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EXECUTIVE SUMMARY
LEVEL II FEASIBILITY STUDY

WHEATLAND IRRIGATION CANAL
IMPROVEMENTS PROJECT

PREPARED FOR
WYOMING WATER DEVELOPMENT COMMISSION

AUGUST, 1990

CIVIL ENGINEERING PROFESSIONALS, INC. CEPI
EXECUTIVE SUMMARY

1. INTRODUCTION

The Wheatland Irrigation District (hereinafter referred to as the "District") is located in eastern central Wyoming. The District encompasses lands located around the Town of Wheatland as shown in Figure 1. Approximately 55,284 acres are irrigated by 911 water users. These lands are located primarily west of Wheatland, although a small part of the District is located east and north of Town.

Water for irrigating is provided through direct flow water rights from the Laramie River (633 cfs) and Sybille Creek (135 cfs). In addition, the District has storage rights from the Ringsby Ranch located in Carbon County and three Wheatland Reservoirs, totaling nearly 162,730 acre feet. The stored water is used as a supplemental water supply to extend the irrigation season.

The District has approximately 50 miles of canals and laterals for distribution of the irrigation water. Water delivery usually begins around mid-May and continues through September.

Canal No. 2 is one of the District's major supply canals. This canal was constructed in the early 1900's prior to development of the Town. As population increased, growth occurred around the canal. As it exists today, the canal courses through the central portion of Wheatland through a dense residential area, under a retail store, and through a frequently used public park. It carries water to the District's lands located east and north of Wheatland. Because of its location through Town, the canal is also used to carry storm drainage from the southern parts of Town and parts of Town west of I-25. In its location through Town, the canal requires considerable maintenance. In addition, the open canal is a safety hazard, and in the past two drownings have occurred.

In March 1989, the Wyoming Water Development Commission (WWDC) along with the District and Town of Wheatland as co-sponsors, implemented this Level II Feasibility Study. The study was divided into two phases. Phase I included evaluation of alternatives for relocating and/or reorganizing Canal No. 2, and selection of the preferred alternative. Phase II included conceptual design of the selected alternative.

2. DEFINING THE ALTERNATIVES

The goal of the study was to find the most feasible solution to reduce or eliminate the safety hazards and maintenance concerns created by Canal No. 2 in its present alignment through Wheatland. Two approaches were developed to determine a feasible solution. One approach was to make improvements to Canal No. 2 through Wheatland in its present alignment and to continue using
the canal to carry irrigation and stormwater flows. The other approach was for the District to discontinue use of the canal through Wheatland and find other methods of providing irrigation water to the lands east of Wheatland. This second approach assumes the flows needed for irrigating east of Wheatland could be carried by other canals in the District's system, and that Canal No. 2 through Wheatland could be turned over to the Town for the Town's sole use. Evaluation of the capacity, operation, and control structures associated with these alternative canals were required to determine the improvements needed to accomplish bypassing of the Canal No. 2 through Town.

Five improvement alternatives were identified for evaluation of the Wheatland irrigation canal project. A brief description of each alternative and associated cost estimates are presented below.

ALTERNATIVE "A"

Alternative "A" dealt with upgrading Canal No. 2 in its present alignment from Wheatland Creek westward through Wheatland, and for six miles west of Town. This alternative would continue the canal's current function of carrying both the District's irrigation delivery flows, as well as stormwater flows from the southern parts of Town and lands west of Wheatland. Improvements included concrete lining the canal from Wheatland Creek westward through Wheatland, and covering the canal with a precast concrete cover to reduce safety hazards and maintenance concerns. To reduce erosion and seepage losses, the canal would also be concrete lined from the west edge of Town westward for approximately six miles. These improvements are shown in Figure 2.

Significant stormwater runoff enters Canal No. 2 from drainages in the southern part of Wheatland and from areas west of Town west of I-25. In addition, seven major drainages located to the west and south of Wheatland are crossed by Canal No. 2 and present stormwater runoff concerns. A hydrological analysis was performed to determine the effects of stormwater influences on Canal No. 2. Storms varying in intensity from 2, 5, 10, 25 and 100 year events were used to evaluate the stormwater runoff effects on the canal.

