This is a digital document from the collections of the Wyoming Water Resources Data System (WRDS) Library.

For additional information about this document and the document conversion process, please contact WRDS at wrds@uwyo.edu and include the phrase “Digital Documents” in your subject heading.

To view other documents please visit the WRDS Library online at: http://library.wrds.uwyo.edu

Mailing Address:
Water Resources Data System
University of Wyoming, Dept 3943
1000 E University Avenue
Laramie, WY 82071

Physical Address:
Wyoming Hall, Room 249
University of Wyoming
Laramie, WY 82071

Phone: (307) 766-6651
Fax: (307) 766-3785

Funding for WRDS and the creation of this electronic document was provided by the Wyoming Water Development Commission (http://wwdc.state.wy.us)
Executive Summary

West Side Canal
Rehabilitation of the Jons Drop Structure and the Four Mile Flume
Level II Study

Prepared for:

Wyoming Water Development Commission
Cheyenne, Wyoming

Prepared by:

States West Water Resources Corporation
Cheyenne, Wyoming

In association with:

Gannett Fleming, Inc.
Denver, Colorado
2002
I. Introduction

A. Purpose of the Study

This report presents the findings of a Level II study to investigate the potential rehabilitation or replacement of the Jons Drop Structure and the Four Mile Flume on the West Side Canal. The study was conducted under the direction and funding of the Wyoming Water Development Commission (WWDC) by States West Water Resources Corporation, in association with Gannett-Fleming, Inc.

The purpose of the study was to determine the most feasible and economical solutions to the problems at the Jons Drop, and the Four Mile Flume. The Jons Drop was rehabilitated as a part of the previous West Side Canal rehabilitation project. However the channel below the drop has eroded severely since that time. The purpose of the study of the Jons Drop was to determine the most feasible and economical method of eliminating the erosion problem. The Four Mile Flume has developed leaks, overtops, and is in generally poor structural condition. The purpose of this study was to develop the most feasible and economical method of conveying the water across the drainage. The study also determined the permitting effort to construct the project. Economic analysis of the project financing to determine cost to the sponsors were completed. Hydropower potential at the Jons Drop was also considered. This report summarizes the findings of the study.

II. Jons Drop

A. Existing Conditions

Jons Drop was rehabilitated as part of the West Side Ditch project. A new splitter structure was constructed and a new HDPE pipe was installed. The first drop pipe installed was thin wall corrugated HDPE pipe. The thin wall could not withstand the debris and failed. A thick wall HDPE pipe was installed which could withstand the debris. However, the channel below the drop has actively eroded and steps to prevent the erosion have failed to solve the problem. A CMP extension and dissipation pool with additional riprap have been installed. The channel below has continued to erode and increased the drop. The erosion can be seen down stream for a length of 1200 feet.

We surveyed the channel to determine if erosion is likely to continue in the future. The slopes of the channel are 2%-3% which is too steep to be stable.
Consequently, the erosion will continue for some time. We estimate that the channel could erode an additional 20 feet over time.

The capacity of the proposed drop was determined by the maximum capacity of the canal upstream of the splitter structure. The maximum capacity of the canal before overtopping was estimated to be approximately 100 cfs. The capacity of the splitter structure to pass the flow to a pipe outlet was determined to be approximately 110 cfs. The alternatives were designed for 100 cfs. Normal maximum flows for irrigation purposes are approximately 54 cfs.

B. Alternative Solutions

The NRCS has prepared preliminary designs on a pipe alternative that would bypass the eroded section of the channel. This alternative was reviewed and cost estimates developed. Channel stabilization alternatives and a concrete chute alternative were also developed to compare with the pipe alternative. A detailed discussion of the preferred alternative follows.

New Pipe – This alternative would involve constructing a new drop pipe from the splitter structure to the channel downstream of the eroded sections as shown in figure II-2. The proposed route would align the pipe east of the erosion cut for a distance of approximately 150 feet on a relatively flat area. The pipe would then bend and be routed down a steep slope for a distance of approximately 750 feet to the channel. The channel appears to be stable below this location. The upper portion of the drop pipe would require a 36 inch pipe to carry the 100 cfs flow at a slope of approximately 2.5\% as shown on figure II-3. The steeper section of the pipe with average slopes of 8.5\% would require a 30 inch pipe to carry the flow. The velocity in the 36 inch pipe section would be approximately 14 feet per second, while the velocity in the 30 inch pipe would be a maximum of 27 feet per second. The higher velocity in the steep sections coupled with the possibility of accumulating debris lead to the need for the thick wall HDPE pipe. SDR 26 HDPE pipe would be recommended for this application, because it has a 1.38 inch wall for the 36 inch pipe and 1.15 inch thickness for the 30 inch pipe. This pipe would be the best product for the application, but it is relatively expensive. Energy would be dissipated in a riprap pool at the bottom of the slope before it enters the channel as shown on figure II-3. Riprap from the existing pool could be utilized. Cost estimates for this alternative were developed. Total project cost including construction, engineering and contingencies were considered. No costs for rehabilitation of the eroded channel were included. The total project cost is estimated to be $92,000. If rehabilitation of the existing channel is included, the cost estimate would increase by $20,000. The detailed cost estimate is shown on page 6. This alternative would allow for the installation of a hydropower generation unit in the future.
C. Summary and Recommendations

The pipe alternative as recommended by the NRCS is the most economical and would be reliable. The estimated total cost is $92,000. This alternative did not include costs for rehabilitation of the eroded channel. The rehabilitation of the channel would increase the estimated costs by approximately $20,000. This alternative also allows for the installation of hydropower.

