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EXECUTIVE SUMMARY

GOOSEBERRY CREEK
LEVEL I STUDY

Prepared for:

Wyoming Water Development Commission
Cheyenne, Wyoming

Prepared by:

Lidstone and Associates, Inc.
4025 Automation Way, Building E
Fort Collins, Colorado 80525

October 2005
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INTRODUCTION

The Wyoming Water Development Commission (WWDC) and the Project Sponsor, Gooseberry Irrigation District (District) retained Lidstone and Associates, Inc. (LA) to complete a Level I Study of the Gooseberry Creek watershed. The watershed is located in the Big Horn Basin with portions in Park, Hot Springs, and Washakie counties. Gooseberry Creek generally flows in an easterly direction, beginning with its headwaters in the Absaroka Range to its confluence with the Big Horn River south of Worland. Gooseberry Creek’s flow characteristics are typical of snowmelt driven systems with a high spring runoff peaking in mid-May to mid-June followed by a sharp drop in flow during the summer.

Historically, there has been a shortage of water to meet the mid to late season irrigation demand. This shortage of water has resulted in annual yields of approximately 1.5 tons per acre alfalfa/grass hay. Beginning with the Wyoming State Planning Board in the 1930’s, a series of studies have been conducted to remedy this shortage. Results from these prior studies indicated that, on average, the watershed yield is sufficient to meet irrigation demands if it could be re-regulated. This Level I study re-evaluated the hydrologic analyses completed under the prior studies to determine if the initial premise concerning water availability was reasonable. Potential sources of supply outside the watershed were also evaluated with regard to their viability of being able to meet the District’s irrigation demand.

In order for an irrigation project to actually reach the construction phase using public funding, the Project Sponsor must be a fiscally responsible entity. In the early 1980’s, the landowners along Gooseberry Creek, from Highway 120 east to Highway 20 formed the District. In September 2005 the District consisted of approximately 3,200 acres — the landowners of which were willing to pay an annual assessment to finance potential irrigation projects.

The District has indicated they are willing to pay a maximum of $25 per acre to fund projects to meet the goals set forth. If 80% of this assessment goes to debt payments, the maximum project cost the District can afford is $1.71 million dollars. This assumes that the WWDC provides a 50% grant to the District to help with the project as shown below in Table 1.

Therefore, for an irrigation project to be considered for future study it must meet two criteria; stay within the estimated funding level of $1.71 million dollars and provide District members with enough water to increase their crop yields to a minimum of 2.7 tons/acre, the Hot Springs County average.

To meet the District’s goal of increasing the volume of mid to late season irrigation water and ultimately crop yield, seven options were evaluated for the District during the Phase I study. Those Options were:

1. Construct an 8,000 acre-foot Reservoir
2. Acquire Water from the Grass Creek Oil Field
3. Complete Irrigation System Upgrades
4. Bluff Ditch Lift Station – Boysen Reservoir
5. Trans-basin Diversion
6. Drill Alluvial Wells
7. Drill Deep Water Wells
Table 1, Gooseberry Reservoir Site Economic Information

<table>
<thead>
<tr>
<th>Economic Information</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Irrigated Acres</td>
<td>3200 Acres Enrolled as of Sept. 7, 2005</td>
</tr>
<tr>
<td>80% Irrigated Acres Billed</td>
<td>2560</td>
</tr>
<tr>
<td>Cost Per Acre</td>
<td>$25.00</td>
</tr>
<tr>
<td>Annual Income (100%)</td>
<td>$80,000.00</td>
</tr>
<tr>
<td>Annual Income (80%)</td>
<td>$64,000.00</td>
</tr>
<tr>
<td>Assumed Annual O&amp;M</td>
<td>$16,000.00</td>
</tr>
<tr>
<td>Annual O&amp;M (100%)</td>
<td>$12,800.00</td>
</tr>
<tr>
<td>Funding Source (Loan %)</td>
<td>50%</td>
</tr>
<tr>
<td>Funding Source (Grant %)</td>
<td>50%</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>6.25%</td>
</tr>
<tr>
<td>Loan Maturity</td>
<td>30 Years</td>
</tr>
<tr>
<td>Maximum Loan Amount</td>
<td>$857,876.22</td>
</tr>
<tr>
<td>Maximum Project</td>
<td>$1,715,752.45</td>
</tr>
<tr>
<td>Minimum Loan Amount</td>
<td>$686,300.98</td>
</tr>
<tr>
<td>Minimum Project</td>
<td>$1,372,601.96</td>
</tr>
</tbody>
</table>