It was determined by hydrologic analysis that Canal No. 2 could carry a 10 year storm through Town without overtopping. Storms occurring west of Wheatland that are carried by the canal through Town could cause overtopping and possible canal failure if the 10 year event is exceeded. In order to eliminate stormwater that enters the canal west of Wheatland, and subsequently flows through Town, three alternative wasteways were evaluated. The selected wasteway was termed the Merrill Wasteway. It would carry excess canal flows to the north of Wheatland and discharge them into Wheatland Creek. Therefore, in addition to lining Canal No. 2 west of Wheatland, the Merrill Wasteway, being an unlined wasteway approximately 2 miles long, would be constructed
FIGURE 1
WHEATLAND IRRIGATION DISTRICT
IRRIGATION SYSTEM

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ALTERNATIVE A IMPROVEMENTS
1 TO 2 LINE CANAL WITH CONCRETE - 24,000 FT.
2 TO 3 CONSTRUCT MERRILL WASTEWAY - 11,500 FT.
3 TO 4 REDUCE CANAL SIZE, LINE WITH CONCRETE - 9,000 FT.
4 TO 5 LINE CANAL WITH CONCRETE, COVER WITH TWIN-TEE CONCRETE DECK
5 REPLACE WHEATLAND CREEK DIVERSION STRUCTURE

ALTERNATIVE A-1 IMPROVEMENTS
6 TO 7 LINE CANAL WITH CONCRETE, COVER WITH TWIN-TEE CONCRETE DECK
7 REPLACE WHEATLAND CREEK DIVERSION STRUCTURE

FIGURE 2
ALTERNATIVE A

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as part of Alternative "A". The improvements required under Alternative "A" were summarized as follows:

- Upper Canal No. 2 west of I-25 would be concrete lined from the end of the presently lined canal north of Reservoir No. 1 to the Merrill Wasteway. From the Merrill Wasteway to I-25, the canal section would be decreased in size due to the reduced volume of stormwater flow to be carried.

- Merrill Wasteway would require construction of a diversion structure in Canal No. 2 and approximately two miles of channel extended north and easterly from the canal, past Merrill Lake to a connection with Wheatland Creek. Culverts under roadway crossings and railroad crossings would be increased in size, and new culverts would be needed at some road crossings.

- Upper Canal No. 2 through Wheatland would be concrete lined and covered with precast concrete twin-tee sections spanning the canal top width. The twin-tee sections could be covered with earth fill or left exposed. Existing street bridges crossing over the canal would be modified to develop full width and pedestrian walkways. Storm drainage facilities to deliver runoff from the southern parts of Wheatland into the canal would be installed.

- The Wheatland Creek Diversion Structure would be removed and reconstructed to divert the irrigation flows into Lower Canal No. 2 and by by-pass storm flows down Wheatland Creek.

ALTERNATIVE "A-1"

Alternative "A-1" is the same as Alternative "A" except that canal improvements are only incorporated through Wheatland. Under this alternative, the seepage losses and erosion problems west of I-25 are not considered to be significant enough to warrant lining the canal. Merrill Wasteway would not be constructed since a lined and covered canal through Town could provide the same level of flood protection as the unlined open canal currently provides. The same considerations for upgrading the canal through Town as for Alternative "A" would be made for Alternative "A-1".

ALTERNATIVE "B"

Alternative "B" was the first of three alternatives that were evaluated for bypassing irrigation flows around the Town of Wheatland thereby leaving Canal No. 2 through Wheatland available for the exclusive use of the Town. This alternative proposes carrying the irrigation needs for lands east of Wheatland through Lower Lateral No. 1 and routing it through Rumsey Ditch, which would be extended eastward to connect to an existing siphon tube located under I-25. From the siphon, water would be routed through a new conveyance system into Wheatland Creek where it could be diverted into Lower Canal No. 2 through the Wheatland
Creek Diversion Structure. Upper Canal No. 2 would end west of Wheatland and the portion of it through Town could then be used to collect and convey the Town's stormwater runoff. To reduce the safety hazards and maintenance concerns associated with the canal through Wheatland, the canal would be concrete lined and covered as described under Alternative "A". The alignment and improvements for Alternative "B" are shown in Figure 3, and summarized below:

- Both the Upper Canal No. 1 - Upper Lateral No. 1 Diversion Structure and the South Feeder Structure would be replaced with new structures.

