EXECUTIVE SUMMARY

WYOMING WATER DEVELOPMENT COMMISSION

ENTERPRISE CONSERVATION PROGRAM LEVEL II STUDY

September, 2008
FINAL EXECUTIVE SUMMARY

ENTERPRISE CONSERVATION PROGRAM
LEVEL II STUDY

Prepared for:

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September 2008

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EXECUTIVE SUMMARY

This Level II study was requested to provide a comprehensive review and evaluation of the current condition of the Enterprise system, make recommendations for improvement of the system, and provide concept designs and financial analysis in accordance with WWDC requirements for Level III funding. All efforts on this project are aimed at helping Enterprise manage their existing water supplies and yield the highest efficiency irrigation deliveries practical.

The project focus is on assessment of current conditions in the system, including identification and mapping of existing facilities, determination of seepage losses, and evaluation of delivery efficiency on laterals and farms. These efforts contributed to the development of a canal and farm efficiency improvement strategy, concept design of canal improvements, and financial analysis. The final product of this effort is a report, which describes the results of the data collection, analysis and design conducted during the course of this project, and a geographic information system containing all geospatial data developed as a part of this, or previous, projects for use by Enterprise in the management of this system in the future.

The goal of this study is to provide Enterprise with a comprehensive picture of the present condition of the system, tools to maintain and manage system data, and a suite of improvement recommendations that can be implemented in phases, as funding allows.

A. PROJECT BACKGROUND

The Enterprise Watershed Improvement District (Enterprise or EWID) was formed in 2006 by a unanimous vote of the landowners within the district boundaries, generally defined as the service area of the Enterprise Irrigation and Power Company. EWID was formed to create an approved entity which can receive funding for studies or construction projects through the Wyoming Water Development Commission. The present Level II study builds on the results and recommendations of the Level I Popo Agie Watershed study completed for the Popo Agie Conservation District (PACD) in 2003.

The Enterprise Irrigation and Power Company (Enterprise) currently operates and maintains all segments of the main Enterprise Ditch, Frye Lake, and appurtenant laterals which comprise the Enterprise Ditch system (Plates 1 and 2 in Appendix A). This system collects and conveys runoff generated in the Middle Popo Agie River Basin to irrigated farm ground in the district service area. The main canal system is approximately 14 miles long, and is comprised of a system of diversion channels and natural watercourses. Deliveries are made into two bifurcated laterals, 4.4 miles and 4.1 miles, respectively, which convey water to shareholders located on the north and south sides of the Willow Creek drainage. The Enterprise system also includes Frye Lake which has a storage capacity of 1,697.6 acre-feet and provides later season irrigation water to shareholders.

The Company has 1,000 shares outstanding which serve approximately 91 shareholders and an adjudicated acreage of approximately 3,660 acres. Shares are divided using approximately 23 turnout boxes installed in the main ditch and primary north and south
lateral. Additional private laterals extend to individual farms and may include additional share division devices or informal water sharing agreements between shareholders. Private laterals were not included in this study, except as described in subsequent sections.

Typical irrigated acreages range from less than 1 acre to more than 200 acres, with a number of smaller acreages in the range of 1 to 3 acres. Urbanization has occurred in portions of the system in the past and is expected to continue as Lander continues to grow. Typically, farms under this system grow pasture grass, alfalfa, or an alfalfa-grass mix for use as animal feed. Some farmers bale and sell crops from their farms, while many use crops to feed their own cattle and horses.

B. LITERATURE REVIEW

The Enterprise irrigation system has been studied several times in the past, by both the United States Department of Agriculture Soil Conservation Service (now Natural Resources Conservation Service or NRCS) and the State of Wyoming via the State Engineer’s Office (SEO) and the Wyoming Water Development Commission (WWDC). Each of these studies was reviewed and summaries are presented in this document. Particular attention was paid to elements of the previous work that is relevant to the current work effort.

