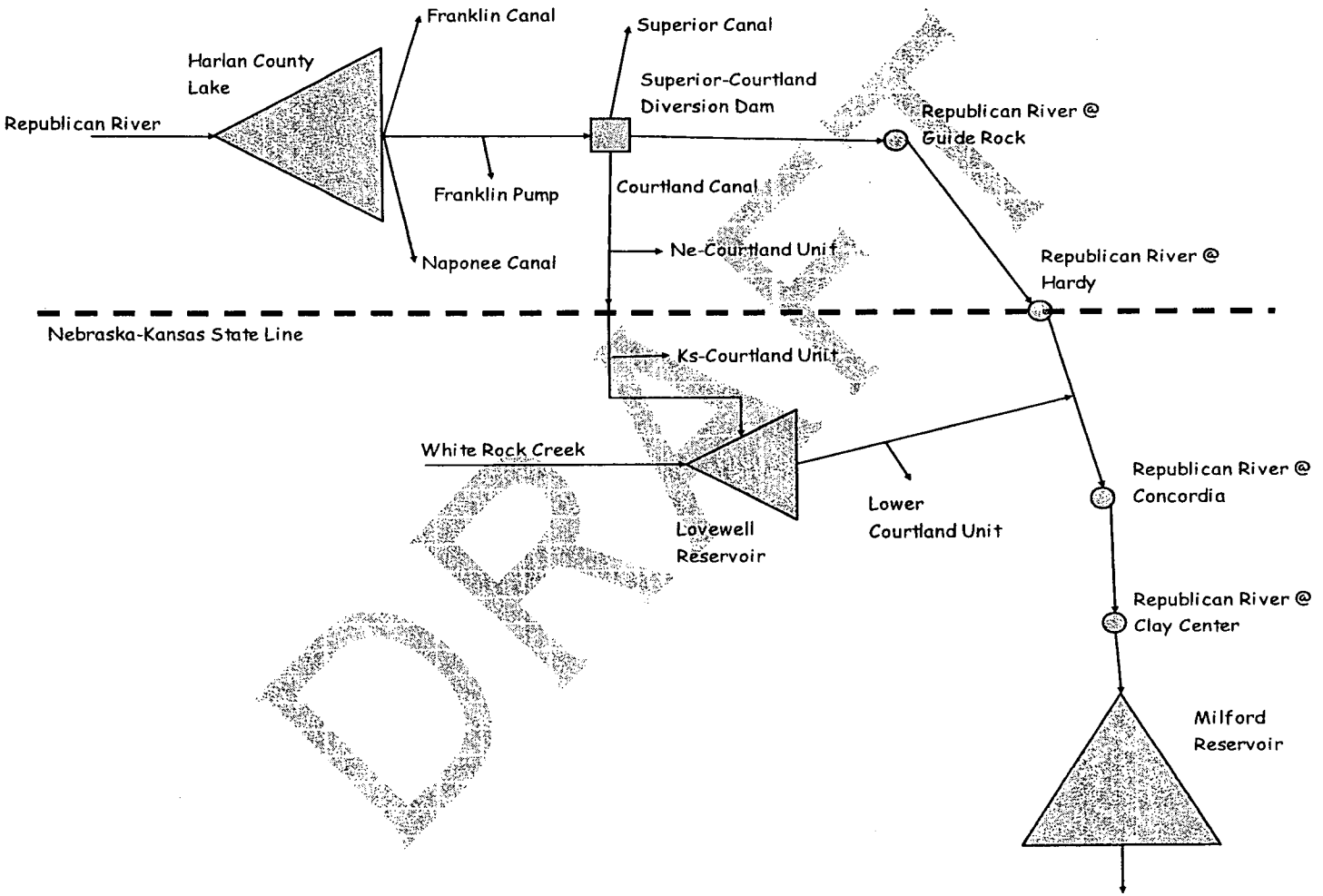


Table 2.—Lower Republic Appraisal Study Alternative Definitions

	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

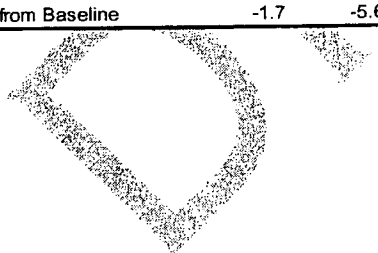


Table 3.—Summary of Model Simulation Results (continued)

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

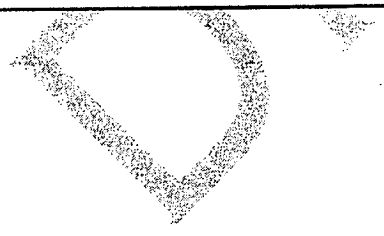
Table 4.—MDS Results

Republican River at Clay Center, Nebraska
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, Nebraska
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

FEATURE: 16-Dec-03

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\[LOCKED Alt A.xls]Sheet 2

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: 16-Dec-03

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\[LOCKED Alt A.xls]Sheet 2

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

SHEET__1__ OF __2__

FEATURE: 16-Dec-03
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\New 12.16.3\[

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 12/16/2003	PRICE LEVEL Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 16-Dec-03

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\New 12.16.3\I

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 12/16/2003	PRICE LEVEL Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 16-Dec-03

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

PROJECT: Missouri River Basin

REGION: GP **WOID: 6B465**

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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, for the control of the existing motorized radial gates including basic RTU software and RTU special function software.	D-8140	12	ls	$10,000.00	$120,000.00
	2	Furnishing and installing 120V power for RTU from Power drop. Assume 250' steel conduit and single phase power cable.	D-8140	12	ls	$4,000.00	$48,000.00
	3	Furnishing & Installing motor operator w/ combination motor/starter NMA Type 4 enclosure, 240 V single phase. (5 Bays @ headwrks)		20	ls	$7,000.00	$140,000.00
		Stilling wells at 11 sites:	D-8140				
	4	Furnishing and installing 36B25 RCP installed vertically on conc pad. Assume 5' dia x 13' deep excavation in soil prior to installation.		325	ft	$350.00	$113,750.00
	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 well and RTU - four wire twisted pairs.		6,250	ft	$8.00	$50,000.00
	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 at 11 checks and at Diversion Dam.		800	ft	$20.00	$16,000.00
	10	Furnishing and installing 2-inch galvanized steel manifold pipe at at 11 checks and at Diversion Dam.		200	ft	$20.00	$4,000.00
	11	Furnishing and installing air compressor (4 cfm, 5 hp size) at 11 checks and Diversion Dam.		12	each	$1,000.00	$12,000.00
	12	Furnishing and installing single phase 5kv power line (w/wood poles) for the bubblers (1 mile pull per location) at 10 checks and at Diversion Dam.		12	each	$20,000.00	$240,000.00