- Lower Lateral No. 1 would be enlarged and concrete lined from the South Feeder Structure to the Rumsey Ditch Diversion Structure to carry additional flows.

- A new diversion structure would be constructed to divert the increased flows into Rumsey Ditch.

- Rumsey Ditch would be enlarged and concrete lined, and extended to I-25.

- The existing siphon crossing under I-25 would be modified by lowering the eastern most 80 feet to increase its capacity. The outlet piping would be extended to discharge to Wheatland Creek.

- The Wheatland Creek Diversion Structure would be replaced and constructed to divert irrigation flows into Lower Canal No. 2 and bypass stormwater flows down Wheatland Creek.

- Upper Canal No. 2 west of I-25 would be concrete lined from the end of the existing lined section to the proposed Merrill Wasteway. From the Merrill Wasteway to the last irrigator, a buried pipe would be installed.

- Merrill Wasteway would be constructed as described under Alternative "A".

- Upper Canal No. 2 through Wheatland would be concrete lined and covered with precast concrete twin-tee sections as described under Alternative "A"; however, the canal's capacity could be reduced because the irrigation flows have been bypassed around the Town into Wheatland Creek.

**ALTERNATIVE "C"**

This alternative involves diverting the irrigation flows needed for lands east of Wheatland through Upper Canal No. 1 across I-25 and into Lower Canal No. 1 where the flows can be discharged into Wheatland Creek. From Wheatland Creek the flows can be diverted into Lower Canal No. 2. Improvements for Canal No. 2 through Wheatland are the same as required under Alternative "B". Those improvements and the alignments are shown in
ALTERNATIVE B IMPROVEMENTS

1. REPLACE UPPER CANAL NO. 1-LATERAL NO. 1 DIVERSION
2. REPLACE SOUTH FEEDER STRUCTURE
3. TO 4. ENLARGE AND LINE LOWER LATERAL NO. 1 WITH CONCRETE
4. CONSTRUCT NEW RUMSEY DITCH DIVISION STRUCTURE
5. TO 6. ENLARGE AND LINE RUMSEY DITCH WITH CONCRETE
6. TO 7. EXTEND RUMSEY DITCH TO I-25, LINE WITH CONCRETE
7. LOWER AND EXTEND I-25 SIPHON TO WHEATLAND CREEK
8. TO 9. LINE UPPER CANAL NO. 2 WITH CONCRETE
9. TO 10. CONSTRUCT MERRILL WASTEWAY
10. TO 11. CONSTRUCT BURIED IRRIGATION PIPE IN CANAL
11. TO 12. CLOSE CANAL
12. TO 13. UPGRADE CANAL FOR STORMWATER FLOWS, LINE WITH CONCRETE, COVER WITH CONCRETE DECK
13. REPLACE WHEATLAND CREEK DIVERSION STRUCTURE

FIGURE 3
ALTERNATIVE B

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Figure 4 and summarized below:

- The Upper Canal No. 1 - Upper Lateral No. 1 Diversion Structure and Mid Canal No. 1 - Lower Canal No. 1 Diversion Structure would be replaced with new structures.

- The existing concrete lined portions of Lower Canal No. 1 from the diversion structure to I-25 would be removed and replaced with a larger capacity concrete lined canal.

- A new 42 inch diameter pipe would be installed under I-25 and the railroad to increase capacity of the existing crossings.

- Lower Canal No. 1 from the railroad crossing to Wheatland Creek would be removed and replaced with a larger capacity concrete lined canal. A diversion structure will be constructed to divert flows into a 42 inch diameter pipe to Wheatland Creek.

- The Wheatland Creek Diversion Structure would be replaced as under Alternative "B".

- Upper Canal No. 2 west of I-25, the Merrill Wasteway and Upper Canal No. 2 through Wheatland would be improved as described under Alternative "B".

