Greybull Valley Irrigation District
Hydropower Level II Study
Executive Summary of the Final Report
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1.0 Introduction

AECOM Technical Services, Inc. (AECOM) and its sub consultant WWC Engineering (WWC) entered into a contract with the Wyoming Water Development Commission (WWDC) to conduct a Level II Study of the feasibility of developing hydropower at the outlet works of the Greybull Valley Irrigation District’s (GVID) Upper Sunshine and Roach Gulch Reservoirs. The report summarized herein documents the results of this Level II Feasibility Study.

The GVID services 80,000 acres of irrigated land in Park and Big Horn Counties in north-central Wyoming. The GVID has three storage reservoirs (Upper Sunshine, Lower Sunshine, and Roach Gulch) that have a total combined storage capacity of 143,000 acre-feet. GVID typically supplies water to the irrigation system from April through the second week of October. The system diverts water from the Greybull River to the Upper Sunshine Reservoir, which is then released from the dam outlet through a channel to the Lower Sunshine Reservoir. Lower Sunshine Reservoir is also supplied by a diversion from the Wood River. Water is then released back to the Greybull River out of Lower Sunshine to flow down to irrigators or Roach Gulch Reservoir as needed.

2.0 Reservoir Operation and Hydrologic Analysis

Background research was performed with the coordination of GVID, the State Engineer’s Office (SEO), and the Wyoming Water Development Commission (WWDC) to obtain hydrologic data and irrigation system practices for the GVID system. The evaluation uses average daily flow records from available USGS gaging stations through December 2012.

Flows available for diversion were reduced to allow for downstream irrigation demands (50 cfs from April 15 to September 30) plus a minimum amount for instream flows (up to 100 cfs). The bypass requirements and instream flow values were provided by GVID with input from the Wyoming Game and Fish Department. For Upper Sunshine, on average, flows are available for hydropower generation from mid-April through the end of September, peaking at approximately 450 cfs at the end of June. For Roach Gulch, on average, flows are available for hydropower generation from mid-April through to early November, peaking at approximately 730 cfs at the end of June.

Historic reservoir operating elevations were used as an estimate of the potential head available to operate the turbines. The flow and head data sets that were developed were used in the power generation analysis.

3.0 Power Generation Analysis

For the flow and head conditions that are anticipated at Roach Gulch and Upper Sunshine Reservoirs, a Francis turbine would typically be used. This turbine can operate safely from 25 percent to 100 percent of the maximum rated flow. It was determined that a turbine rating of 150 cfs would be optimal for Upper Sunshine Reservoir, and a turbine rating of 300 cfs would be optimal for Roach Gulch Reservoir.
With an installed power of 3.6 MW, Roach Gulch would produce approximately 8,380,000 kWh per year, if constant head of 120 feet is assumed, while Upper Sunshine would produce approximately 3,520,000 kWh per year with an installed power of 1.7 MW.

4.0 Preliminary Design

**Upper Sunshine:** A 36-inch bifurcation is proposed from the old outlet structure to connect to the new power house that would be constructed approximately 10 feet away. The transmission system from the Upper Sunshine outlet works to an existing 25 kV line would need to be modified and upgraded. An upgraded 4 kV transmission line from the outlet works would need to be installed and located along the same route as the existing service line, and a step-up substation would need to be located at the interconnection with the 7.2 kV line.

**Roach Gulch:** It is proposed that the powerhouse be located further downstream of the stilling basin to allow for the additional head to be recovered. The conceptual layout of the powerhouse is shown in Appendix A. The most appropriate solution for the transmission line is to construct a step-up substation at the hydropower plant, and install a new 25 kV transmission line to the interconnection with Big Horn REA’s 12.4 kV line along Lower Greybull Road. Big Horn REA’s 12.4 kV line along Lower Greybull Road would need to be upgraded to 25 kV from the interconnection point to the substation in Emblem (16 miles).

The total estimated construction cost is estimated to be $7,876,000 for Upper Sunshine and $12,011,000 for Roach Gulch. This estimate includes the pre-construction costs, permitting, and engineering costs as well as a 15 percent contingency.

5.0 Economic Analysis

A 50-year economic analysis beginning in 2013 was performed based on the projected hydropower generation (2013 to 2062). AECOM assumed an interest rate and a discount rate of 4 percent for both projects and an escalation rate on energy price and Operation and Maintenance (O&M) costs of 2 percent. The loan repayment period is 20 years and the energy value is initially set at $0.06/kWh for the base study.

- Based on the assumptions listed above, the economic analysis estimates a benefit cost ratio below one for both Roach Gulch (0.77), and Upper Sunshine (0.51). Both Projects are showing a loss in Net Present Value over the project life span of approximately -$3,800,000 for Roach and -$5,000,000 for Upper Sunshine.
- The Roach Gulch project would become economically feasible at an energy retail price of $0.078 or higher, while this price would have to be $0.12 or higher for Upper Sunshine. If a constant head of 120 feet could be maintained, Roach Gulch would become feasible at a value of power of $0.064/kWh.
- To achieve a positive net cash flow in the first year of operation, a value of power greater than $0.14/kWh would be required at Roach Gulch and Upper Sunshine. However, this value would be $0.115/kWh for Roach if a constant head of 120ft would be maintained.
6.0 Conclusions and Recommendations

The values of power required for the project to be economically feasible are much higher than most regional wholesale rates, but the value of power is determined by many different factors that will depend on the characteristics of individual sites and the buyer of the power.

AECOM does not recommend further pursuit of hydropower development at Upper Sunshine Reservoir at this time. If, in the future, market conditions improve or incentives are provided that would make development of hydropower at Upper Sunshine Reservoir feasible, the steps towards development would be the same as those listed below for the Roach Gulch site. In addition to the steps listed below for Roach Gulch, environmental studies would need to be completed for Upper Sunshine due to its connectivity with the Upper Greybull River and to assess impacts on the Upper Sunshine Reservoir fishery.

For Roach Gulch, the analysis shows that a value of power of $0.078/kWh would be required to have a Benefit Cost Ratio greater than one. This value of power is still higher than regional wholesale rates, but it would not be unreasonable to potentially negotiate a rate in this range, especially in consideration of the utilities’ need to provide renewable power.

If GVID decides to continue to pursue development of hydropower at Roach Gulch, the following steps should be taken:

1. **Interconnection System Study.** The cost of this study is typically in the range of $10,000 to $50,000, and can be completed in approximately three months. This study will identify additional costs that GVID would have to pay for interconnection, upgrades, and modifications to the local grid.

2. **Further Discussions with Utilities.** AECOM recommends that GVID engage in further discussions and potentially initial negotiations with Big Horn REA and Tri-State to determine the potential value of power. This would not cost GVID money, only an investment of staff time. This can happen immediately.

3. **Water Management Study.** To evaluate how water is used in the Greybull River watershed. This study is estimated to cost from $50,000 to $200,000. It would take approximately six months.

If, after completing these items, development of hydropower at the Roach Gulch site is still deemed to be feasible, the following steps may be taken:

1. **FERC Exemption Application.** This process typically can take 6 to 18 months to complete, depending on the complexity of the project. This cost is estimated to be approximately $40,000. This may vary depending on the scope.

2. **Final Design and Construction.** It is estimated that the final design process would take 12 months and that construction would take approximately 12 months to complete.