Option 1 – Construct an 8,000 acre-foot Reservoir

Earlier studies completed on behalf of the District suggested that a reservoir capable of storing 8,000 acre-feet of water was the minimum size necessary to meet the District demand and also provide for some carryover to assist the District during a limited drought. This study evaluated sites previously recommended as well as performed a reconnaissance level investigation of several other possible sites within the basin. Based on this initial screening eight sites were selected for field evaluation. Four of the sites were eliminated due to poor site characteristics, economic or political reasons - these sites include South Fork of Fifteen Mile Creek, Sand Draw, Lower Gooseberry Creek, and Enos Creek. The remaining four sites - Rankine Basin, Gillies Draw, Quartz Gulch, and Buffalo Creek were retained for additional geotechnical and economic evaluation.

Each of the retained sites had a preliminary field geotechnical analysis performed to determine the foundation requirements for a dam. Based on the results of the limited drilling program and geotechnical analysis, the Buffalo Creek and Gillies Draw sites were determined to be the most conducive for dam construction. Each of the four sites nominated for field investigation were also evaluated based on the potential cost for dam construction.

Feasibility level construction costs were developed for each site based on WWDC Level III study construction cost estimates for the Upper Gooseberry Creek Reservoir, which was never built due to foundation issues. Reservoir constructions were estimated to be $8.34 million dollars in 1987. Using the Army Corp of Engineers Civil Works Construction Cost Index System the construction costs were inflated to $14.74 million dollars for 2007 construction. This estimate was compared to recent reservoir construction costs on a unit storage volume basis and was determined to be reasonable. Results of the economic analysis indicated that the construction of a reservoir with sufficient volume to meet the District’s demand was not a viable option due to financial constraints.

Option 2 – Acquire Water from the Grass Creek Oil Field

Through research of the Wyoming State Engineer’s Office (SEO) database, LA identified 14 wells within the Grass Creek Oil Field that produce more that 200 gallons per minute of water. These wells could provide approximately 5,900 gpm of water or 800 acre-feet per month. This
volume of water is sufficient to make up most of the irrigation water deficit that exists during July and August, assuming an average water year. This additional supply of water would allow the District to extend the current irrigation by approximately six weeks. The water resource requires some additional investigation, including a discussion with Marathon Oil about acquiring the water.

This option will require installing approximately 6 miles of pipe from the Grass Creek Oil Field, one lift station, and a collection system. The approximate cost for the system would be $2.97 million as shown below in Table 2. This feasibility level estimate initially appears beyond the District’s ability to pay. However, given that feasibility cost estimates have inherent uncertainty and the cost is relatively close to the District’s capabilities, it is recommended that this option be retained for further investigation.

Table 2, Grass Creek Water Wells Estimated Probable Cost

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Units</th>
<th>Unit Cost</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-Inch Transmission Line</td>
<td>32,275</td>
<td>Feet</td>
<td>$60</td>
<td>$1.94 Million</td>
</tr>
<tr>
<td>Easements</td>
<td>1</td>
<td>LS</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>Collection System</td>
<td>20,200</td>
<td>Feet</td>
<td>$30</td>
<td>$606,000</td>
</tr>
<tr>
<td>Lift Station</td>
<td>1</td>
<td>LS</td>
<td>$400,000</td>
<td>$400,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$2.97 Million</strong></td>
</tr>
</tbody>
</table>

**Option 3 – Irrigation System Improvements**

As part of this Study, LA evaluated the existing system and collected information to construct a Geographic Information System (GIS) of the District. Data collected from the field inventory of the existing system, which consists of diversion dams, head gates, measuring devises and wasteways, was also incorporated into the GIS.

Results of LA’s field inventory suggested that the irrigation infrastructure was inefficient and had deteriorated over time. In 1984, the Natural Resources Conservation Service (NRCS) conducted a similar system inventory and concluded the same. The NRCS recommended that the District install new diversion dams and headgates to reduce problems with sedimentation. They also suggested that the District consider consolidating several diversions to eliminate approximately 11 miles of ditch which would reduce conveyance losses by approximately 20%.

These NRCS recommendations are generally still viable today and would increase the amount of available water by reducing losses. They would also improve the overall system efficiency by reducing the amount of maintenance required and by removing the ditch; some fields could be irrigated more effectively. There are other opportunities to reduce conveyance losses within the system. These include utilizing pipe or lining ditches with a synthetic liner. In order to most fully implement any of these options, sedimentation within the system must be addressed.