III. FOUR MILE CROSSING

A. Existing Conditions

The existing structure at the Four-Mile crossing was investigated for potential rehabilitation or replacement. The structure utilizes a steel half pipe supported on a steel support structure to convey water across the drainage. Normal maximum flows at the flume are approximately 30 cfs based on water rights. However, the canal can carry extra water so the design basis was the maximum carrying capacity of the canal. The maximum capacity of the canal was estimated to be 50 cfs which was used for the preliminary design. The structure has the following problems.

1. Steel half pipe leaks – At the time of inspection, there was a trickle of water passing through the structure which indicated that the half pipe leaks at several locations. The steel half pipe is very thin walled and it has rusted through at several points.

2. Overtopping of structure – It has been reported that the half pipe overtops at high flows. We surveyed and checked the slopes of the crossing, the road culvert downstream, and the twin culvert further downstream. The slope on the half pipe indicates that the crossing should pass 36 cfs before overtopping. This would indicate that the problem would be downstream. The 48” CMP road culvert has the capacity to pass more than 50 cfs before backing up. The twin 48” CMP located further downstream also have plenty of capacity, but are used as a check dam for an irrigation turn out. A permanent plate has been installed in front of the culverts. There is evidence that debris collects on the crossing. It has been reported that the probable cause of the overtopping has been sedimentation of the canal below the twin culverts. The canal is very flat and the sediment from the Jons Drop erosion has accumulated in this area. It was reported that the overtopping problem was less severe before the erosion at the drop became severe.

3. Structural Adequacy – The steel half pipe is supported by a steel pipe support system that appears marginally adequate structurally and is exposed to debris build up during flood flows. A structural engineer could
probably prove that the structure failed long ago. The support pipes do not show rust deterioration either above or below ground.

B. Alternatives

Four permanent alternatives and one temporary alternative to address the rehabilitation or replacement of the crossing were investigated. These included replacing the half pipe and structural rehabilitation, installation of an inverted siphon pipe, and construction of two types of overhead crossings. The preferred alternative is discussed.

Inverted siphon pipe – It is proposed to utilize corrugated high density polyethylene pipe (HDPE) with water tight connections capable of the pressures involved. This alternative would replace the overhead crossing with a 48” HDPE pipe as shown on figure III-2. The total length would be approximately 130 feet. Concrete structures would be constructed at the inlet and outlet ends of the pipe. A trash rack would be installed on the upstream inlet structure. Erosion protection (riprap) would be placed over the pipe in the creek bottom to prevent erosion during large floods. A drain and flushing pipe would be installed at the bottom of the siphon. Cost estimates for this alternative were developed. Total project cost including construction, engineering and contingencies were considered. The total project cost is estimated to be $50,000.

C. Recommendation

The recommended permanent alternative is the inverted siphon pipe, due to economics and the protection it provides from floods. The sediment should be removed from the canal below the crossing. With the elimination of the sediment from the Jons Drop the water back up problem should be greatly reduced.


IV. Economic Analysis

This project qualifies as a rehabilitation project with the WWDC. Rehabilitation projects are presently funded with 50% grant and 50% loan at 6% interest. With these funding conditions and assuming a 20 year loan, the annual payments for the two projects are as follows.

Jons Drop –
  Total Project Estimated cost – $92,000
  50% Loan Amount – $46,000
  Annual Payment @ 6% for 20 years – $4,071.00

Four Mile Flume
  Total Project Estimated cost – $50,000
  50% Loan Amount – $25,000
  Annual Payment @ 6% for 20 years – $2,212.5

The total estimated project cost for both projects is $142,000. These costs were estimated assuming separate projects. If both projects are bid as a package, some cost savings would be expected. Mobilization of people and equipment should be reduced.

The irrigated acres benefited by the Jons Drop improvements total 1,345.8 acres. The cost per acre per year would be $3.02.

The irrigated acres benefited by the Four Mile improvements total 1,045.5 acres. The cost per acre per year would be $2.12.