C. EXISTING SYSTEM INVENTORY

The first major task to be completed under this project was a comprehensive inventory of all structures on the Enterprise system, including the upper reaches of the system and the North and South laterals (Figure 1). An extensive network of private laterals conveys water from the main system for application on individual farms, and this system was not surveyed except as pertains to the completions of Task 5, described in a subsequent section of this report.

The field inventory was completed using hand-held GPS technology using ArcPAD software. Field data collection then included collection of GPS coordinates and completion of the structure questionnaire resulting in comprehensive collection of pertinent data about each structure. The field data collected was directly imported into ArcGIS for creation of the mapping products specified as a part of Task 9.

A Geographical Information System (GIS) was developed from the field inventory data collected by the project team as well as from spatial data developed by others, in accordance with Task 9 from the Scope of Work. GIS is a software computer package, the most widely used brand being ArcMap, which can be used to make maps from a myriad of spatial data. The software is used for much more than just making “pretty maps.” GIS is used to analyze, store, and manipulate data that is tied to a spatial display on a map.

The GIS maps for Enterprise have two primary uses:

- To store data about the various structures and canal reaches which comprise the Enterprise system. Stored data can include physical measurements, photos, and conditions assessments. Documents related to future improvements can also be
stored, allowing Enterprise to have an accurate data storage system which is infinitely expandable.

- To provide Enterprise with hard-copy maps which can be used to enhance understanding of a particular issue, define maintenance or improvement areas, and communicate the complexity of the Enterprise system with Enterprise shareholders who have had minimal involvement in the past.

D. SEEPAGE LOSS ANALYSIS

Seepage loss measurements were conducted at several locations throughout the Enterprise system, including the upper canal and both main laterals. Cross-sections were selected at key locations based on position in the system and ease of access. Further, study reaches were selected such that irrigation diversions were not present in the study reach. Seepage loss measurements were conducted using the water balance method with the assumption that the inflow should equal the outflow plus losses (seepage and evapotranspiration, with evapotranspiration neglected for the purposes of this study). Flow measurement at each section was conducted using an Acoustic Doppler Current Profiler (ADCP) manufactured by Teledyne. Flow measurement using this device is similar to methodologies using current meters or other devices. The discharge is computed at the end of each transect based on the collected data with an accuracy of plus or minus 2 percent.

Canal seepage results are summarized in the following two tables. At points, seepage from the Enterprise system is quite significant. Overall seepage results indicate that at least 30 percent of water collected for irrigation is lost in the upper system. Lower system results indicate that 20 percent to 50 percent of the water in the main laterals may be lost to seepage, resulting in a total loss of over 50 percent. Seepage from private laterals is also expected to be quite high, though not all Enterprise irrigators use private laterals to convey irrigation water to their farms.

**Upper Canal Seepage Results Summary**

<table>
<thead>
<tr>
<th>Section</th>
<th>Test section length (miles)</th>
<th>Test Date</th>
<th>Discharge Upstream (CFS)</th>
<th>Discharge Downstream (CFS)</th>
<th>Change in Flow (cfs)</th>
<th>Change in Flow per mile (CFS)</th>
<th>Estimated Seasonal Loss/Gain (AF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Canal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF-1 to RF-2</td>
<td>0.72</td>
<td>7/16/07</td>
<td>6.9</td>
<td>8.7</td>
<td>-1.8</td>
<td>-2.5</td>
<td>-270</td>
</tr>
<tr>
<td>Sawmill Creek</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FL1 to SM1 (+)</td>
<td>1.90</td>
<td>7/17/07</td>
<td>36.6</td>
<td>32.2</td>
<td>4.4</td>
<td>2.3</td>
<td>665</td>
</tr>
<tr>
<td>SM1 to SM2</td>
<td>0.88</td>
<td>7/17/07</td>
<td>32.2</td>
<td>26.6</td>
<td>5.6</td>
<td>6.3</td>
<td>845</td>
</tr>
<tr>
<td>SM2 to SM3</td>
<td>0.67</td>
<td>7/17/07</td>
<td>26.6</td>
<td>25.1</td>
<td>1.5</td>
<td>2.2</td>
<td>225</td>
</tr>
<tr>
<td>SM3 to CC1</td>
<td>1.50</td>
<td>7/17/07</td>
<td>25.1</td>
<td>24.6</td>
<td>0.5</td>
<td>0.3</td>
<td>75</td>
</tr>
<tr>
<td>Crooked Creek &amp; Cascade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CC1 to CC2</td>
<td>1.70</td>
<td>7/17/07</td>
<td>24.6</td>
<td>23.4</td>
<td>1.2</td>
<td>0.7</td>
<td>180</td>
</tr>
<tr>
<td>CC2 to CAS2</td>
<td>3.47</td>
<td>7/17/07</td>
<td>23.4</td>
<td>24.2</td>
<td>-0.8</td>
<td>-0.2</td>
<td>-120</td>
</tr>
</tbody>
</table>