**ALTERNATIVE "D"**

Alternative "D" involves re-routing the additional irrigation flows needed for the lands east of Wheatland into Lower Canal No. 1, then diverting these flows into a pipe at Brookside Road to Rock Creek and subsequently Wheatland Creek, and eventually diverting the flow at the Wheatland Creek Diversion Structure into Lower Canal No. 2. Improvements and alignments for Alternative "D" are shown in Figure 5 and a summary of the improvements is given below:

- Upper Canal No. 1 - Upper Lateral No. 1 Diversion Structure would be replaced with a new structure as in Alternative "C".

- Mid Canal No. 1 - Lower Canal No. 1 Diversion Structure would be replaced with a new structure to handle increased flows as in Alternative "C".

- The existing concrete lined section of Lower Canal No. 1 from the division structure to the turn from Brookside Road would be removed and replaced with a concrete lined canal, enlarged for the increased flows.

- A new diversion structure would be required to divert flow from Lower Canal No. 1 into a 42 inch diameter pipeline to be constructed along Brookside Road to Rock Creek.
The Wheatland Creek Diversion Structure, Upper Canal No. 2 west of I-25, the Merrill Wasteway, and the Upper Canal No. 2 through Wheatland would be improved as described under Alternatives "B" and "C".

COST ESTIMATES

Cost estimates were developed for the alternatives and are listed below.

<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>ESTIMATED PROJECT COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$6,950,000</td>
</tr>
<tr>
<td>A-1</td>
<td>3,600,000</td>
</tr>
<tr>
<td>B</td>
<td>8,550,000</td>
</tr>
<tr>
<td>C</td>
<td>8,700,000</td>
</tr>
<tr>
<td>D</td>
<td>7,600,000</td>
</tr>
</tbody>
</table>

COST ALLOCATIONS

A preliminary allocation of project costs between the Wheatland Irrigation District and the Town of Wheatland was performed. The allocation of cost was made based on relative benefit of the proposed improvements. The cost allocation for each of the alternatives are given below.

<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>TOTAL COST</th>
<th>DISTRICT COST</th>
<th>PERCENT</th>
<th>TOWN COST</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$6,950,000</td>
<td>$4,625,000</td>
<td>66.6</td>
<td>$2,325,000</td>
<td>33.4</td>
</tr>
<tr>
<td>A-1</td>
<td>3,600,000</td>
<td>1,225,000</td>
<td>34.0</td>
<td>2,375,000</td>
<td>66.0</td>
</tr>
<tr>
<td>B</td>
<td>8,550,000</td>
<td>5,885,000</td>
<td>68.8</td>
<td>2,665,000</td>
<td>31.2</td>
</tr>
<tr>
<td>C</td>
<td>8,700,000</td>
<td>6,035,000</td>
<td>69.4</td>
<td>2,665,000</td>
<td>30.6</td>
</tr>
<tr>
<td>D</td>
<td>7,600,000</td>
<td>4,935,000</td>
<td>64.9</td>
<td>2,658,000</td>
<td>35.1</td>
</tr>
</tbody>
</table>

3. RECOMMENDED ALTERNATIVES

Based upon an evaluation of the total estimated project costs, improvements to safety, reduced seepage and a reduced operation and maintenance costs, it was recommended that Alternatives "A", "A-1", and "D" be economically evaluated. Alternatives "B" and "C" are similar to "D" in operation but were more costly, and were therefore dropped from consideration.

4. ECONOMIC EVALUATION OF FEASIBLE ALTERNATIVES

The economic evaluation included a review of the ability to pay for canal improvements by the District and the Town of Wheatland, an analysis of financing options for each alternative, and a discussion of the project costs and benefits.
ALTERNATIVE C IMPROVEMENTS

1. REPLACE UPPER CANAL NO. 1 - LATERAL NO. 1 DIVERSION
2. REPLACE MID CANAL NO. 1 - LOWER CANAL NO. 1 DIVISION
3. REMOVE AND ENLARGE LOWER CANAL NO. 1 TO 1-25, LINE WITH CONCRETE
4. CONSTRUCT I-25 AND RAILROAD BORES
5. REMOVE AND ENLARGE LOWER CANAL NO. 1 TO DIVERSION NEAR CREEK, LINE WITH CONCRETE
6. CONSTRUCT A DIVERSION STRUCTURE AND BURIED PIPE TO WHEATLAND CREEK
7. LINE UPPER CANAL NO. 2 WITH CONCRETE
8. CONSTRUCT MERRILL WASTEWAY
9. CONSTRUCT BURIED IRRIGATION PIPE IN CANAL
10. CLOSE CANAL
11. UPGRADE CANAL FOR STORMWATER FLOWS, LINE WITH CONCRETE, COVER WITH CONCRETE DECK
12. REPLACE WHEATLAND CREEK DIVERSION STRUCTURE