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: 16-Dec-03

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\New 12.16.3\[

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 recomd)					
	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

SHEET_3_ OF _3_

FEATURE: 16-Dec-03

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\New 12.16.3\[

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

FEATURE: 16-Dec-03

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\New 12.16.3\[

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: 16-Dec-03

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\New 12.16.3\I

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** SHEET__1__ OF __3__

FEATURE: 16-Dec-03

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\New 12.16.3\I

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: 16-Dec-03

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\New 12.16.3\[

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

FEATURE: 16-Dec-03

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\New 12.16.3\[

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: 16-Dec-03

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\New 12.16.3\I

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, for the control of the existing motorized radial gates including basic RTU software and RTU special function software.	D-8140	12	ls	$10,000.00	$120,000.00
	2	Furnishing and installing 120V power for RTU from Power drop. Assume 250' steel conduit and single phase power cable.	D-8140	12	ls	$4,000.00	$48,000.00
	3	Furnishing & Installing motor operator w/ combination motor/starter NMA Type 4 enclosure, 240 V single phase. (5 Bays @ headwrks)		20	ls	$7,000.00	$140,000.00
		Stilling wells at 11 sites:	D-8140				
	4	Furnishing and installing 36B25 RCP installed vertically on conc pad. Assume 5' dia x 13' deep excavation in soil prior to installation.		325	ft	$350.00	$113,750.00
	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 well and RTU - four wire twisted pairs.		6,250	ft	$8.00	$50,000.00
	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 at 11 checks and at Diversion Dam.		800	ft	$20.00	$16,000.00
	10	Furnishing and installing 2-inch galvanized steel manifold pipe at at 11 checks and at Diversion Dam.		200	ft	$20.00	$4,000.00
	11	Furnishing and installing air compressor (4 cfm, 5 hp size) at 11 checks and Diversion Dam.		12	each	$1,000.00	$12,000.00
	12	Furnishing and installing single phase 5kv power line (w/wood poles) for the bubblers (1 mile pull per location) at 10 checks and at Diversion Dam.		12	each	$20,000.00	$240,000.00

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 2 OF 2

FEATURE: 16-Dec-03
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\New 12.16.3\I

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

FEATURE: 16-Dec-03

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\New 12.16.3\

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

FEATURE: 16-Dec-03

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\New 12.16.3\[

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: 16-Dec-03

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\New 12.16.3\

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: 16-Dec-03

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\New 12.1

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	12/16/03	APPROVED	DATE 12/16/03	PRICE LEVEL Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 16-Dec-03

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\New 12.16.3\

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		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: 16-Dec-03

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\New 12.16.3\

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

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 or Feasibility level 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

Element	Description	Assumptions	Unit Cost	Project Cost
Marina (continued)				
Fuel storage and distribution			**NO COST DATA**	
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

Element	Description	Assumptions	Unit Cost	Project Cost
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
Gross Total Cost				**$2,045,525**
Total Cost with Location Factor				**$1,881,883**
Lovewell Wildlife Area				
	Oak Hill 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. 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

Element	Description	Assumptions	Unit Cost	Project Cost
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
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

Element	Description	Assumptions	Unit Cost	Project Cost
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.	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
Ft. X 16 ft.				
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				

Element	Description	Assumptions	Unit Cost	Project Cost
	Oak Hill Primitive Camping Area	No impact.		
	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

Lower Republican Irrigation 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 preliminary 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.

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 Applied	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

Lower Republican River Appraisal Study – Recreation

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.

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

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

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 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 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.

B 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.

B.1 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 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

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
• 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
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	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	***Yes***	***Yes***	No	No	No
• Highway 14	1586.6	1582.6	***Yes***	***Yes***	No	No	No
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 Area	1583	1578	***No***	***No***	***Yes***	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	***Yes***	***Yes***	No	No	No
• Highway 14	1586.6	1582.6	***Yes***	***Yes***	No	No	No
Lovewell Marina	1583	1577	***No***	***No***	***Yes***	No	No
Lovewell Beach	1583	1573	***No***	***No***	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	1583	1578	***No***	***No***	***Yes***	No	No
• Marina	1583	1579	***No***	***No***	***Yes***	No	No
• Cabin Area	1583	1579	***No***	***No***	***Yes***	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	***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 Area	1583	1578	***No***	***No***	***Yes***	No	No
• Marina	1583	1579	***No***	***No***	***Yes***	No	No
• Cabin Area	1583	1579	***No***	***No***	***Yes***	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	***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
9) Alternative H (Raise Lovewell 16,000 AF):							
Water Levels:			**1583.6**	**1583.8**	**1576.6**	**1572.9**	**1574.6**
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	***Yes***	***Yes***	No	No	No
• Highway 14	1586.6	1582.6	***Yes***	***Yes***	No	No	No
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 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	***Yes***	***Yes***	No	No	No
• Highway 14	1586.6	1582.6	***Yes***	***Yes***	No	No	No
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

B.1.1 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.

B.1.2 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.

B.1.3 ALTERNATIVE B - AUTOMATE, WINTERIZE COURTLAND CANAL

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

B.1.4 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.

B.1.5 ALTERNATIVE D - AUTOMATE, WINTERIZE COURTLAND CANAL; RAISE LOVEWELL 16,000 AF

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.

B.1.6 ALTERNATIVE E - AUTOMATE, WINTERIZE, COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 16,000 AF

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.

B.1.7 ALTERNATIVE F - AUTOMATE, WINTERIZE COURTLAND CANAL; RAISE LOVEWELL 35,000 AF

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.

B.1.8 Alternative G - Automate, Winterize, Courtland Canal to Design Capacity; Raise Lovewell 35,000 AF

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

B.1.9 Alternative H - Raise Lovewell 16,000 AF

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.

B.1.10 Alternative I - Courtland Canal to Design Capacity; Raise Lovewell 16,000 AF

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.

