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I. INTRODUCTION

1.1 Authorization and Purpose

In the Fall of 1990, the Wyoming Water Development Commission (WWDC) received an application to fund a feasibility study to identify deficiencies in facilities owned and operated by the Goshen Irrigation District (GID). Specifically, these facilities included a pumping station, two tunnels and four siphons. On June 5, 1991 Lidstone & Anderson, Inc. (LA) entered into a contract with the WWDC to provide professional services related to the Level II-Goshen Irrigation District Rehabilitation Project. As stated in the contract, the purpose of the Level II project is threefold: (1) inventory and evaluate the potential bottlenecks in the main irrigation delivery system, specifically consisting of the two tunnels and four siphons; (2) evaluate and design an efficient pumping station on the Laramie River; and (3) identify and describe those rehabilitation measures necessary to increase capacity and ensure a more efficient operation of the water supply system. The scope of services for the project consists of two separate tasks: Task A which involves the evaluation of the Laramie River Pump Station, and Task B which entails the evaluation of the siphons and tunnels. This report documents the results of the work associated with the completion of Task A.

1.2 Project Location and Summary of Existing Problems

The Goshen Irrigation District (GID) is located in Goshen County, Wyoming. The primary source of irrigation water is obtained from the North Platte River via the Fort Laramie Canal. Approximately 52,484 acres of land in Wyoming and an additional 53,000 acres of land in Nebraska are served by the water conveyed in the canal. In addition to the water diverted from the North Platte River, a supplemental supply (100 cfs) from the Laramie River has been earmarked for the GID and is presently diverted by a pump station located 4 miles west of Fort Laramie. The general location map for the project is presented on Figure 1.1.
The GID was formed in November of 1926 following the construction of the project by the U.S. Bureau of Reclamation. Presently, the primary conveyance system consists of approximately 85 miles of the Fort Laramie Canal in Wyoming, two tunnels, four siphons, appurtenant structures, lateral canals and pipelines. Of particular interest to this report is the pump station along the Laramie River. The existing pump station, depicted in Figure 1.2, consists of a CrisaFulli 24-inch centrifugal pump driven by a 200-horsepower electric motor. This pump station became operational following the abandonment of a diversion canal from the Laramie River to the Fort Laramie Canal located approximately 0.5 miles upstream. Recent studies [1] funded by the WWDC concluded that the existing pump station is operationally inefficient and incurs high power and maintenance costs. Furthermore, the existing pump station is capable of diverting less than half of the 100 cfs supplemental supply. In general, these factors have led to limited use of the pumping facility.

Figure 1.2 Pumping Station on the Laramie River

In recent years, the GID has been unable to provide the full irrigation requirements of its users. The problems stem from the reduced runoff and below average snowfall within the watershed of the North Platte River. To partially alleviate these shortfalls, construction
of a more reliable and efficient pumping station on the Laramie River appeared warranted. Aside from the engineering aspects associated with the implementation and design of a new pumping station, several other pertinent considerations were evaluated. These considerations included:

1. requirements of the downstream senior appropriators on the Laramie River;
2. institutional constraints associated with the agreement with the Basin Electric Power Cooperative, State Engineers Office, U.S. Bureau of Reclamation and conditions imposed by the North Platte Decree, especially with respect to the recent claim filed on the tributaries to the North Platte River;
3. flow availability of the Laramie River with respect to meeting the supplemental supply (100 cfs) requirements of the GID while taking into account senior water appropriators and releases mandated by the Basin Electric Agreement; and
4. environmental concerns and permitting associated with the installation of the pumping station.

1.3 Overview of Level II Investigation

The Level II investigation focused on an evaluation of the existing pump station and the development of rehabilitation alternatives to expand the existing pumping capacity. Following the project scoping meeting, an extensive field investigation was conducted to inventory and evaluate the existing system as well as determine the stability of the river channel near the point of diversion. Additional work involved an appraisal of the water right issues, quantification of available flow in the Laramie River, and evaluation of the potential impacts associated with institutional constraints. Several rehabilitation alternatives were developed including the preparation of preliminary cost estimates. A recommended alternative was selected and conceptual design information and cost estimates prepared. Permits necessary for construction of the recommended alternative were also identified. Finally, an economic analysis was completed to assist the State of Wyoming in the development of a fair and equitable financing plan for the project improvements.

The remaining chapters of this report document the procedures used and the results obtained during the completion of the Level II investigation.
II. PROJECT SCOPING MEETING

A project scoping meeting was held on June 27, 1991 in Torrington, Wyoming at the office of the GID. The purpose of the meeting was to discuss specific problems associated with the GID conveyance facilities as well as project goals, scope of work, and project schedule. The scoping meeting included a discussion of the work required to complete both Task A (Evaluation of the Laramie River Pump Station) and Task B (Evaluation of Siphons, Tunnels and Appurtenant Structures). Prior to the meeting, an agenda was prepared and submitted to the project sponsor and WWDC for review and comments. A copy of the agenda as well as the minutes to the meeting are provided in Appendix A.

