EXECUTIVE SUMMARY
FOR
YORK / SOUTH SIDE DITCH
MASTER PLAN, LEVEL I

Prepared For:
Wyoming Water Development Commission
Herschler Building, 4th Floor West
122 W. 25th Street
Cheyenne, WY 82002

Prepared By:
Anderson Consulting Engineers, Inc.
772 Whalers Way, Suite 200
Fort Collins, CO 80525

November 25, 2002
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EXECUTIVE SUMMARY

1.0 INTRODUCTION

On June 1, 2002, Anderson Consulting Engineers, Inc. (ACE) entered a contract with the Wyoming Water Development Commission (WWDC) to provide professional services to the York / South Side Ditch Master Plan Project. The purpose of this Level I study was to identify and evaluate the feasibility of various rehabilitation and improvement alternatives for mitigating conveyance limitations and ditch efficiency problems associated with the York Ditch, the South Side Ditch, and the Hardin-Campbell Ditch. These three ditches are located in the vicinity of Ranchester and Dayton, Wyoming.

1.1 History of the Project

As indicated in Figure 1, the study area is located along the Tongue River in Sheridan County near the Towns of Ranchester and Dayton. In September of 2001, a cooperative effort by the South Side Ditch Company and York Ditch Company culminated in the submittal of a request to the WWDC for funding a Level I study of their existing irrigation facilities. Following the initial submittal for WWDC funding, the Hardin-Campbell ditch was included in the study area because of its integral role in the operations of the York Ditch. The South Side Ditch diverts water from the Tongue River and Little Tongue River and conveys it easterly via approximately 8.6 miles of earthen ditch to irrigated lands located between Dayton and Ranchester. There are approximately 1,345 acres irrigated by the South Side Ditch.

The York Ditch diverts water from the Tongue River approximately 5 miles downstream of the South Side Ditch’s point of diversion. The York Ditch is entirely earthen and is approximately 7.6 miles long providing water to approximately 978 irrigated acres. In addition to flows diverted from the Tongue River, a portion of its irrigation water is diverted from Wolf Creek and delivered to the York Ditch by means of the Hardin-Campbell Ditch.

The Hardin-Campbell Ditch diverts water from Wolf Creek and flows northerly approximately 1 mile to the York Ditch where it terminates.

1.2 Summary of Existing Problems

Existing problems associated with the ditches include aging infrastructure; conveyance limitations due to ditch slope, vegetation, and undersized structures; and seepage losses. The York Ditch suffers from problems associated not only with the age of its infrastructure, but a very low slope. An average slope of approximately 0.0012 ft/ft, combined with an abundance of aquatic vegetation, results in significant reduction in conveyance capacity. Instability of the hillslopes has resulted in the need for ditch realignment and a considerable amount of earthwork. Other maintenance problems with the ditch include potential blockage attributable to beaver dams and noticeable seepage losses.
Figure 1. Study Area

The South Side Ditch suffers the same problems as the York Ditch; much of the infrastructure is old and deteriorated. Seepage, beavers, and to a lesser extent, aquatic vegetation, all create maintenance problems and loss of conveyance within the ditch. In addition to these items, continued growth in the Town of Dayton has resulted in numerous homes being constructed alongside and below the ditch. Consequently, concern over potential seepage (basement flooding) and breaching (surface flooding) is heightened. Beaver activities have caused a recent breach resulting in damages to the ditch and subsequent ditch repair expenses.

The Hardin-Campbell Ditch is relatively free of problems. However, its diversion structure is situated in a tight bend of Wolf Creek and in the event of channel avulsion, the creek could abandon the diversion structure.

2.0 INVENTORY OF WATER RIGHTS AND EXISTING CONDITIONS

Based on information reviewed at the Wyoming State Engineers Office (WSEO), the South Side Ditch has a direct flow water right of 22.45 cfs from the Tongue River. The ditch also has
supplemental supply rights of 19.26 cfs from the Little Tongue River. The WSEO data for the York Ditch indicates direct flow rights totaling 13.6 cfs. The York Ditch also has supplemental supply rights of 7.60 cfs from the Tongue River. The Hardin-Campbell Ditch conveys direct flow water rights consisting of 10.30 cfs. Portions (approximately 7.6 cfs) of the Hardin-Campbell diversions are conveyed to the York Ditch and ultimately diverted to the water users.