B.2 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 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	No	No
• Highway 14	1586.6	1582.6	No	No	No	No	No
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 Area	1583	1578	No	***Yes***	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	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	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 Area	1583	1578	No	***Yes***	No	No	No
• Marina	1583	1579	No	***Yes***	No	No	No
• Cabin Area	1583	1579	No	***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	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 Area	1583	1578	No	***Yes***	No	No	No
• Marina	1583	1579	No	***Yes***	No	No	No
• Cabin Area	1583	1579	No	***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	No	No	No
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 Area	1583	1578	No	***Yes***	No	No	No
• Marina	1583	1579	No	***Yes***	No	No	No
• Cabin Area	1583	1579	No	***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	No	No	No

	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:			**1577.8**	**1580.0**	**1571.7**	**1571.4**	**1571.4**
Boat Ramps:							
• Concessions Area	1583	1578	No	***Yes***	No	No	No
• Marina	1583	1579	No	***Yes***	No	No	No
• Cabin Area	1583	1579	No	***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	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 Area	1583	1578	***Yes***	***Yes***	No	No	No
• Marina	1583	1579	No	***Yes***	No	No	No
• Cabin Area	1583	1579	No	***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	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 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	No	No	No
9) Alternative H (Raise Lovewell 16,000 AF):							
Water Levels:			**1575.1**	**1574.9**	**1571.7**	**1571.4**	**1571.4**
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	No	No
• Highway 14	1586.6	1582.6	No	No	No	No	No
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 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	No	No
• Highway 14	1586.6	1582.6	No	No	No	No	No
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

B.2.1 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.

B.2.2 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.

B.2.3 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.

B.2.4 ALTERNATIVE C - AUTOMATE, WINTERIZE, COURTLAND CANAL TO DESIGN CAPACITY

Same as Alternative B.

B.2.5 ALTERNATIVE D - AUTOMATE, WINTERIZE COURTLAND CANAL; RAISE LOVEWELL 16,000 AF

Same as Alternative B.

B.2.6 ALTERNATIVE E - AUTOMATE, WINTERIZE, COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 16,000 AF

Same as Alternative B.

B.2.7 ALTERNATIVE F - AUTOMATE, WINTERIZE COURTLAND CANAL; RAISE LOVEWELL 35,000 AF

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.

B.2.8 ALTERNATIVE G - AUTOMATE, WINTERIZE, COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 35,000 AF

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.

B.2.9 ALTERNATIVE H - RAISE LOVEWELL 16,000 AF

Same as baseline alternative.

B.2.10 ALTERNATIVE I - COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 16,000 AF

Same as baseline alternative.

B.3 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
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							
• 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***
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***

Recreation Facility	Thresholds		Availability by Month				
	High End	Low End	May	June	July	Aug	Sept
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
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	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	No	***No***
• Highway 14	1586.6	1582.6	***No***	***No***	No	No	***No***
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
9) Alternative H (Raise Lovewell 16,000 AF):							
	Water Levels:		**1587.4**	**1587.4**	**1585.4**	**1575.9**	**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***	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 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***
Key: No = Facility Unavailable, Yes = Facility Available ***Yes or No*** in Bold, Italics, and Centered in Cell = different from baseline							

B.3.1 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.

B.3.2 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.

B.3.3 ALTERNATIVE B - AUTOMATE, WINTERIZE COURTLAND CANAL

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

B.3.4 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.

B.3.5 ALTERNATIVE D - AUTOMATE, WINTERIZE COURTLAND CANAL; RAISE LOVEWELL 16,000 AF

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.

B.3.6 ALTERNATIVE E - AUTOMATE, WINTERIZE, COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 16,000 AF

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.

B.3.7 ALTERNATIVE F - AUTOMATE, WINTERIZE COURTLAND CANAL; RAISE LOVEWELL 35,000 AF

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.

B.3.8 ALTERNATIVE G - AUTOMATE, WINTERIZE, COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 35,000 AF

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.

B.3.9 ALTERNATIVE H - RAISE LOVEWELL 16,000 AF

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.

B.3.10 ALTERNATIVE I - COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 16,000 AF

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.

C 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.

C.1 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

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

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.

C.2 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.

C.3 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
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

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	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
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

C.3.1 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.

C.3.2 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.

C.3.3 ALTERNATIVE B - AUTOMATE, WINTERIZE COURTLAND CANAL

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

C.3.4 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).

C.3.5 ALTERNATIVE D - AUTOMATE, WINTERIZE COURTLAND CANAL; RAISE LOVEWELL 16,000 AF

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.

C.3.6 ALTERNATIVE E - AUTOMATE, WINTERIZE, COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 16,000 AF

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.

C.3.7 ALTERNATIVE F - AUTOMATE, WINTERIZE COURTLAND CANAL; RAISE LOVEWELL 35,000 AF

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.

C.3.8 ALTERNATIVE G - AUTOMATE, WINTERIZE, COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 35,000 AF

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).

C.3.9 ALTERNATIVE H - RAISE LOVEWELL 16,000 AF

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

C.3.10 ALTERNATIVE I - COURTLAND CANAL TO DESIGN CAPACITY; RAISE LOVEWELL 16,000 AF

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

PLAN OF STUDY

FEASIBILITY STUDY

LOWER REPUBLICAN RIVER BASIN

NEBRASKA-KANSAS

FEASIBILITY STUDY

PRELIMINARY PLAN OF STUDY

NEBRASKA-KANSAS AREA OFFICE
GREAT PLAINS REGION
BUREAU OF RECLAMATION

DRAFT
January 16, 2004

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 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 and continues through the preparation of the final feasibility report (Planning Report/EIS) and signing of the ROD by the Commissioner. Advance Planning activities such as project design and other implementation activities will be covered in a subsequent project management plan or final engineering report 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* (P&Gs).

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

The POS is also a basis for change. Because planning is an iterative process without a predetermined outcome, more or less 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 Planning Report/EIS. 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 key findings of the appraisal study and the plan formulation rationale. The appraisal study was completed in January 2003. The Chapter also identifies feasibility study assumptions, the planning process to be followed and the level of detail of the analyses to be undertaken.

Chapter III — 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 IV. This chapter provides a reference to the detailed scopes of work that are included as Enclosure C.

Chapter IV — 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 V — Quality Management.

This chapter addresses quality management and lists the members of the study team and the independent review team.

Chapter VI — Procedures and Criteria.

This chapter identifies references to the Reclamation Manual and other guidance that coversthe planning process and reporting procedures.