To prepare for the meeting, the project team conducted a preliminary review of all available literature, reports, and data. This work included:

1. reviewing the tabulation of adjudicated water rights relevant to the GID and this Level II investigation;
2. reviewing the agreement between Basin Electric Power Cooperative and the GID as well as the agreement for the distribution of natural river flows of the North Platte River in accordance with the North Platte Decree;
3. reviewing the gage data for the USGS gage near Fort Laramie and the State Engineers Office (SEO) gaging information on the Laramie River near Grayrocks Reservoir;
4. discussing potential institutional constraints with Frank Carr and Bill Jones of the State Board of Control and Mike Purcell of the WWDC;
5. reviewing the recent rehabilitation projects funded by the WWDC related to the GID;
6. discussing the permitting requirements associated with the proposed improvements with Matt Bilodeau of the Corps of Engineers;
7. discussing the costs associated with providing electricity to the pumping station on the Laramie River with Jim Hudelson of Wyrulec at Lingle, Wyoming; and
8. collecting and reviewing the original plans for the tunnels and siphons available from the USBR office in Mills, Wyoming;
Following the scoping meeting, a preliminary field investigation of the study area was conducted. The field work included identification of surveying requirements, brief inventory and initial assessment of the existing pump station, and preliminary evaluation of channel stability and the downstream diversion structure. As part of the work for Task B, a preliminary evaluation of the wasteways in the First Interstate Canal was also completed in an effort to develop alternatives for improving the wasteways in the Fort Laramie Canal.
III. WATER RIGHTS AND FLOW AVAILABILITY

3.1 General

The purpose of this task is to determine the effectiveness of the GID supplemental water right to supply a late season water diversion of 100 cfs. Completion of this work involved: (1) an investigation into the viability/priority of the GID supplemental water right in the lower Laramie River Basin, and (2) an evaluation of flow availability at the point of diversion. The results of this analysis provided the information necessary to determine the capability of the natural flows to meet the requirements of the GID and all senior appropriators as well as releases implied under the agreement between Basin Electric Power Cooperative and the State of Nebraska. This work culminated in a recommendation for the design capacity associated with rehabilitation of the existing pump station.

3.2 Water Rights

The investigation of water right information involved a review of all records at the State Engineers Office (SEO) specifically including the tabulation of adjudicated and non-adjudicated water rights for Water Division Number One. The original supply of water for the GID consists of both direct flow from the North Platte River and storage in Pathfinder Reservoir and Guernsey Reservoirs. A supplemental supply is available for diversion from the Laramie River. Specific information concerning the original and supplemental water rights is provided below.

<table>
<thead>
<tr>
<th>Permit Number</th>
<th>Priority</th>
<th>Total CFS</th>
<th>Total Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>18544 (Original Supply)</td>
<td>12-06-1904</td>
<td>748.64</td>
<td>52,459.8</td>
</tr>
<tr>
<td>5014E (Secondary Supply)</td>
<td>4-20-1923</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4883E (Supplemental Supply)</td>
<td>1-20-1942</td>
<td>748.64</td>
<td>52,459.8</td>
</tr>
</tbody>
</table>
The original supply for the GID is diverted at the Whalen Dam and conveyed by the Fort Laramie Canal to provide water to irrigate approximately 52,484 acres within Goshen County. An adjudicated allocation of 1 cfs/70 acres is permitted in accordance with the administration of the water rights through the SEO. Due to flow availability in the North Platte River combined with inadequate conveyance facilities, the GID consistently diverts approximately 1 cfs/100 acres. It is noted, however, that the secondary supply (reservoir storage) is frequently utilized to supplement the original supply whenever necessary to meet the irrigation requirements of the GID. Utilization of the secondary supply in this manner frequently results in a short-term diversion allocation of approximately 1 cfs/70 acres.

The supplemental water right on the Laramie River is adjudicated for 100 cfs with the point of diversion located near the Laramie River Siphon. In accordance with the statutes administered by the SEO, the supplemental supply may be utilized anytime the original supply is not satisfied. This means that given the limitations associated with the existing conveyance facilities, the supplemental supply can be legally utilized on an annual basis.

Related issues evaluated during this investigation included abandonment of the supplemental supply and transfer of the point of diversion for the supplemental supply. According to the SEO, abandonment proceedings on the supplemental supply may be filed and may be successful if the petitioner can prove: (1) the present pumping facility is not capable of diverting 100 cfs, and (2) the GID has not historically diverted their full supplemental supply of 100 cfs. Should the GID have a facility capable of pumping 100 cfs, diverting the full supplemental supply once every 5 years would remove the likelihood of an abandonment proceeding. Given the historic diversions associated with the existing pumping facility, an abandonment proceeding could be filed on portions of the 100 cfs supplemental supply.

In accordance with the statutes administered by the SEO, the supplemental supply must be obtained from a different source than the North Platte River; in addition, it may not be moved upstream of its present point of diversion without investigating the impact upon intervening water users. A recent query by the GID to transfer the supplemental supply to the North Platte River was not considered because it is the same source as the original supply.
The water available to satisfy the supplemental supply from the Laramie River is presently controlled by releases from Grayrocks Reservoir. Consequently, an investigation of senior water right appropriators downstream of Grayrocks Reservoir was conducted. The following table presents the results of the investigation.