FIGURE 4
ALTERNATIVE C
ALTERNATIVE D IMPROVEMENTS

1. REPLACE UPPER CANAL NO. 1-LATERAL NO. 1 DIVERSION
2. REPLACE MID CANAL NO. 1-LOWER CANAL NO. 1 DIVISION
3. REMOVE AND ENLARGE LOWER CANAL NO. 1 TO BROOKSIDE ROAD, LINE WITH CONCRETE
4. ROCK CREEK OUTFALL, 42" PIPE AND DIVERSION STRUCTURE
5. LINE UPPER CANAL NO. 2 WITH CONCRETE
6. CONSTRUCT MERRILL WASTEWAY
7. CONSTRUCT BURIED IRRIGATION PIPE IN CANAL
8. CLOSE CANAL
9. UPGRADE CANAL FOR STORMWATER FLOWS, LINE WITH CONCRETE, COVER WITH CONCRETE DECK
10. REPLACE WHEATLAND CREEK DIVERSION STRUCTURE

FIGURE 5
ALTERNATIVE D

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WHEATLAND IRRIGATION DISTRICT - ABILITY TO PAY

It was estimated that lining the unlined portion of Upper Canal No. 2 would reduce seepage and make additional water available. This additional water could be used by District members to increase their crop yields and income, resulting in a potential new source of revenue to repay improvement costs. Estimates for annual water savings for Alternatives "A" and "D" were 4000 acre feet per year and 820 acre feet per year for Alternative "A-1". Previous WWDC funded irrigated crop budget studies indicate supplemental irrigation water would increase farm income by approximately $25 per acre foot of water. Therefore Alternatives "A" and "D" are expected to generate $100,000 annually, while Alternative "A-1" would generate $20,500 annually.

In addition to increases in farm income, the District would experience lowered operation and maintenance costs due to the proposed canal improvements. These cost savings are expected to approximate $7,500 annually for Alternative A and $5,000 annually for Alternatives A-1, and D.

The combined additional farm income generated for each alternative was therefore estimated to be $107,500 for Alternatives "A" and "D", and $25,500 for Alternative "A-1".

To capture this additional revenue, the District would have to increase assessment charges on each of the 55,284 irrigated acres in the District, and also dedicate operation and maintenance cost savings to repayment of project costs. The District's current assessment is $8.50 per acre per year. To capture the additional revenue, the District would need to increase assessments by $1.81 per acre to $10.31 for Alternatives "A" and "D". For Alternative "A-1", the assessments would be increased by $0.37 to $8.87 per acre.

An investigation was made to determine what Wheatland Irrigation District members are currently paying for water compared to other irrigation districts in Wyoming. It was determined that at $8.50 per acre per year, the District is presently assessing 22 percent more than the average of other districts. With the assessment increased to $10.31 per acre per year, the District's assessment rate would still be lower than assessments for LaPrele and Goshen Irrigation Districts.

TOWN OF WHEATLAND ABILITY TO PAY

It was determined the Town of Wheatland's ability to pay for canal improvements within the Town boundaries was a function of revenue sources available to fund such improvements. The only significant new sources of revenue available to Wheatland are the optional one-cent capital facilities sales tax, which is not in effect in Platte County at this time, and passage of a general obligation bond issue supported by property taxes. Either of these two options would require voter approval, but the one-cent capital facilities sales tax would provide greater ability to
repay improvement costs on an annual basis. It was estimated that if the optional one-cent capital facilities tax were implemented in Platte County, the Town would expect to receive approximately $290,000 in revenues annually.

Because the Town's 1989 assessed valuation was only $7.96 million, each one-mill property tax increase would raise only about $7,960 annually. Thus, it would take a property tax increase of 37 mills to generate annual revenues equal to those forthcoming from the one-cent capital facilities tax. It appeared doubtful that such a steep property tax increase would win voter approval. Thus, the best option for funding needed canal improvements within the Town would be the one-cent capital facilities tax. This tax would have to pass voter approval on a county-wide basis, however, before it could be implemented.