LIST OF ENCLOSURES

CHAPTER II

APPRAISAL STUDY SUMMARY

I LOWER REPUBLICAN RIVER BASIN APPRAISAL STUDY

The appraisal study was completed by Reclamation in cooperation with the States of Kansas and Nebraska. The draft executive summary of the study follows:

GENERAL

The study area for this appraisal report is the Lower Republican River Basin from below Harlan County Dam in south central Nebraska to Clay Center, Kansas just above the upper reaches of Milford Reservoir in north central Kansas. Included in this area is the Bostwick Division located in Nebraska and Kansas, a Reclamation project which includes Lovewell Dam and Reservoir. The Republican River Compact (Compact) provides for allocation and use of the waters in the basin above the Nebraska/Kansas stateline near Hardy, Nebraska to Colorado, Nebraska, and Kansas. The entire water supply originating downstream from Hardy is allocated to Kansas. Projects that divert water above Hardy must comply with provisions of the Republican River Compact. In 1984 Kansas established Minimum Desirable Streamflow (MDS) requirements at two locations in the study area on the Republican River at Concordia and Clay Center. Periodically, streamflows have been below established MDS target levels requiring administration of water rights in these areas. The purpose of this appraisal study is 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.

KS v. NE & CO LAWSUIT AND SETTLEMENT NEGOTIATIONS

In May, 1998, the State of Kansas filed a motion with the U.S. Supreme Court (Court) alleging the States of Nebraska and Colorado were violating the Republican River Compact. The case was given to a Special Master and Colorado, Kansas, and Nebraska (States) entered into negotiations for settlement. Representatives of the United States were involved in the negotiations. On May 19, 2003 the Court approved the Final Settlement Stipulation (FSS) entered into by the States. The Supreme Court accepted the Special Master's Final Report on October 20, 2003.

The FSS addressed the need for system improvements in the Republican River Basin. In Section IV.E of the FSS it states: "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." Also in Section V.A its states: "Kansas and Nebraska, in collaboration with the United States agree to take actions to minimize the bypass flows at Superior-Courtland diversion Dam."

During the negotiations for settlement, a Value Study Report was completed and the Republican River Compact Commissioners recommended the following proposals 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

DEVELOPMENT OF ALTERNATIVES

The Lower Republican River Basin is subject to periodic flooding, periods of excess precipitation, and occasional droughts. The Bostwick Division includes two irrigation districts, the Bostwick Irrigation District in Nebraska with service available for 22,935 acres and Kansas Bostwick Irrigation District No. 2 with service available for 42,500 acres. Due to altered hydrologic conditions within the entire Republican Basin, these districts frequently experience water delivery shortages. The existing project facilities for the Bostwick Division in Nebraska and Kansas are approximately 50 years old. The problems associated with these aging facilities and the changed hydrologic conditions require better utilization of the available water supplies. There are opportunities to improve the efficient use and overall management of the Lower Republican River Basin's water resources in such a manner as to increase the water supplies for Bostwick Division lands and provide additional flexibility for the States to comply with the Compact settlement provisions or supply waters for supplementing flows to meet established MDS flows.

Nine alternatives were formulated 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. 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 or Jamestown Wildlife Management Area sites. Because of the operations model limitations, the hydrology analyses modeled the operation of the system for each alternative with the intent to maximize irrigation benefits. 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 have been quantitatively estimated. Allocation of water to provide MDS benefits would reduce the water available to provide irrigation benefits.

RESULTS FROM STUDY

The irrigation benefits accruing from the changes in operations associated with each alternative were estimated and the benefits were then compared to project costs. At this time, the alternatives which involve Lovewell Reservoir enlargements along with automating and winterizing the Courtland Canal appear to be the most viable. The enlargement alternatives could also, potentially, increase the recreational use at Lovewell Reservoir. There are environmental impacts 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 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. Four of the alternatives have benefits which exceed costs. The benefit-cost ratios for the alternatives ranged from 0.13 to 4.2.

FINDINGS

Reclamation has been involved in the Lower Republican Basin for over 60 years. Federal contracts to provide water service to the two irrigation districts have recently been renewed. 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. In addition, streamflows will periodically be less than the MDS established flows in Kansas. Presently some water supplies in the Lower Republican River 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. 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 feasibility study.

The POS assumes that Reclamation is directed by Congress to conduct the study and therefore that there is a Federal (Reclamation) interest in participating in a cost-shared feasibility study for providing water supply improvements in the Lower Republican River Basin Area.

- Planning Objectives and Constraints – (To be completed later)

- Feasibility Study Authority–Draft legislation. On October 2, 2003, Congressman Tom Osborne (NE) introduced H.R. 3241 and 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 Republican River Basin between Harlan County Lake in Nebraska and Milford Lake in Kansas"

II LOCATION OF STUDY, NON-FEDERAL SPONSOR AND CONGRESSIONAL DISTRICTS

Based on the draft authorizing legislation, the study area is located in the Republican River 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 Lower Republican Basin over the last sixty years. Some of the more significant reports are listed. The 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.

- Bostwick Division, Nebraska-Kansas, Volume 1, Parts 1, 2, 3, and 4, Definite Plan Report (DPR), June 1953, USBR, Region 7, Denver, Colorado.
- Bostwick Division, Nebraska-Kansas, Volume 1, Supplement, General Plan of Development, Definite Plan Report (DPR), April 1956 by USBR, Region 7, Denver, Colorado.
- Resource Management Assessment, Republican River Basin, Water Service Contract Renewal, Bureau of Reclamation, Great Plains Region, July 1996

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

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

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

- Value Study Report, Proposals for More Efficient Management of Lower Republican River Water Supplies, USBR, Technical Service Center, Denver, Colorado, December 17, 2002.
- Final Settlement Stipulation, Supreme Court of the United States, Kansas vs. Nebraska and Colorado, December 15, 2002.

- Volume Analysis and Revised Flood Frequency Analysis for Comprehensive Facility Review, Lovewell Dam, USBR, 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, USBR, TSC, September 2003.

IV PRELIMINARY FINANCIAL ANALYSIS

As the non-Federal sponsors, the States of Nebraska and Kansas will be required to provide 50 percent of the cost of the feasibility study. The sponsors are also aware of the cost sharing requirements for potential project implementation. A letter of intent from the local sponsors stating a willingness to pursue the feasibility study and to share in its cost and an understanding of the cost sharing is included as Enclosure XX (to be inserted later).

V ASSUMPTIONS AND EXCEPTIONS

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

- Without Project Condition. The planning horizon is anticipated to be year 2040. The team will verify previous analyses and reports, including but not limited to water supply needs.

- Study Area. Assume that the Act directs Reclamation to conduct a study for meeting the water supply needs in the Lower Republic Basin between Harlan County Lake in Nebraska and Milford Reservoir 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 and developed 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 assessment to document existing versus modified reservoir dam safety risks will be completed in 2004.

The specific changes in risk scenarios associated with the enlargement proposal will be documented. The risk assessment 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 consider the nine alternatives identified in the Appraisal Study plus two additional storage reservoir sites refered to as Beaver Creek and Jamestown sites.