The inventory evaluated the existing facilities associated with the three ditches. Structures evaluated included diversion structures, ditch headgates, farm turnouts, measurement devices, culverts, flumes, and siphons. In addition, ditch conditions and seepage losses were evaluated. The purpose of the field inventory was to assess the condition of the existing structures and to determine their rehabilitation/replacement needs. Information collected during the inventory phase of the project was incorporated into a comprehensive geographic information system (GIS).

Results of the seepage study document that seepage is occurring at locations along both the York and the South Side Ditches; at several locations losses can be considered significant. Total gaged losses on the South Side Ditch were approximately 2 cubic feet per second. This value represents approximately 10% of the flow diverted from the Tongue River. More losses are likely to be incurred through reaches that were not measured during this study. However, for the purpose of discussion, if one assumes a constant loss of 2 cfs over the course of an irrigation season (approximately 130 days), total losses approach 520 acre-feet. Similarly, on the York Ditch, the total gaged losses of approximately 4.7 cfs translate to over 30% of the river diversions and a seasonal loss of nearly 1,220 acre-feet.

3.0 ON-FARM IMPROVEMENTS

Using a spreadsheet water-use model of the study area, potential conservation savings associated with various on-farm improvements were evaluated. The model demonstrated that conversion of approximately 300 acres from flood irrigation to sprinklers on each of the South Side and York Ditches (total conversion of 600 acres) would result in annual conservation savings at the headgates would total approximately 1,290 acre-feet. This value is equivalent to an average reduction in the river diversions of approximately 4.9 cfs during the irrigation season.

4.0 REHABILITATION PLAN

Conceptual design alternatives to mitigate problems identified the inventory and seepage study phases of the project were presented. Specifically, development of the alternatives focused on:

- Rehabilitation / replacement of existing structures
- Mitigation of seepage losses
- Improvements in delivery of water
- Mitigation of problems associated with aquatic vegetation
- Reduction in annual operation and maintenance costs
- Improvement in ditch management and efficiency through water measurement
- Economic practicality of the alternative
- Physical feasibility of the alternative
In addition to the alternatives presented herein, other alternatives were initially evaluated but were screened because they were either economically impractical or physically infeasible. Alternatives evaluated, but eliminated from further investigation, included: (a) combining flows of both the South Side and York Ditches into a single pipeline; and (b) individual pipelines for each ditch system. These alternatives were eliminated due to the high relative cost of pipeline construction (economic feasibility), and pressurized flow in the pipelines precludes utilization of the diversions from the Hardin-Campbell Ditch (physical feasibility).

4.1 Hardin-Campbell Improvements

The results of the field inventory for the Harden-Campbell Ditch identified the need for rehabilitation of the existing diversion structure. The improvements to the diversion structure are related to: (a) minor scour below the concrete floor at the outlet to the diversion structure; and (b) potential abandonment of the diversion structure due to channel avulsion in Wolf Creek. The scour at the base of the structure can be mitigated by placement of grout in the void created by the scour hole along with installation of a rock riprap apron immediately downstream of the structure.

Channel stabilization measures in Wolf Creek were identified and evaluated following a review of a design plan prepared by the NRCS.

4.2 Rehabilitation Alternative 1: Consolidated Ditch System / Lining

This alternative involves the consolidation of diversions for both the South Side and York Ditches. The point of diversion of the York Ditch would be moved to that of the South Side Ditch. The South Side Ditch requires enlargement to convey the combined discharges. At the end of the South Side Ditch, a pipe drop structure has been identified to convey irrigation diversions back to the York Ditch. That portion of the York Ditch located upstream of the pipe drop structure outlet would be abandoned. The development of this alternative, involved the following components.