FINANCING OPTIONS

A comparison was made to determine the project sponsors' ability to pay for canal improvements versus the repayment burdens that would be generated under two different funding scenarios. Financing Scenario No. 1 included a 50 percent WWDC grant and a 50 percent WWDC 50-year loan at 4 percent interest. Financing Scenario No. 2 included a 75 percent WWDC grant and a 25 percent WWDC 50-year loan at 4 percent interest.

The financial implications of the three alternative improvement plans and financing options are summarized in Table 1. The calculations indicate the District Assessment increases required to support the project under financing Scenario A exceeds the District's ability to pay for all improvement alternatives. The Town could finance its portion of project costs under financing Scenario A by implementing a one-cent capital facilities tax (county-wide) for a period ranging from 52 to 62 months. For financing Scenario B, it appears that all improvement alternatives are within the financial means of both the Town and the District.

BENEFIT-COST ANALYSIS

It was determined that several types of benefits would accrue to the District and Town from the alternative canal improvements, some which could be readily quantified and some that could not. The benefits could be quantified include value of irrigation water saved through canal improvements, secondary benefits to the local economy from increases in irrigation water and farm income, and decreased operations and maintenance expenditures for Wheatland and the District.

The project benefits that could not be readily quantified were the safety improvements that would result from covering the portion of the canal within the Town of Wheatland, and the possibility that excess ground moisture problems in Wheatland would be reduced if the canal were lined. Two drownings in the Wheatland portion of the canal have been reported over the past 90 years,
and covering the canal in Wheatland would greatly reduce the possibility of any future occurrences.

The results shown in Table 2 indicate that none of the alternatives have quantifiable benefits in excess of project costs. Of the three alternatives, it appeared that Alternative D is the least desirable because it has the largest gap between benefits and costs (approximately $3.5 million). Using this criteria, Alternatives A and A-1 appeared to be equal although Alternative A has a higher benefit-cost ratio.

In the final analysis, the economic feasibility of the project depended upon the value that could be placed on human life. The possibility was anticipated that at least one additional drowning could occur over with next 50 years if no safety improvements are made within the Town. If the present value of that life was in excess of $2.5 million, the project would be economically feasible. Otherwise, it would not.

5. SELECTED ALTERNATIVE

Based upon the preliminary alternative evaluations and the economic analysis, the superior alternative was determined to be Alternative "A". This alternative included concrete lining of Upper Canal No. 2 from a point approximately six miles west of Wheatland, all the way through Wheatland, and covering the canal through Wheatland.

Following a presentation of the Phase I study results to representatives of the Wyoming Water Development Commission, the Wheatland Irrigation District, and the Town of Wheatland, it was decided that the Phase II portion should include only the conceptual design of the lining of Upper Canal No. 2 and construction of the Merrill Wasteway. In addition, those canal structures identified in the alternative analysis as needing immediate repair or replacement were included in the study and conceptual designs. At the request of the Town of Wheatland, lining and covering the canal through Wheatland was dropped from Phase II and received no further consideration.

Phase II of the study therefore was developed to divide the preferred alternative into segments which could be funded and constructed in separate packages. Segment No. 1 was defined to include lining of Upper Canal No. 2 and construction of the Merrill Wasteway. Segment No. 2 was defined to include rehabilitation of the canal structures.

6. SEGMENT NO. 1, UPPER CANAL REHABILITATION

Two conceptual design options were developed for rehabilitating Upper Canal No. 2. Option 1 evaluated lining the canal for its length and constructing Merrill Wasteway to discharge excess flow before it enters Wheatland. Option No. 2 included lining the canal for its length and not constructing a wasteway. Instead, under Option No. 2, combined irrigation and stormwater
flows would continue to be conveyed through Wheatland and wasted at Wheatland Creek.

Canal design flows were developed for both options using 25-year storm flows and existing irrigation flows.

Several lined canal sections were investigated to determine the most economical canal sections that would fit the existing terrain and convey the design flows under each option.