- Start Date. Assume a start date of 10/01/2004.

- Cost Estimates. Costs are current through FY 2004.

- Policy Exceptions. The study will be conducted in accordance with the feasibility study authorizing legislation, the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) (Water Resource Council, 1983), Reclamation law and policies contained within the Reclamation Manual. No exceptions to established guidance and policy have been identified.

VI POTENTIAL ISSUES AFFECTING INITIATION OF FEASIBILITY STUDY

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

VII THE PLANNING PROCESS IN THE FEASIBILITY STUDY

- Principles and Guidelines. 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 Lower Republican River Basin Feasibility Study is provided as Enclosure F.

- Plan Formulation. 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 are identified and evaluated to address problems, take advantage of opportunities, meet planning objectives and avoid constraints. Potential storage options plans have been under various levels of study for several years and the alternatives from earlier studies will be reviewed and summarized as part of the formulation process. 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 NED Plan. Plans that address State and local concerns or emphasize other functions such as environmental quality and other social effects will also be formulated. The No Action or Future Without plan will be identified which describes 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.

- 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 (OMR) 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.

VIII PROJECT AREA MAP

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

CHAPTER III

SUMMARY SCOPES OF WORK

MILESTONES

Seven milestones are identified for the 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 Planning Report/EIS to Regional Director

F7 ROD Signed by Commissioner

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:

Hydrology Studies and Report

Engineering and Design Analysis and Report

Socioeconomic Studies and Report

Real Property Studies and Report

Environmental Studies and Report

Fish and Wildlife Coordination Act Report

Cultural Resource Studies and Report

Public Involvement Process

Project Management

Review Team

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 II 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 II, Section VII D, 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.

A. Hydrology Studies and Report. $X

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.

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

   a. Operations (reservoir yield, storage allocations, return flow and storage, exchanges, in-stream flows, etc.

   b. Water Rights

   c. Compacts

   d. Environmental and Recreation (water quality, in-stream flows, flat-water recreation)

B. Engineering and Design Analysis and Report. $X

1. Future Without (No Action) —

2. Future With — Engineering involvement in support 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.

C. Socioeconomic Studies and Report. $X

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 described.
2. Future With — Alternatives will be developed and evaluated to meet identified needs and will include coverage of the P&G items such as NED, RED, EQ and OSE.

D. Real Property Studies and Report. $X

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.

E. Environmental Studies and Report. $X

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 report (Planning Report/EIS) preparation.

F. Fish and Wildlife Coordination Act Report. $X

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 Jamestown Site and overall water quality in the study area.
2. 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.

G. Cultural Resource Studies and Report. $X

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 Jamestown Site.

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, utility, road and recreation area relocation, borrow areas, etc. When a recommended plan is identified, extensive fieldwork will be conducted and a detailed resource inventory developed which will be important for signing a MOA or Programmatic Agreement with 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.

H. Public Involvement Process. $X

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.

I. Project Management. $X

This includes study management responsibilities and cost for the study team leader over a 3-year period.

J. Review Team. $X

This item includes "peer review" activities as described in Chapter V for an independent review team assumed to be comprised of members representing D-5000, D-8000, GPRO, NKAO and the Field Solicitor's Office.

CHAPTER IV

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 Project Manager and first line supervisors of functional organizations in the Area Office, Regional Office, Technical Service Center and the sponsors. The primary responsible organization for each parent task is identified by organization codes in the following table, keeping in mind that Reclamation and the sponsor could likely each have responsibilities with any given parent task.

Parent Task	Reclamation	Sponsor	Other
Hydrology Studies and Report	D-8000	NE/KS ??	
Engineering Design Analysis and Report	D-8000		
Socioeconomic Studies and Report	D-8000		
Real Property Studies and Report	NKAO/GP		
Environmental Studies and Report	NKAO/GP		
Fish and Wildlife Coordination Act Report	--	--	USFWS
Cultural Resource Studies and Report	NKAO		
Public Involvement Process	NKAO	NE/KS	
Project Management	NKAO		
Review Team	D-5000 D-8000 GPRO NKAO SOL	NE/KS	

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 1,2004 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 detailed scopes of work that are included in Enclosure C. Study cost estimates include allowances for inflation by using a 5 percent factor. Before indexing for inflation, the total study cost is $X and after applying the 5 percent factor, the total estimated cost is $X.

Appropriate contingencies are 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 is $X, rounded to $X

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 the following table. Nebraska and Kansas have agreed to equally share the non-Federal cost share portion with either cash or in-kind services.

DRAFT— PLAN OF STUDY
LOWER REPUBLICAN RIVER BASIN—FEASIBILTY STUDY

Description	Total Cost $	Federal Cost $	NE In-Kind or Cash $	KS In-Kind or Cash $
Hydrology Studies and Report				
Engineering Design Analysis and Report				
Socioeconomic Studies and Report				
Real Property Studies and Report				
Environmental Studies and Report				
FWCA Report				
Cultural Resource Studies and Report				
Public Involvement Documents				
Project Management				
Review Team				
SUBTOTAL				
5% for inflation				
Contingencies @ 10% of above				
TOTAL (rounded)				

CHAPTER V

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 and other technical as well as policy and legal considerations. Quality management will be undertaken via a quality control (QC) process and a quality assurance (QA) process to achieve a feasibility report, NEPA document and services that meet or exceed customer requirements and are consistent with Reclamation policies, rules and regulations.

For QC, the interdisciplinary planning team will undertake the study, at key junctures functional supervisors will perform a check and an independent review team will review the products. In addition, work performed by TSC team members will utilize the existing TSC "peer review" process.

For QA, the Regional Planning Coordinator will assure that the QC process has been adequately incorporated into the POS (see Enclosure D). During the study, the Area Manager will certify that technical reviews ("checks") and TSC "peer reviews" and reviews conducted by the independent review team were completed, documented and addressed by the study team.

II DOCUMENTS TO BE REVIEWED AND SCHEDULE FOR REVIEW ACTIVITES

The process for accomplishing policy and technical review will begin with study initiation and will proceed throughout the study. 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 "checking" and TSC "peer review" are included in the cost estimates for each discipline while costs for the independent review team are accounted for separately.

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. The independent review team will participate at each of these milestone meetings with the study team. 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

"Check" and TSC Peer Review Protocol—Functional supervisors in the 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. TSC disciplines will utilize the standard "peer review" process developed and implemented by TSC several years ago.