- Improved Diversion Facility and Headgate on the Tongue River
- Improved Diversion Structure and Headgate on the Little Tongue River
- Enlargement of the South Side Ditch
- Replacement of Culvert Crossings on South Side and York Ditches
- Placement of a Pipe Drop Structure Connecting South Side and York Ditches
- Lining of Four Seepage Reaches on the South Side Ditch.
- Remediation of Wolf Creek Diversion Structure/Channel Stabilization
- Installation of Measurement Structures
- Replacement of Farmer’s Turnout Structures
- York Ditch Trash Rack at Wolf Creek Crossing

4.3 Rehabilitation Alternative 2: Individual Ditch Systems / Lining

Under this alternative, the ditch diversions remain separated and the individual ditches are improved accordingly. The development of this alternative, involved the following components.
Improved South Side Ditch Diversion Structure/Headgate on the Tongue River
Improved Diversion Structure/Headgate on the Little Tongue River
Replacement of Culvert Crossings on South Side Ditch/York Ditch
Lining of Four Seepage Reaches on the South Side Ditch
Lining of Four Seepage Reaches on the York Ditch
Improved York Ditch Diversion Structure/Headgate
Remediation of the Wolf Creek Diversion Structure/Channel Stabilization
Installation of Measurement Structures
Replacement of Farmer’s Turnout Structures
York Ditch Trash Rack at Wolf Creek Crossing

4.4 Alternative Evaluation

An evaluation of the alternatives was completed and included a comparison of factors related to project cost, number of acres that benefit by the improvements, ease of permitting, and flexibility of implementation. Project costs were determined to be comparable and selection of the preferred alternative relied on the evaluation of the remaining factors. Based on the relative flexibility of implementation, the results of the alternative evaluation identified Rehabilitation Alternative 2-Separate Diversions as the preferred alternative. The components of Rehabilitation Alternative 2 can be implemented as individual projects or the alternative can be implemented in its entirety. Rehabilitation Alternative 1-Consolidated Diversions, on the other hand, does not provide the flexibility to implement portions of the alternative. Because it involves enlargement of the South Side Ditch to convey the consolidated diversions, this essentially locks the district into completing that task before any other components can be completed.

5.0 CONCEPTUAL DESIGN AND COST ESTIMATES

Following the selection of Rehabilitation Alternative 1-Separate Diversions as the preferred alternative, conceptual design details were prepared for the individual components of the plan. Figure 2 presents the components of the conceptual design for the preferred alternative.

Based on the conceptual design details, detailed cost estimates for construction of improvements to the three irrigation ditch systems were prepared. The construction cost components associated with the recommended improvements were identified and total project costs assigned to each component as indicated in Table 1.

6.0 ECONOMIC ANALYSIS

An economic analysis was completed to assess the ability of the users to pay for the cost associated with the proposed improvements. Before this project can become eligible for funding under the Wyoming Water Development Commission’s guidelines, an entity must be formed which can incur debt. For this analysis, it was assumed that an irrigation district is formed encompassing the entire study area. Therefore, evaluation of impacts to current assessments were based upon an estimated irrigated acreage of 2,700 acres and a 50% loan / 50% grant through the WWDC.
York Ditch:
- Install approximately 16 measurement devices
- Rehabilitate approximately 8 farm turnouts
- Replace approximately 3 culverts

South Side Ditch:
- Install approximately 30 measurement devices
- Rehabilitate approximately 14 farm turnouts
- Replace approximately 4 culverts

Hardin-Campbell Ditch:
- Install approximately 4 measurement devices
- Rehabilitate approximately 1 farm turnout

Figure 2: Alternative 2 Conceptual Design Components
Table 1. Summary of Improvement Costs and Repayment Plan.