* Assumes same flow rate as tested. Varying flow rates will result in varying losses. Seasonal loss based on consistent flow over the 2007 season (6/1 - 8/15 or 76 days)
** Seepage loss is indicated by a positive number (+). Measured inflow or a “gain” is indicated by a negative number (-).
* Measurement may have been affected by construction use
~ Included inflow from other watercourses
### Lateral Seepage Results Summary

<table>
<thead>
<tr>
<th>North Lateral Sections</th>
<th>Test section length (miles)</th>
<th>Test Date</th>
<th>Discharge Upstream (CFS)</th>
<th>Discharge Downstream (CFS)</th>
<th>Change in Flow (cfs)</th>
<th>Change in Flow per mile (CFS)</th>
<th>Estimated Seasonal Loss/Gain (AF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL3 to NL4</td>
<td>0.31</td>
<td>7/15/07</td>
<td>12.3</td>
<td>11.5</td>
<td>0.8</td>
<td>2.6</td>
<td>120</td>
</tr>
<tr>
<td>NL2 to NL1</td>
<td>0.49</td>
<td>7/14/07</td>
<td>9.0</td>
<td>8.5</td>
<td>0.5</td>
<td>1.0</td>
<td>60</td>
</tr>
</tbody>
</table>

**South Lateral Sections**

| SL4 to SL3             | 1.58                       | 7/15/07   | 18.9                     | 19.7                      | -0.8                | -0.5                          | -120                            |
| SL1 to SL2             | 0.31                       | 7/14/07   | 10.4                     | 5.4                       | 5.0                 | 16.0                          | 755                             |

**Note:** Tested completed using ADCP Acoustic Doppler Flow measurement.

** Assumes same flow rate as tested. Varying flow rates will result in varying losses. Seasonal loss based on consistent flow over the 2007 season (6/1 - 8/15 or 76 days)**

** Seepage loss is indicated by a positive number (+). Measured inflow or a “gain” is indicated by a negative number (-).

+ Measurement may have been effected by construction use

~ Included inflow from other watercourses

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### E. CURRENT OPERATIONS AND IRRIGATION EFFICIENCY ANALYSIS

Enterprise operations are relatively complex for an irrigation system of this size. There are three separate diversion structures and a reservoir which much be managed in order to maximize the available supply for Enterprise irrigators. Irrigations flows delivered under Enterprise fall into two regimes: direct flow and storage flow. Each regime occurs at a separate point during the irrigation season and typically overlaps for a short period each season.

In the lower basin, deliveries are completed via two laterals and a series of division structures. The entire system is nearly 20 miles long, and private laterals convey irrigation delivers many miles further to beneficial application on farms under the Enterprise system. Upper basin and lower basin operations are significantly different and typically fall to different personnel to manage.

Most irrigators under Enterprise employ surface or flood irrigation methods. Farms under the Enterprise system tend to have rolling, hilly topography, including relatively steep topography at points on many farms. During recent years, older application methods have generally given way to the use of gated pipe. Crops grown under Enterprise are typically pasture grass, alfalfa, or a mixture of grass and alfalfa. These crops are typically harvested and stored to feed cattle and horses during the winter months, or harvested and sold to other, local animal feeding operations.