Independent Review Team.—An independent review team will be established to review products at key junctures in the study and will be comprised from a representative from D-5000, D-8000, GPRO, NKAO, and the Field Solicitor's Office. 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. The team will also review the Draft Planning Report/EIS 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 and Regional Director. The memoranda will be used to revise or incorporate changes to the study, to complete all required detailed analyses and prepare the draft Planning Report/EIS 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 memorandum are fully addressed.

IV REVIEW CHECKLIST

These reviews 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 reviewers, a checklist is provided as Enclosure G.

V ROSTER OF THE FEASIBILITY STUDY TEAM

Organization/Function	Name/Title	Address	Phone/e-mail

VI ROSTER OF THE REVIEW TEAM

Organization/Function	Name/Title	Address	Phone/e-mail
D-5000			
D-8000			
GPRO			
NKAO			
SOL			

VII POS QUALITY CERTIFICATION

The Regional Planning Coordinator has certified that the review process for the study has been adequately described and incorporated into this POS. The signed certification is included as Enclosure D.

VII FEASIBILITY STUDY QUALITY CERTIFICATION

The documentation produced during the review process ("checking", TSC "peer review" and independent review team) will be included with the submission of the Planning Report/EIS 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 resolved. The Regional Director will similarly certify the entire final Planning Report/EIS upon submittal to the Commissioner.

CHAPTER VI

PROCEDURES AND CRITERIA

I EVOLUTION OF THE POS

The POS describes all activities through the signing of the ROD by the Commissioner. As the POS is based primarily on existing information, it will be subject to scope changes as the technical picture unfolds. This POS will be reviewed at the initiation of the study and additional detail will be added to the scopes of work as needed. During the feasibility study, the current POS, including the documentation of agreements on changes to the conduct of the study, will be addressed at each of the milestone meetings.

THE PLANNING PROCESS

The P&G is the basic planning guidance which establishes a six-step planning process. This process is a conceptual planning sequence for developing solutions to water resource problems and opportunities and will be followed in this study.

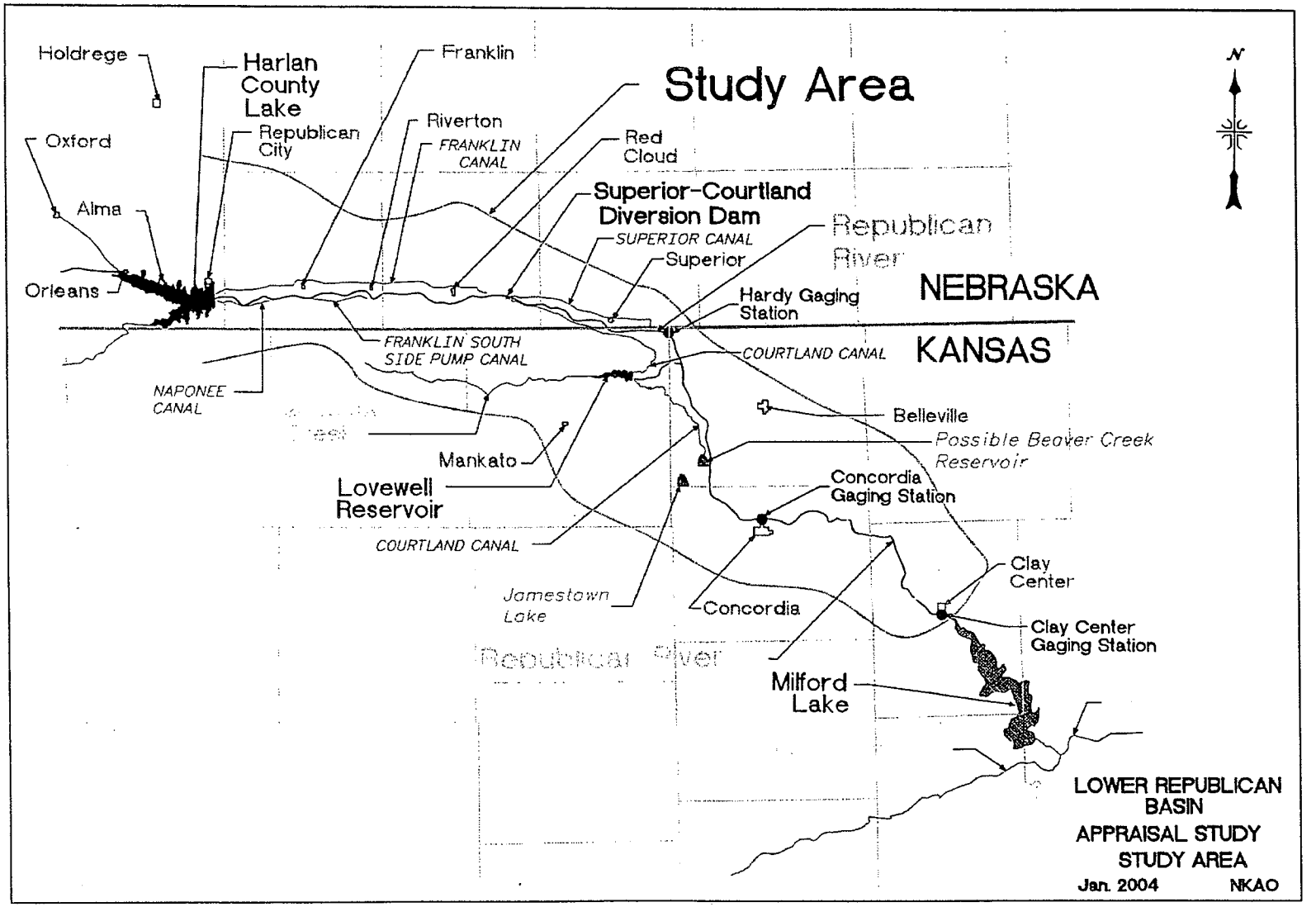
POLICY

In addition to the P&G, the policies that govern the development of projects are contained in the Reclamation Manual and Regional guidance memoranda.