The total irrigated acreage under the West Side Canal is approximately 5,600 acres. If the total combined project cost were to be spread throughout the canal, the annual cost per acre would be approximately $1.12.
## COST ESTIMATE - JONS DROP - PIPE ALTERNATIVE

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>CONNECTION 36&quot; PIPE</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>36&quot; HDPE PIPE</td>
<td>L.F.</td>
<td>150</td>
<td>70</td>
<td>$10,500.00</td>
</tr>
<tr>
<td>REDUCER</td>
<td>Ea.</td>
<td>2</td>
<td>1500</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>30&quot; HDPE PIPE</td>
<td>L.F.</td>
<td>750</td>
<td>55</td>
<td>$41,250.00</td>
</tr>
<tr>
<td>RIPRAP</td>
<td>C.Y.</td>
<td>200</td>
<td>20</td>
<td>$4,000.00</td>
</tr>
<tr>
<td>GROUTED RIPRAP</td>
<td>C.Y.</td>
<td>20</td>
<td>100</td>
<td>$2,000.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$64,750.00</strong></td>
</tr>
</tbody>
</table>

CONSTRUCTION COST SUBTOTAL #1: $64,750.00
ENGINEERING COST = CCS#1 X 10%: $6,475.00
SUBTOTAL #2: $71,225.00
CONTINGENCY = SUBTOTAL #2 X 15%: $10,683.75

CONSTRUCTION COST TOTAL: $81,908.75
PREPARATION OF FINAL DESIGNS: $8,000.00
PERMITTING AND MITIGATION: -
LEGAL FEES: -
ACQUISITION OF ACCESS & RIGHT OF WAY: $2,000.00

PROJECT COST TOTAL: $91,908.75
USE: $92,000.00

## COST ESTIMATE - FOUR MILE CROSSING - INVERTED SIPHON PIPE

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>DEMOLITION</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$2,000.00</td>
</tr>
<tr>
<td>42&quot; PIPE</td>
<td>L.F.</td>
<td>130</td>
<td>100</td>
<td>$13,000.00</td>
</tr>
<tr>
<td>HEAD WALLS</td>
<td>C.Y.</td>
<td>15</td>
<td>400</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>RIPRAP</td>
<td>C.Y.</td>
<td>50</td>
<td>50</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>42&quot; FITTINGS</td>
<td>Ea.</td>
<td>2</td>
<td>1500</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>DRAIN</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$2,000.00</td>
</tr>
<tr>
<td>TRASHRACK</td>
<td>L.S.</td>
<td>-</td>
<td>-</td>
<td>$500.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$34,000.00</strong></td>
</tr>
</tbody>
</table>

CONSTRUCTION COST SUBTOTAL #1: $34,000.00
ENGINEERING COST = CCS#1 X 10%: $3,400.00
SUBTOTAL #2: $37,400.00
CONTINGENCY = SUBTOTAL #2 X 15%: $5,610.00

CONSTRUCTION COST TOTAL: $43,010.00
PREPARATION OF FINAL DESIGNS: $4,000.00
PERMITTING AND MITIGATION: $2,000.00
LEGAL FEES: -
ACQUISITION OF ACCESS & RIGHT OF WAY: -

PROJECT COST TOTAL: $49,010.00
USE: $50,000.00
JONS DROP PIPE ALTERNATIVE
JONS DROP PIPELINE PROFILE

END OF EXISTING STRUCTURE
EXISTING 36" HDPE
36' HDPE PIPE
2.9% SLOPE
150'
36" CONNECTION

4" VENT PIPE
36"-30" REDUCER
EXISTING GROUND

30' HDPE PIPE
10.6% SLOPE
463'

6.7% SLOPE
291'

PLUNGE POOL

CONCRETE HEADWALL

6'
6'

30' HDPE PIPE

GROUTED RIPRAP

2' RIPRAP

SCALE

60 0 60 120

PLUNGE POOL

60 0 60 120

JONS DROP PIPE ALTERNATIVE

STATES WEST WATER RESOURCES CORPORATION
1904 EAST 15TH STREET
CHEYENNE, WY 82001
307-634-7848
307-634-7851 (FAX)

WARNING:

NOT TO SCALE

DATE
1991

REV. 1:2:3

II-3
FOUR MILE CROSSING - INVERTED SIPHON PROFILE

SCALE

10 0 10 20

TOP OF BANK

130'

EXISTING GROUND

2' RIPRAP

30° BEND

22.5° BEND

48' HDPE PIPE

FLOW

OUTLET STRUCTURE

CANAL INVERT

CAST IN PLACE HDPE PIPE

BEVELED END IN THE HEADWALL

INLET AND OUTLET STRUCTURE DETAIL

INLET AND OUTLET STRUCTURE DETAIL

FLUSH AND DRAIN VALVE DETAIL

TRASH RACK (INLET)

TOP OF BANK

48' HDPE

CANAL INVERT

INLET AND OUTLET STRUCTURE DETAIL

INLET AND OUTLET STRUCTURE DETAIL

FLUSH AND DRAIN VALVE DETAIL

CHD EVISION

STATES WEST WATER RESOURCES CORPORATION

1934 EAST 15TH STREET

CHEYENNE, WY 82003

307-634-7848 (TEL)

307-634-7851 (FAX)

WARNING

IF THIS BAR BOX

FITS THE DRAWING

DEVELOPMENT COMMISSION

FOUR MILE CROSSING

INVERTED SIPHON

ALTERNATIVE 2

III-2