On average over the study period, Enterprise requires approximately 6,200 acre-feet of irrigation water to fully supply the crops grown in the service area. The total water supply to Enterprise (as measured by SEO diversion records) ranges from 5,000 acre-feet to 7,800 acre-feet for the period that data is available. After conveyance losses, the total irrigation supply delivered to farms under Enterprise ranges from 3,350 acre-feet to approximately 5,200 acre-feet. The usable portion of this delivered flow (after reduction due to inefficiency in surface irrigation methods) ranges from approximately 2,000 acre-feet to 3,100 acre-feet, or one-third to one-half the amount of water required to fully meet the crop water requirement under Enterprise.

The Enterprise system has significant fall across the system, especially in the lower reaches and even in the reaches downstream from the Cascade. This fall could be expected to provide adequate pressure for irrigation deliveries to farms on both the North and South laterals. The lower reach currently lacks a reservoir to sufficiently pressurize a delivery system and equalize deliveries such that water from the upper system is not spilled due to the inequality between delivery and demand. It is likely that supply lines in the lower system would be smaller than in the upper system, but the
length of run to supply just the laterals would also result in construction costs totaling several million dollars. Individual irrigators and those served by private laterals would have to bear additional costs to upgrade on-farm and lateral distribution systems to take advantage of the pressurized delivery. In short, these improvements would likely not generate sufficient financial benefits to justify the costs to the Enterprise shareholders.

F. REHABILITATION AND MANAGEMENT PLAN

The rehabilitation and management plan for Enterprise is composed of several different strategies designed to combat the deficiencies noted previously and institutional challenges that Enterprise faces. As noted previously, Enterprise farms are typically not as productive as they might be and the economic environment under Enterprise may preclude implementation of costly improvements. As a result, the majority of suggestions presented as a part of this plan is designed to be low-cost and can be phased in by the Enterprise Board with approval of the shareholders.

The Enterprise system inventory described previously identified several critical structures which were in need of repair or near the end of their useful life. Additionally, canal reaches with especially high seepage or which are in poor condition were identified. Based on consultation with WWDC personnel and the Enterprise Board, several high-priority structures were identified in the first tier of improvement priorities.

High-Priority Improvement Summary

<table>
<thead>
<tr>
<th>Priority</th>
<th>Structure Name</th>
<th>Proposed Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Sawmill Canal – Diversion to Rock-cut</td>
<td>Canal Lining</td>
</tr>
<tr>
<td>1b</td>
<td>Sawmill Creek Diversion</td>
<td>Structure Replacement</td>
</tr>
<tr>
<td>2a</td>
<td>Bifurcation Structure</td>
<td>Structure Replacement</td>
</tr>
<tr>
<td>2b</td>
<td>Wood Flume</td>
<td>Canal Piping</td>
</tr>
<tr>
<td>3</td>
<td>Roaring Fork Diversion</td>
<td>Structure Replacement</td>
</tr>
<tr>
<td>4</td>
<td>Frye Lake Outlet</td>
<td>Structure Replacement and Automation</td>
</tr>
<tr>
<td></td>
<td>Turnout</td>
<td>Structure Replacement (ongoing, as needed)</td>
</tr>
</tbody>
</table>

Canal operational improvements are the next category of improvement considered for the Enterprise system. Operational improvements encompass several categories such as equitable share division, system maintenance, and system management including monitoring and control. Maintenance of the Enterprise system is a major work effort, due to the length of the system, the adjoining natural conditions along much of the system, and the relatively small number of active shareholders who typically participate in the work. Maintenance activities required for Enterprise are typical of those required for other irrigation canal systems, but much of the Enterprise system is remote and accessible only by four-wheel drive or ATV vehicles.