Plan and profile sheets were developed indicating existing and proposed canal and wasteway alignments and grades. Replacement of existing head gates, check structures, and discharge pipes was included in the conceptual design as well as improvements to bridges and culverts which cross the canal. Preliminary designs were developed for a wasteway structure that would discharge excess flows down Merrill Wasteway to Wheatland Creek.

Under conceptual design of the Merrill Wasteway it was determined the wasteway should be constructed by balancing the cut and fill along the alignment. The proposed wasteway crosses several county roads and an abandoned railroad bed. New culverts were sized to carry the storm flows under these facilities.

ENVIRONMENTAL AND LEGAL CONSIDERATIONS

Rehabilitation of Upper Canal No. 2 and the Merrill Wasteway have environmental and legal implications. The primary environmental concerns with rehabilitation of the canal with concrete lining are the effects created by eliminating seepage from the canal. Wetlands that have developed below the canal could be heavily impacted by canal lining. The legal considerations primarily center on the District's liability for possible flood damages that may occur in Wheatland. The Merrill Wasteway would considerably reduce the flood flows that would reach Town and reduce the possibilities for canal failure in Town.

The primary environmental concerns of Merrill Wasteway involve effects on the water table along the wasteway route. The wasteway is likely to dewater any of the wetlands it passes through. Legal implications of the wasteway could result where sub-irrigated pastures are dried up by the wasteway. Springs that are in close proximity to the wasteway could also be negatively impacted.

COST ESTIMATES

Cost estimates were developed for both rehabilitation options, and are presented in summarized below.

Option No. 1 - Canal Lining with Merrill Wasteway $4,200,000
Option No. 2 - Canal Lining without Merrill Wasteway 3,400,000
7. **SEGMENT NO. 2, STRUCTURE REHABILITATION AND REPLACEMENT:**

Conceptual designs for rehabilitation and replacement of five of the major canal structures in the District's system were developed, along with cost ranges. These structures and cost ranges are given as follows:

<table>
<thead>
<tr>
<th>Structure Name</th>
<th>Cost Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheatland Canal Diversion Structure</td>
<td>$182,000 to $390,000</td>
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<tr>
<td>South Feeder Structure</td>
<td>160,000 to 215,000</td>
</tr>
<tr>
<td>Upper Canal No. 1 - Lateral No. 1 Diversion Structure</td>
<td>207,000 to 258,000</td>
</tr>
<tr>
<td>Lower Canal No. 1 - Bordeaux Canal Diversion Structure</td>
<td>10,000 to 10,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$559,000 to $873,000</td>
</tr>
</tbody>
</table>

8. **ECONOMIC ANALYSIS**

A refinement of the economic analysis presented in the Phase I portion of the study was performed for Segment No. 1. Because rehabilitation or replacement of the irrigation structures under Segment No. 2 have minimal benefits, economic analysis for the structures was confined to project financing.

**CANAL PROJECT BENEFITS**

The total estimated water savings by reducing seepage from Upper Canal No. 2 was reduced to 3,100 acre feet per year. The supplemental water savings at $25 per acre foot per year is projected to be $77,500. In addition, operational and maintenance savings from the canal improvements were estimated to be $2,500. The total anticipated direct benefit to the District from lining Upper Canal No. 2 was estimated to be $80,250 per year.

**CANAL PROJECT FINANCING**

Table 3 presents the repayment costs for both Option No. 1 (canal lining with Merrill Wasteway), and Option No. 2 (canal lining without Merrill Wasteway) for the canal rehabilitation.

The Wheatland Irrigation District water users are currently assessed $8.50/acre/year. For Option No. 2, the per acre assessments would need to be increased to $9.93/acre with a 50 percent grant and to $9.22/acre with a 75 percent grant. Option No. 1 assessments would be $10.27/acre with a 50 percent grant and $9.38/acre with a 75 percent grant.