LIST OF ENCLOSURES

ENCLOSURE A

STUDY AREA MAP


Holdrege
Harlan County Lake
Franklin
Study Area
Oxford
Republican City
Riverton
FRANKLIN CANAL
Red Cloud
Alma
Superior-Courtland Diversion Dam
SUPERIOR CANAL
Superior
Republican River
Orleans
Hardy Gaging Station
NEBRASKA
KANSAS
FRANKLIN SOUTH SIDE PUMP CANAL
COURTLAND CANAL
NAPONEE CANAL
Belleville
Possible Beaver Creek Reservoir
Mankato
Lovewell Reservoir
Concordia Gaging Station
COURTLAND CANAL
Clay Center
Jamestown Lake
Concordia
Clay Center Gaging Station
Republican River
Milford Lake
LOWER REPUBLICAN BASIN
APPRAISAL STUDY
STUDY AREA
Jan. 2004
NKAO

ENCLOSURE B

FEASIBILITY STUDY MILESTONES

MILESTONE NAME	DESCRIPTION
Initiate Study	Milestone F1 This is the date Reclamation receives study funds.
Final Public Workshop/Scoping Meeting	Milestone F2 This is the final public workshops/scoping meeting to inform the public and obtain input, public opinions and fulfill scoping requirements for NEPA purposes.
Preliminary Formulation Scoping Meeting	Milestone F3 The scoping meeting is with the study team, the independent review team and the sponsor to address potential changes in the POS, to establish 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.
Alternative Formulation Meeting	Milestone F4 The Alternative Formulation Meeting (AFM) completes plan formulation. At this meeting among the study team, the independent review team and the sponsor, 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.
Public Review	Milestone F5 This milestone is the conclusion of field level coordination of the draft Planning Report/EIS including review by the public and the independent review team.

Final Planning Report/EIS to RD	Milestone F6 Date of submittal of final report package to GP Region including technical and legal certifications, compliance memoranda and other required documentation.
ROD or FONSI Signed	Milestone F7 Date of the signature. This milestone is used as the completion of the feasibility study.

ENCLOSURE C

SCOPES OF WORK

I HYDROLOGY STUDIES AND REPORT

ISSUES & CONCERNS TO BE ADDRESSED

Determine extent of the existing hydrologic studies and address additional model development requirements.

A. Project Operations
   1. Yield of the Project
   2. Storage Allocations
   3. Exchanges

B. Project Water Rights

C. Compact Obligations

D. Environmental Issues
   1. Affects to water quality
      A. Instream flows

Task	Overall Time For Task	Resources	Unit (Days)	Cost
Review Exist Doc.*				
Obtain Contract*				
Review Exist. Model				
Modify / Extend Model				
Rerun Model				
Evaluate Results				
Totals				

**can be concurrent*

II ENGINEERING AND DESIGN ANALYSIS AND REPORT

Staff day estimates, estimated cost, and involved TSC codes are shown on the following table:

TSC Code	Staff Days			Labor	Non Labor	Total
	L1	L2	L3			
D-8312 (Geotechnical Engineering)						
D-8130 (Spillways and Concrete Dams)						
D- 8170 (Specs & Estimates)						
D-8320 (Geology)						
D-8350 (Technicians)						
D-8140 (Roads)						
Totals						
CRB (Consultant Review Board)						
Grand Total						

Lovewell Reservoir Enlargements and other storage sites –

SUMMARY OF DAM SAFETY ACTIVITIES

1. Feasibility Design Estimates

TSC Code	Staff Days			Labor	Non Labor	Total
	L1	L2	L3			
D-8010						
D-8110						
D-8130						
D-8160						
D-8170						
D-8311						
D-8312						
CRB						

TSC Code	Staff Days			Labor	Non Labor	Total
	L1	L2	L3			
Total						

VALUE ENGINEERING (VE) PLANNING STUDIES

Task	Member (code)	Staff Day Cost	Staff Days	Task Cost
Team Lead (Preparation)				
Team Lead (Value Study)				
Team Lead (Report)				
Report				
Team Support				
Team Member				
Team Member				
Team Member				
Team Member				
Team Member				
Team Member				
Team Member				
Team Member				
Team Member				
Team Member				
Team Member				
Review, Incidental				
Liaison				
	Non-Labor			
	Travel			
	Total Value Study Cost			

Each of the VE studies would be reviewed by a technical TSC team and a consulting review board (CRB). The review costs for a single VE study is as follows:

Group	Total SD	Labor	Non Labor	Total
D8010				
D8130				
D8160				
D8170				
D8300				
D8320				
CRB				
Total				

III SOCIOECONOMIC STUDIES AND REPORT

STUDY ELEMENTS:

1. Problems and needs:

   Task:

EVALUATION OF ALTERNATIVES

1. National Economic Development evaluation of alternatives involves a comparison of the costs of the proposed plan against the cost of the next most likely alternative to be implemented in the absence of the proposed NED development. The cost of implementing the next most likely alternative becomes the measure of M&I benefit. Therefore, the measure of economic benefit will require engineering studies to determine the costs of the alternative(s). Some of these were scoped in phase II of the storage committee's analysis. Reclamation will have to review these for adequacy.

   Task: Review analysis of storage alternatives and assess whether they are of sufficient detail to permit use for the most likely alternative.

2. Regional Economic Analysis will look at the impacts of the different alternatives from a regional perspective. The Region will necessarily include areas within the district but may include others further downstream if the potential impacts from the proposed plans may change economic activity significantly in downstream areas. This also provides input in to the social analysis in terms of jobs and other economic shifts that have social implications.

   Task: Develop regional economic model, analyze alternatives.

Other social effects: Social analysis will identify social impacts of changes engendered by the plans. These can be shifts in population, industry, jobs, and other social impacts. Social analysis will also have input to the acceptability alternatives. The NEPA compliance documents require social analysis

Task	Staff Days	Total
A. Review needs assessment		
B1. Review analysis of storage alternatives		
B2. Develop regional economic model		
B3. Social analysis		
Total		

IV REAL PROPERTY STUDIES AND REPORT

ISSUES/CONCERNS

Dam raise/reservoir enlargements - verify the need for real property land acquisitions including take line adjustments and determined need for flowage easements;

WORK SCHEDULE

Resource 0.25 FTE	Cost Estimate
Staff	
Materials/Supplies/Ownership Record Searches	
Total	

V 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: Need to acquire additional lands interest as a result of enlargements and higher water surfaces at east slope storage facilities.
3. Recreation: Changes in Points of Diversion and stream flows that affect fishery habitat, recreation, water quality
4. Socioeconomic impacts: Effects on downstream agricultural interests and growth.
5. Stream flow changes: Stream flow changes as they affect other resources should be modeled to help determine effects.
6. Threatened and Endangered Species: To be determined through consultation with FWS
7. Wildlife: effects on avian nesting species and other species that are affected by changes in operation and enlargements. Determined thru 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 flows regimes.
10. Recreation: Impacts to existing recreation facilities due to dam enlargements

Resources (staffing, materials, etc.)