Institutional improvements include improvements to the Company bylaws or other elements of ditch administration. These improvements range from easement protection to succession planning at key staff levels and can be implemented at a relatively low cost. These improvements should help Enterprise in continued management of the existing system and in management of future urbanization which is expected to occur under the system.
G. CONCEPT LEVEL DESIGNS

Field inspection of the structures under the Enterprise system, observation of Enterprise operations, and discussion with the Enterprise Board led to the development of the structural rehabilitation plan. Concept designs and cost estimates were prepared for high-priority improvements identified in the previous section. Cost estimates were prepared in accordance with WWDC requirements for Level III funding requests and are shown in both 2007 and 2011 dollars, as specified in the contract documents.

Opinion of Probable Costs for High-Priority Improvements

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Total Cost (2007 $’s)</th>
<th>Total Cost (2011 $’s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Sawmill Reach 1 Lining</td>
<td>$162,300</td>
<td>$190,600</td>
</tr>
<tr>
<td>1b</td>
<td>Sawmill Diversion, including SCADA backbone</td>
<td>$174,600</td>
<td>$205,050</td>
</tr>
<tr>
<td>2a</td>
<td>Bifurcation Structure</td>
<td>$64,000</td>
<td>$75,160</td>
</tr>
<tr>
<td>2b</td>
<td>Replace Wooden Flume on North Lateral with pipe</td>
<td>$116,100</td>
<td>$136,350</td>
</tr>
<tr>
<td>3</td>
<td>Roaring Fork Diversion</td>
<td>$167,200</td>
<td>$196,360</td>
</tr>
<tr>
<td>4</td>
<td>Frye Lake Outlet</td>
<td>$53,200</td>
<td>$62,479</td>
</tr>
<tr>
<td></td>
<td><strong>Total for High Priority Projects</strong></td>
<td><strong>$737,400</strong></td>
<td><strong>$866,000</strong></td>
</tr>
</tbody>
</table>

Notes: Inflation rate is assumed to be 4.2%

H. ECONOMIC AND FINANCIAL ANALYSIS

In order to receive funding from the Rehabilitation Program of the WWDC, Enterprise must demonstrate the ability to support both their part of the development costs and the normal yearly operation and maintenance (O&M) costs. Funding from the WWDC is usually divided into two portions: a grant amount and a loan amount. For a Rehabilitation Program project, the grant amount would typically be 67 percent of the construction cost; however, it can be raised to 75 percent at the discretion of the WWDC. Currently, the interest rate is 4 percent and this is the loan interest rate that has been used in the tables below. The maximum term of the loan is 50 years from the time of substantial completion of the project, though the maximum term is keyed to the anticipated lifespan of the proposed improvement.

Other funding sources can be viewed as both supplemental sources to WWDC and as alternative funding options to the extent that the improvements under consideration would ‘fit’ with the resources and goals of other funding agencies. It is in the Enterprise’s interest to explore supplemental funding sources and to put together a package of funding opportunities. Taken together, it may be possible for the Enterprise to structure their funding to improve their opportunity of being funded by any one of them. Most funding sources have limits on the amounts that can be provided; therefore breaking up the total cost of the improvements among a variety of sources increases the Enterprise’s chances of ‘fitting’ with the resources of a greater number of funding agencies. Several cost-sharing funding sources were identified, where the funding agency will provide a grant and the project sponsor must be able to provide other funding for the balance of the project costs.
Probable Annual Assessments to Repay WWDC Loan