<table>
<thead>
<tr>
<th>Improvement</th>
<th>Description</th>
<th>Total Project Cost</th>
<th>Annual Payment</th>
<th>Assessment (1)</th>
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<tbody>
<tr>
<td>Improvement 1:</td>
<td>South Side Ditch Diversion Facility</td>
<td>$105,463</td>
<td>$4,597</td>
<td>$1.70</td>
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<td>Improvement 2:</td>
<td>Little Tongue River Diversion Structure</td>
<td>$43,745</td>
<td>$1,907</td>
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<td>Improvement 3:</td>
<td>South Side Ditch Lining</td>
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<tr>
<td>Improvement 3A:</td>
<td>Lining of Reach S-1</td>
<td>$37,125</td>
<td>$1,618</td>
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<td>Improvement 3B:</td>
<td>Lining of Reach S-2</td>
<td>$39,212</td>
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<tr>
<td>Improvement 3C:</td>
<td>Lining of Reach S-3</td>
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<tr>
<td>Improvement 3D:</td>
<td>Lining of Reach S-4</td>
<td>$112,266</td>
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<td>Improvement 4:</td>
<td>Rehabilitation / Replacement of Culvert Crossings: South Side Ditch</td>
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<td>Improvement 5:</td>
<td>Installation of Measurement Structures - South Side Ditch</td>
<td>$41,745</td>
<td>$1,820</td>
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<td>Improvement 6:</td>
<td>Rehabilitation of Farmer's Turnouts - South Side Ditch</td>
<td>$7,653</td>
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<td>Improvement 7:</td>
<td>York Ditch Diversion Facility</td>
<td>$106,363</td>
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<td>Improvement 8:</td>
<td>York Ditch Lining</td>
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<td>Improvement 8A:</td>
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<td>Improvement 8B:</td>
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<td>Improvement 9:</td>
<td>Rehabilitation / Replacement of Culvert Crossings: York Ditch</td>
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<td>Improvement 10:</td>
<td>Installation of Measurement Structures - York Ditch</td>
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<td>Improvement 11:</td>
<td>Rehabilitation of Farmers' Turnouts - York Ditch</td>
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<td>Improvement 12:</td>
<td>Replacement of Trash Rack at Wolf Creek Crossing - York Ditch</td>
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<td>Improvement 13:</td>
<td>Remediation of the Wolf Creek Diversion Structure - Hardin-Campbell Ditch</td>
<td>$38,038</td>
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<td>Improvement 14:</td>
<td>Rehabilitation of Farmers' Turnouts: Hardin-Campbell Ditch</td>
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<td>Improvement 15:</td>
<td>Installation of Measurement Structures - Hardin-Campbell Ditch</td>
<td>$6,066</td>
<td>$264</td>
<td>$0.10</td>
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</table>

Notes:
(1) Annual assessment is based upon total irrigated acres of approximately 2,700 acres

A final cost estimate and repayment plan for the project improvements is also presented in Table 1. The final cost estimate and repayment plan includes 10% for engineering services during construction and 15% for construction contingencies. The WWDC funding for the project was assumed to be in the form of a 50% grant and 50% loan. The terms of the loan were assumed to be 6.0% for a period of 20 years.

The present assessment for irrigated acreage in the study area varies from $2 to $4 per acre. Depending upon which improvement(s) are selected for completion, the increase in assessment ranges from less than $0.10 per acre to approximately $2 per acre.

7.0 PERMITTING

If various components of this project proceed to construction, certain permits, rights-of-way and easements will be required. State and federal agencies were contacted regarding potential requirements associated with construction of the project. This effort concluded that the Corps of Engineers (COE) should be contacted with a letter describing the project during the initial stages of the final design of improvements involving stream diversions structures. Given the scope of the majority of improvements as presented in this report, Section 404 permitting will likely not
be required as they relate to irrigation system infrastructure. Should 404 permitting be required, additional permits and clearances would be required from Wyoming Game and Fish Department, Wyoming DEQ, Water Quality Division, State Historic Preservation Office, and Wyoming State Engineer’s Office. Where applicable, permission should also be negotiated for easement/right-of-access for all construction activities associated with the project.

