HIGHLINE DITCH REHABILITATION
PROJECT LEVEL II
FEASIBILITY STUDY

EXECUTIVE SUMMARY

October 26, 1987

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This report, prepared for the Wyoming Water Development Commission (WWDC), presents the results of a Level II Feasibility Study of rehabilitation of the Highline Ditch. The Highline Ditch Company submitted an application for assistance to the WWDC and is the project sponsor for the study. Primary objectives of the study were to: (1) determine the feasibility of constructing a pipeline to replace critical (high-maintenance) portions of the upper reach of the ditch in Tongue River Canyon and (2) develop Level II (feasibility-level) cost estimates for alternate pipe materials, construction methods, water delivery schedules or operating methods to reduce water losses and annual maintenance expenses and to increase the ditch capacity. The location of the ditch is shown on Figure 1 and the study reach of the ditch is shown on Figure 2.

Water rights for the Highline Ditch were researched to determine the total diversion right and diversion records were obtained to determine historic use of the ditch. The present capacity of the ditch was determined to be governed by the allowable depth in the reach immediately upstream from a reach where the flows are conveyed in a 42-inch corrugated metal pipe. At this point the maximum flow is 24 to 25 cfs, which is only about 60 to 62 percent of the total diversion right, including surplus (pre-March 1945) rights, of 40.18 cfs.

A field reconnaissance of the ditch was conducted during the summer of 1987 to identify problem areas. Ditch operators were interviewed to discuss historic maintenance issues, and the portions of the study reach of the ditch where the cost of maintenance is excessive were located.
FIGURE 2
SCHEMATIC OF STUDY REACH, HIGHLINE DITCH
Areas with visible seepage losses and capacity problems were also identified.

The study reach of the ditch was surveyed to determine elevations and dimensions for hydraulic computations and design studies. The survey showed that the overall slope of the ditch varies considerably over the length of the study reach. The existing pipeline section of the ditch has a slightly adverse slope which reduces the capacity of the ditch.

A canal loss study was conducted to locate the reaches within the study section of the ditch where seepage losses are most severe. Losses were found to be substantial throughout the study reach, including the section that is presently concrete-lined. Losses through the concrete-lined section were greater than losses typically seen in an unlined ditch of the same length and dimensions.

The subsurface conditions along the lined section of the study reach were investigated to determine the cause of cracking and heaving of the concrete liner. Boreholes were drilled and logged at regular intervals along the concrete-lined section. Slumping and expansive soils were ruled out as potential causes of the damage. The probable cause of the damage was determined to be freezing and thawing of the saturated soil beneath the concrete liner.

Six alternatives for rehabilitation of the entire study reach were evaluated. Preliminary designs were prepared and materials costs were obtained from local vendors. Installation costs were estimated and the total cost of each alternative was determined. Two of the alternatives were eliminated on the basis of cost and two were eliminated because they failed to meet the objectives of the project.
The two remaining alternatives were chosen for further study: Alternative 1 and Alternative 3. Alternative 1 consists of replacing the entire study reach of the ditch with a pipeline and has a total cost of approximately $242,000. Alternative 3 consists of replacement of portions of the study reach of the ditch with a pipeline and lining the concrete-lined section with a high density polyethylene liner. Alternative 3 also includes slope stabilization and drainage for the section that is presently concrete lined and an access road to the portion of the study reach that will not be rehabilitated. The total cost of Alternative 3 is about $149,300.

The study section of the ditch was also studied by reach in order to establish priorities for a phased plan of rehabilitation. Several alternatives were developed for each reach, and costs were estimated for each alternative. A preferred alternative for each reach was chosen based on cost or ability to meet the project objectives. A combination of the preferred alternatives for each reach is identical to Alternative 3 for rehabilitation of the entire study reach. The total costs for the preferred alternative for each reach are: Reach 1 - $49,300; Reach 2 - $0.00; Reach 3 - $33,700; and Reach 4 - $66,300.

Historical maintenance costs for the entire Highline Ditch were obtained from the Highline Ditch Company. The proportion of the total cost attributable to the study section was estimated and used to estimate annual general maintenance expenses for the study reach. Construction costs for replacement and improvement projects undertaken over the years were added to general maintenance costs to obtain total annual maintenance costs. These costs were adjusted to 1987 dollars and averaged over the period of record to determine the average annual
maintenance cost for the study reach. The average annual maintenance cost is approximately $10,500.

The financial feasibility of each of the chosen alternatives was determined based on the expected reduction in annual maintenance costs. The annual amortization cost of each alternative was estimated assuming that the WWDC would provide a grant for 50 percent of the total cost and a loan for the remaining 50 percent at 4 percent interest over a 30-year period. The rate of return that could be expected from investment in each rehabilitation alternative was determined and priorities were established for rehabilitation on a reach-by-reach phased plan.

The annual amortization cost of Alternative 1 is approximately $7,000. The estimated annual reduction in maintenance costs is about $9,975. The rate of return on investment for rehabilitation under Alternative 1 is about 8.2 percent.

Total annual amortization cost for Alternative 3 is about $4,320 and the expected annual reduction in maintenance costs is approximately $9,135. The rate of return on investment is about 12.2 percent.

Annual amortization costs for Reaches 1-4 under the phased plan of rehabilitation are $1,425, $0, $973, and $1,920, respectively. Expected annual reduction in maintenance costs for Reaches 1-4 are: Reach 1 - $898, Reach 2 - $0.00, Reach 3 - $3,990, and Reach 4 - $4,200. The rate of return on investment is 3.6 percent for Reach 1, not meaningful for Reach 2, 23.7 percent for Reach 3, and 12.7 percent for Reach 4.

Reach 3 would receive the highest priority for rehabilitation under the phased plan based on rate of return. Reach 1 has the lowest rate of return among reaches requiring work but must be included with Reach 3
because the pipeline must be extended upstream into Reach 1 in order to obtain enough head to deliver 30 cfs through the existing pipeline. Reach 4 is the second priority for rehabilitation based on rate of return on investment.

Alternatives 1 and 3 were also compared based on the total cost, in 1987 dollars, over a 40-year period in order to take into account the shorter life of the high density polyethylene liner. Total cost of Alternative 1 over a 40-year period is approximately $278,000. Alternative 3 has a total cost over the 40-year period of about $247,900.

Both Alternative 1 and Alternative 3 are feasible from an economic standpoint. Alternative 3 is recommended because of its lower initial capital cost and its lower cost over a 40-year period.

If a phased rehabilitation plan is chosen, rehabilitation of Reaches 1 and 3 should be the first priority. Reach 3 has the greatest rate of return on investment and rehabilitation of Reach 1 is necessary to obtain the full benefit of rehabilitation of Reach 3. The second priority would be rehabilitation of Reach 4.