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Total Cost (2011 $’s)</th>
<th>Annual Assessment ($/share)</th>
<th>Annual Assessment ($/share)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>No Grant</td>
<td>67% Grant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 yr loan</td>
<td>30 yr loan</td>
<td>50 yr loan</td>
</tr>
<tr>
<td>1a</td>
<td>Sawmill Reach 1 Lining</td>
<td>$190,599</td>
<td>$23.16</td>
<td>$10.92</td>
</tr>
<tr>
<td>1b</td>
<td>Sawmill Diversion, including SCADA backbone</td>
<td>$205,044</td>
<td>$24.91</td>
<td>$11.75</td>
</tr>
<tr>
<td>2a</td>
<td>Bifurcation Structure</td>
<td>$75,159</td>
<td>$9.13</td>
<td>$4.31</td>
</tr>
<tr>
<td>2b</td>
<td>Replace Wooden Flume on North Lateral with pipe</td>
<td>$136,344</td>
<td>$16.56</td>
<td>$7.81</td>
</tr>
<tr>
<td>3</td>
<td>Roaring Fork Diversion</td>
<td>$196,354</td>
<td>$23.86</td>
<td>$11.25</td>
</tr>
<tr>
<td>4</td>
<td>Frye Lake Outlet</td>
<td>$62,476</td>
<td>$7.59</td>
<td>$3.58</td>
</tr>
<tr>
<td></td>
<td>High Priority Subtotal</td>
<td>$865,996</td>
<td>$105.21</td>
<td>$49.61</td>
</tr>
</tbody>
</table>

Notes: 4% interest rate on the loan
All values presented in 2011 $’s
1000 shares, costs equally distributed among all shares

It is recommended that Enterprise pursue Level III (final design and construction) funding from WWDC at the highest level and longest term obtainable. During the Level III application and design period, it would be advisable to present the highest priority projects to local NRCS personnel to determine eligibility to participate in state-wide or national grant programs. There are elements of the high-priority projects (i.e. SCADA and remote gate actuation) that may enable participation in some of the technology-based grant programs.

I. FEASIBILITY STUDY MAP PRODUCTS

Riverside Technology, inc. (RTi) and Aqua Engineering, Inc. created an ArcGIS Geodatabase for the Enterprise system. This Geodatabase was created from detailed survey information of the system, digitized data from the 2006 NAIP imagery, and from existing WWDC Level I data. Survey data consisted of point surveys along the ditch system. Included in each point survey were observations, measurements, photos, and the location of structures along the canal and the canal itself. The actual ditches and
laterals were digitized from the NAIP imagery. It is expected that this GIS and the resultant mapping will assist Enterprise to manage its canal structures and service area during future improvements and urbanization that is expected to occur.

J. FINAL COMMENTS AND RECOMMENDATIONS

Enterprise is dedicated to improving the water delivery consistency and canal operating efficiency. A review of the existing facilities and our work directly with Enterprise personnel have led to recommendations that are presented in this report. Implementation of these recommendations will help Enterprise make necessary improvements to improve water deliveries strengthen operations.

The goal of this study was to provide Enterprise with a plan to proceed with project recommendations. Enterprise has a relatively limited water supply and delivery system with significant challenges. Recommendations range from operational and institutional changes that can be implemented at no cost to replacement of key structures and implementation of SCADA to allow for more efficient use of limited resources.

Specific recommendations resulting from this Level II study follow:

1. Maintain the ArcGIS map and utilize as a maintenance and planning tool:
2. Request Level III Funding from the Wyoming Water Development Commission (WWDC) for high-priority improvements according to a schedule which meets the needs and financial constraints of Enterprise shareholders.
3. Recommend that private lateral users consider upgrading delivery systems from the main Enterprise canal and laterals to the points of application on shareholder farms.
4. Implement operational and institutional changes recommended in this report.
5. Engage shareholders in the Enterprise system via Board participation, shareholder work days, and tours of the upper system.
6. Become involved in subdivision planning through reviews of water distribution plans and coordination with the Wyoming State Engineer’s Office.

Recommendations made to the Enterprise Board during the course of this project have already begun to be implemented. These are summarized as follows:

1. The South Lateral reach between SL1 and SL2 identified in the seepage analysis as having an extreme level of seepage was repaired by Enterprise during October and November 2007. Vegetation was removed and a uniform channel cross-section was restored. This is expected to result in a nearly 100 percent improvement in deliveries to shareholder served by the downstream portion of this lateral.
2. The Enterprise Board has decided to implement a “first-acre” assessment, described previously in this report, in addition to the per share assessment collected from each shareholder. This “first-acre” assessment is expected to transfer the additional administrative burden imposed by subdivision to the small-lot shareholders as well as to generate much-needed revenue for the Company.