8.0 ALTERNATIVE FUNDING SOURCES

Project funding/financing is a critical aspect associated with the implementation of this project. During the completion of this project, discussions with ditch representatives indicated that the ability-to-pay among the majority of water users was limited. With respect to irrigation system rehabilitation, funds (50% grant, 50% loan) are available through the WWDC to implement improvements associated with the main canal facilities (i.e., diversion structure, main delivery canal, laterals, turnout structures, etc.). These funds are not available for on-farm improvements and require the formation of a district that can incur debt and assess users fees. The loan obligation may be partially reduced through alternative funding sources that also carry a grant/loan obligation. Alternative sources of funding that should be further investigated are identified below.

- Water Development Commission Small Water Project Program (SWPP)
- Farm Service Agency (USDA): Conservation Reserve Program/Continuous Sign-up for High Priority Conservation Practices
- Natural Resource Conservation Service (NRCS): EQIP/WHIP
- Department of Environmental Quality-Water Quality Division (WDEQ-WQD): Section 319 Funds

In addition to these sources, opportunities for individual landowners may exist through funding available via the Wyoming State Loan and Investment Board.

9.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the preceding information, the following conclusions and recommendations are provided.

1. Deterioration of the existing irrigation facilities is evident. Diversion structures, headgates, and turnout structures are in need of rehabilitation for both the South Side Ditch and York Ditch. Measurement structures are non-existent and system delivery efficiency has reduced in recent years.

2. Conveyance capacity in the main delivery canal has been reduced by sedimentation and aquatic vegetation; especially in the York Ditch.

3. Seepage losses in both the York Ditch and South Side Ditch have increased and continue to reduce the delivery of water to the irrigators.

4. In recent years, stability of the ditch created a problem with respect to ditch failure and potential flooding of adjacent properties.
5. The diversion facility on Wolf Creek associated with the Hardin-Campbell Ditch may be jeopardized by channel avulsion during a flood event.

6. Measurements conducted during this study confirmed losses attributable to seepage. For those sites where measurements were taken, the results indicated a losses ranging from 10% of the total diversions for the South Side Ditch to almost 30% of the total diversions for the York Ditch.

7. Evaluation of alternatives during the development of the Rehabilitation Plan determined that conversion of the open ditch systems to pipelines is not economically or practically feasible.

8. Evaluation of feasible alternatives developed during the preparation of the Rehabilitation Plan resulted in the selection of an alternative (Rehabilitation Alternative 2-Separate Diversions) that focused on improvements within each ditch system. The consolidation of York Ditch and South Side Ditch irrigation diversions into the delivery system of the South Side Ditch was also evaluated. The alternative involving ditch consolidation was discarded due to the need to implement costly improvements on a large scale versus the phased implementation of improvements if diversions are not consolidated.

9. Assuming implementation of Rehabilitation Alternative 2-Separate Diversions, conceptual design information was prepared for individual components of the plan. Project construction cost and assessment information associated with the construction of the individual components was also prepared.

10. Based on the results of this Level I study, the following recommendations are provided:

- The ditch companies should immediately proceed with the legal work necessary to form a district.

- A more detailed seepage investigation should be conducted as part of a Level II study. In addition to additional measurements along the ditch system, the seepage investigation should include measurements at the diversion headgates, wasteway structures, and all farmers' turnout structures. This work will refine the results of the Level I work effort and better define those reaches where placement of a liner will provide the maximum benefit at a minimum of cost.

- Improvements to farmer's turnout structures and installation of individual measurement structures should proceed to Level III design and construction following formation of the irrigation district.

- Improvements to the Hardin-Campbell Ditch diversion structure should proceed to Level III design and construction following formation of the irrigation district.

- Annually, a program involving the routine application of herbicides should be developed to control the growth of aquatic vegetation within the ditch delivery systems.
11. For those improvements recommended for Level III design and construction, funding sources that should be further investigated include:

- Wyoming Water Development Commission Grant/Loan program.
- Wyoming Water Development Commission Small Water Project Program (SWPP)
- Natural Resources Conservation Service (NRCS) : EQIP/WHIP
- State Land and Investments Board