WORK SCHEDULE

Task	Time to completion (months)
Complete draft study reports to address issues identified, but not addressed in the PSOP Technical Reports	
Preliminary Draft EIS/Feasibility Study (FS) for internal agency review	
Preliminary DEIS/FS - agency comments/revisions	
Distribute DEIS/FS for public review/comment, public hearings	
Incorporate/respond to DEIS/FS comments (finalize DEA/FS)	

Prepare and sign ROD - Distribute copies of FEIS/ROD	
Total	

COST ESTIMATE

VI FISH AND WILDLIFE COORDINATION ACT REPORT

ANTICIPATED FISH AND WILDLIFE RELATED ISSUES

Resources (staffing, materials, etc.) needed

Activity	Cost
1. Mapping and quantifying riparian, wetland, and other wildlife habitat types that would be affected by the new maximum water surface elevations	
2. Modeling necessary to predict frequency of flooding of additional areas that will be affected by re-operation and increased elevations.	
3. Models to show changes in stream flow regime of the River and other tributaries affected by enlargement	
4. Analysis of increased fishing demand as a result of enlarged reservoirs and development of mitigation.	
5. Survey new areas for listed or sensitive species	
6. Other	
7. Transfer funding to FWS for FWCA work (includes accomplishment of above work)	
Total	

SCHEDULE FOR THE WORK

The work would be completed by FWS.

COST ESTIMATE FOR THE WORK

Work would take XXX months to complete depending on when work is initiated. Certain plant and animal surveys can only be done during certain times of the year.

ASSUMPTIONS IN PUTTING TOGETHER THE SCOPE OF WORK

VII CULTURAL RESOURCE STUDIES AND REPORT

ISSUES/CONCERNS

WORK SCHEDULE AND COST

Task	Schedule	Unit	Cost
Pueblo			
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			
Total			

ASSUMPTIONS:

VIII 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.

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				
1. Develop and revise public involvement strategy.							
2. Establish and maintain rapport							
3. Identify publics, develop and maintain mailing list							
4. Plan public meetings							
5. Conduct public meetings							
6. Process public comments							
7. Prepare public involvement and public comments summaries							
Paid public notices							
Court reporter							
Facility rental fees							
TOTALS							

PUBLIC INVOLVEMENT DOCUMENTS

As required under the National Environmental Policy Act, 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 could be used to assure sufficient opportunity is provided to make comments.

IX RESOURCE MANAGEMENT

TASK DETAIL

1. Develop service agreements between the TSC and the client and modify in accordance with the needs of the study.
2. 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 client.
3. Coordination with client 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. Technical team meetings will be conducted as needed.

4. The development of a final purpose and need statement, goals and objectives, criteria for alternative development, and alternatives for the proposed project will be coordinated.
5. 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.

The following items will be addressed:

RESOURCE MANAGEMENT	Staff Days			Labor	Non-Labor	Fees	Total
	L1	L2	L3				
1. Develop service agreements and modify as needed.							
2. Track work accomplishments and costs.							
3. Coordinate with client and other participants. Conduct technical team meetings as needed							
4. Coordinate and participate in the development of a final purpose and need statement, goals and objectives, and alternative formulation for the project.							
5. Ensure that all documents meet project requirements in accordance with purpose and need, goals, and objectives of the project.							
TOTALS	0						

X PLAN FORMULATION AND EVALUATION

The feasibility study will be conducted according to the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) (Water Resource Council, 1983). 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 Nations environment.

Alternatives, including potentially viable alternatives identified in PSOP, will be formulated in a systematic manner to ensure that a full range of reasonable alternatives are identified and evaluated. Potential storage options plans have been under various levels of study for several years. Alternatives from earlier studies will be reviewed and summarized as part of the formulation process. 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 NED Plan. Plans that address State and local concerns or emphasize other functions such as environmental quality and other social effects will also be formulated. A no action plan will be identified which describes conditions that would exist in the future if a storage option plan is not implemented. The no action plan will serve as a base from which to measure the benefits and impacts of the various formulated alternative plans.

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 they will be evaluated, compared, and displayed in a four-account system that consists of:

> The national economic development (NED) account which display changes in the economic value of the national output of goods and services; the environmental quality (EQ) account which displays non- monetary effects on significant natural and cultural resources; the regional economic development (RED) account which display changes in the distribution of regional economic activity; and the other social effects (OSE) account which display plan effects not reflected in the other accounts.

Costs for plan formulation and evaluation are not accounted for separately but are included in the estimates for the preceding scopes of work.

ENCLOSURE D

QUALITY MANAGEMENT CERTIFICATION

QUALITY MANAGEMENT CERTIFICATION

CERTIFICATION

Certification is hereby given that appropriate quality control and quality assurance requirements have been adequately described and incorporated into this POS. The POS is adequate for the feasibility study to proceed.

_____ _____

Date Regional Planning Coordinator

ENCLOSURE E

LIST OF ACRONYMS

LIST OF ACRONYMS

AFM	Alternative Formulation Meeting
EA	Environmental Assessment
EIS	Environmental Impact Statement
FSCA	Feasibility Study Cooperative Agreement
FWS	U.S. Fish and Wildlife Service
NED	National Economic Development
NKAO	Nebraska-Kansas Area Office, Grand Island NE
NEPA	National Environmental Policy Act
GPRO	Great Plains Regional Office, Billing MT
P&G	Water Resources Council's Principles and Guidelines
POS	Plan of Study
ROD	Record of Decision
TSC	Technical Service Center, Denver CO

ENCLOSURE F

PRELIMINARY TABLE OF CONTENTS

PRELIMINARY TABLE OF CONTENTS

5.0 ENVIRONMENTAL CONSEQUENCES*

5.1 ENVIRONMENTAL EVALUATION METHODOLOGY
5.2 SIGNIFICANT EFFECTS ON RESOURCES

6.0 PUBLIC INVOLVEMENT, REVIEW AND CONSULTATION*

6.1 PUBLIC INVOLVEMENT PROGRAM
6.2 INSTITUTIONAL INVOLVEMENT
6.3 ADDITIONAL REQUIRED COORDINATION
6.4 REPORT RECIPIENTS
6.5 PUBLIC VIEWS AND RESPONSES

7.0 LIST OF PREPARERS*

8.0 INDEX*

9.0 LIST OF APPENDICES*

* Required for NEPA compliance

ENCLOSURE G

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 inter-state 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. Has design criteria for the project been established and does it include functional requirements, local sponsor requirements, technical design, and environmental engineering considerations?

5. If appropriate, has the U.S. Army Corps of Engineers 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 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 sponsor fully understand and are willing and capable of furnishing the local cost sharing specified?

4. How was the apportionment of cost to sponsor 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?

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