**CANAL BENEFIT-COST ANALYSIS**

A benefit-cost analysis was performed for the proposed canal and wasteway construction projects. It was determined that neither of the alternatives for rehabilitating Upper Canal No. 2 have quantifiable benefits in excess of project costs.
The structure rehabilitation or replacement project is expected to be considered by the WWDC as a rehabilitation project, eligible for 50 percent grant and 50 percent loan at 4 percent interest for 50 years. The project costs presented in Table 4 include the lower and upper range of structure costs.
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>A</th>
<th>ALTERNATIVE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cost</td>
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<td>$3,600,000</td>
<td>$7,600,000</td>
<td></td>
</tr>
<tr>
<td><strong>Financing Scenario A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>District Ability-to-Pay ($ per acre)</td>
<td>$1.81</td>
<td>$0.37</td>
<td>$1.81</td>
<td></td>
</tr>
<tr>
<td>District Required Assessment Increase ($ per acre)</td>
<td>1.95</td>
<td>0.52</td>
<td>2.08</td>
<td></td>
</tr>
<tr>
<td>Town One Cent Tax (months)</td>
<td>53</td>
<td>52</td>
<td>62</td>
<td></td>
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<tr>
<td><strong>Financing Scenario B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>District Ability-to-Pay ($ per acre)</td>
<td>$1.81</td>
<td>$0.37</td>
<td>$1.81</td>
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<tr>
<td>District Required Assessment Increase ($ per acre)</td>
<td>0.97</td>
<td>0.26</td>
<td>1.04</td>
<td></td>
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<tr>
<td>Town One Cent Tax (months)</td>
<td>26</td>
<td>25</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>ALTERNATIVE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------</td>
<td>----------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>A-1</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Quantifiable Benefits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Direct</td>
<td>$100,000</td>
<td>$20,500</td>
<td>$100,000</td>
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</tr>
<tr>
<td>Irrigation Benefits</td>
<td></td>
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<tr>
<td>Secondary Benefits</td>
<td>80,000</td>
<td>16,400</td>
<td>80,000</td>
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<tr>
<td>District O&amp;M Savings</td>
<td>7,500</td>
<td>5,000</td>
<td>5,000</td>
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</tr>
<tr>
<td>Town O&amp;M Savings</td>
<td>7,500</td>
<td>7,500</td>
<td>5,000</td>
<td></td>
</tr>
<tr>
<td>Annual Quantifiable Benefits</td>
<td>$195,000</td>
<td>$49,400</td>
<td>$190,000</td>
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<tr>
<td>Present Value (50 Yrs.</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 4% discount)</td>
<td>$4,189,000</td>
<td>$1,061,200</td>
<td>$4,081,600</td>
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</tr>
<tr>
<td>Costs:</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Construction</td>
<td>$6,950,000</td>
<td>$3,600,000</td>
<td>$7,600,000</td>
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<tr>
<td>Comparison:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Benefit-Cost Ratio</td>
<td>0.6</td>
<td>0.29</td>
<td>0.54</td>
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</tr>
<tr>
<td>Benefit Gap</td>
<td>$2,761,000</td>
<td>$2,539,000</td>
<td>$3,519,000</td>
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### TABLE 3
DISTRICT REPAYMENT REQUIREMENTS FOR WWDC LOAN/GRAANT FINANCING ALTERNATIVES, SEGMENT NO. 1, CANAL REHABILITATION

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Estimated Cost</th>
<th>Annual Payment</th>
<th>Annual Value of Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option No. 1</td>
<td>$4,200,000</td>
<td>Annual Grant Percentage 50-50</td>
<td>$97,755</td>
</tr>
<tr>
<td>Option No. 2</td>
<td>$3,400,000</td>
<td>Annual Grant Percentage 25-75</td>
<td>79,135</td>
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</tbody>
</table>

### TABLE 4
DISTRICT REPAYMENT REQUIREMENTS FOR WWDC LOAN-GRAANT FINANCING SEGMENT NO. 2, STRUCTURE REHABILITATION

<table>
<thead>
<tr>
<th>Structure Alternative</th>
<th>Cost</th>
<th>Annual Payment Loan-Grant Percentage 50-50</th>
<th>Increased Per Acre Assessments</th>
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</thead>
<tbody>
<tr>
<td>Lower Range</td>
<td>$559,000</td>
<td>$12,964</td>
<td>$0.23</td>
</tr>
<tr>
<td>Upper Range</td>
<td>$873,000</td>
<td>20,249</td>
<td>0.37</td>
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</tbody>
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