The NRCS estimated that the work of consolidating the ditches and constructing new diversion structures would require $580,800 in 1984 dollars. That translates into a current project cost of $1.08 million in 2007 dollars. This estimate is well within the budget of the District.

**Option 4 – Bluff Ditch Lift Station – Boysen Reservoir**

While conducting this study the project team contacted SEO to determine if water stored in Boysen Reservoir was available for purchase from the Bureau of Reclamation (BOR). Water
contracted from the BOR could be diverted from the Bighorn River by way of the Bluff Ditch. Irrigators along the lower portion of Gooseberry Creek could be supplied with late season water by constructing a diversion/lift station on the Bluff Ditch and pumping the water upstream.

Two potential initial distribution points were identified; the Holland Ditch and the Holly-Nichols Ditch. The distribution points for the Holland and Holly-Nichols ditches are located approximately 13 and 16 miles up the creek, respectively. Based on acreage enrolled in the District, 1,180 acres would be served under the Holland option and 1,590 acres under the Holly-Nichols option. The estimated costs for a lift station and transmission line for each distribution point are identified in Table 3.

Table 3, Bluff Ditch Pumping Estimated Probable Cost

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Units</th>
<th>Unit Cost</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Line – Option 1</td>
<td>68,775</td>
<td>Feet</td>
<td>$91</td>
<td>$6.26 Million</td>
</tr>
<tr>
<td>Transmission Line – Option 2</td>
<td>86,000</td>
<td>Feet</td>
<td>$91</td>
<td>$7.83 Million</td>
</tr>
<tr>
<td>Lift Station</td>
<td>1</td>
<td>LS</td>
<td>$450,000</td>
<td>$450,000</td>
</tr>
<tr>
<td>TOTAL OPTION 1</td>
<td></td>
<td></td>
<td></td>
<td>$ 6.71 Million</td>
</tr>
<tr>
<td>TOTAL OPTION 2</td>
<td></td>
<td></td>
<td></td>
<td>$8.28 Million</td>
</tr>
</tbody>
</table>

In addition to the capital costs described in Table 3, the estimated operation and maintenance costs for 4 months of operation are approximately $114,000. The other factor to be considered is the water right held by the District will be a junior right in the Bighorn River Basin. In times of drought, when water is most needed by the District, it may not be available because of the District’s low priority. In summary, the high estimated cost and the low water right priority do not make this option attractive for the District.

Other Options – Trans-basin Diversion, Alluvial Wells, and Deep Water Wells

LA performed a cursory evaluation of three other options for the District to obtain additional irrigation water, however these options were quickly dismissed as summarized below:

- Trans-basin Diversions – This option is not feasible due to economics. The cost of pipe alone from Buffalo Bill Reservoir would be $16.9 million.
- Alluvial Wells – This option is rejected due to the fact that the SEO would see this as a junior water right on the Gooseberry and not as a new water resource to be permitted. This would not help the District during the low flow times of the year.
- Deep Water Wells – Unfortunately even though this would be an additional water resource the cost is prohibitive to the District. LA estimates this option would cost approximately $16.98 million or more to be effective.

CONCLUSIONS

Analyses indicate that on an average year, there is sufficient water in the Gooseberry Creek drainage basin to supply the acreage currently being irrigated. The problem is water is not generally available when it is needed most in the latter part of the irrigation season. Initially, storage appeared to be the most viable option for attaining this goal, which corroborated the conclusions from previous studies. However, due to the District’s financial constraints and estimated project cost this alternative was essentially eliminated.
Several other alternatives to increase the volume of late season irrigation water and, ultimately crop yield, were examined during this study. Due to economic impact several of these alternatives were eliminated from future consideration for a Level II study.

However, LA recommends that the following alternatives be retained for future consideration for a Level II study;

1. Perform a thorough inventory of all structures within the District. Develop a list of recommendations that would improve the efficiency and effectiveness of this system.

2. Preliminary economic analysis of the Grass Creek Oil field indicate that this is not within the District’s financial capabilities, however there are uncertainties associated with feasibility level cost estimates. Therefore, a Level II study should be performed to verify whether this option is viable technically and economically.

3. If additional monies became available to the District, the Buffalo Creek and Gillies Draw sites have potential as reservoir sites. A Level II analysis would be needed to further investigate the geotechnical aspects to verify these preliminary results as well as complete other design elements.