Table 3.2 Tabulation of Adjudicated Senior Water Right Appropriators

<table>
<thead>
<tr>
<th>Permit Number</th>
<th>Priority</th>
<th>Discharge (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Senior Appropriators Downstream of the GID Pump Station</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>11-14-1891</td>
<td>6.25</td>
</tr>
<tr>
<td>4034E</td>
<td>9-13-1919</td>
<td>0.43</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>6.68</strong></td>
</tr>
<tr>
<td></td>
<td>Senior Appropriators Upstream of the GID Pump Station</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>3-14-1896</td>
<td>2.13</td>
</tr>
<tr>
<td>64</td>
<td>1-15-1897</td>
<td>0.84</td>
</tr>
<tr>
<td>2105</td>
<td>5-02-1899</td>
<td>4.29</td>
</tr>
<tr>
<td>536E</td>
<td>5-23-1900</td>
<td>1.51</td>
</tr>
<tr>
<td>1661E</td>
<td>2-12-1907</td>
<td>2.24</td>
</tr>
<tr>
<td>2248E</td>
<td>5-03-1910</td>
<td>6.40</td>
</tr>
<tr>
<td>3549E</td>
<td>3-01-1916</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>18.01</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>24.69</strong></td>
</tr>
</tbody>
</table>

As indicated above, the senior appropriators can potentially divert 24.69 cfs between Grayrocks Reservoir and the mouth of the Laramie River. Of this amount, only 6.68 cfs is appropriated by senior water users located downstream of the existing GID pumping station.
3.3 Flow Availability

The feasibility of providing a late season supplemental supply is not only dependent on an investigation of water rights; it is also important to determine the availability of the natural flows within the Laramie River to meet this requirement along with all senior appropriations. A hydrologic analysis was conducted to provide this information and included preparation of an annual flow duration curve and a frequency analysis of low flow data. To promote the design of the selected rehabilitation measures, a peak flow frequency curve was also generated.

Data available from the USGS gaging station near Fort Laramie (#06670500) provided the flow data necessary to conduct this analysis. This station has a record extending from 1915 to the present date, this period of record is considered more than adequate to perform the analysis previously indicated. The gage is also located downstream of all senior appropriators; the results of the analysis will therefore include all historic upstream diversions and will provide a good indication of flow available for diversion at the GID pumping station.

Since the operation of Grayrocks Reservoir may impact the natural flows within the Laramie River, the analysis was conducted for both the period of record (1915 to 1990) and the period since operation of the reservoir (1979 to 1990). Finally, the analysis focused upon the availability of the natural flows in the Laramie River during the irrigation season; hence, only the daily data from May 1st to September 30th were utilized in the analysis.

Three flow rates were identified for evaluation during the analysis. These target flows included: (1) the capacity of the existing pump station (35 cfs); (2) maximum diversion stipulated by the Basin Electric Power Cooperative Agreement (68 cfs); and (3) the diversion of the full supplemental supply (100 cfs).

The results of the annual flow duration and low flow frequency analysis are presented on Figures 3.1 and 3.2, respectively. The information presented on these figures is summarized below.

- The average daily flow which is likely to be exceeded 50% of the time ranges from 51 to 68 cfs.
LARAMIE RIVER FLOW DURATION CURVES

<table>
<thead>
<tr>
<th>Q</th>
<th>PROBABILITY OF EXCEEDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 CFS</td>
<td>74-90 %</td>
</tr>
<tr>
<td>68 CFS</td>
<td>42-50 %</td>
</tr>
<tr>
<td>100 CFS</td>
<td>33-40 %</td>
</tr>
</tbody>
</table>

Figure 3.1. Laramie River Flow Duration Curves.

NON EXCEEDANCE PROBABILITY (%)
Figure 3.2. Laramie River Frequency Analysis of Low Flows.
• On any given day from May 1st to September 30th, the probability of exceeding a given flow value is provided in the following table.

Table 3.3 Results of the Annual Flow Duration Analysis

<table>
<thead>
<tr>
<th>Flow (cfs)</th>
<th>Exceedance Probability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>74 to 90</td>
</tr>
<tr>
<td>68</td>
<td>42 to 50</td>
</tr>
<tr>
<td>100</td>
<td>33 to 40</td>
</tr>
</tbody>
</table>

• During May 1st to September 30th, the lowest average daily flow that will be sustained over a duration of 120 days, and occur once every 2 years, ranges from 72 cfs to 85 cfs. In other words, this means that once every 2 years, the Laramie River near the GID pumping station will average approximately 72 to 85 cfs for a period of 120 days. In a similar manner, the lowest average daily flow that will occur for various durations and recurrence intervals is provided in the following table.

Table 3.4 Results of Low Flow Analysis

<table>
<thead>
<tr>
<th>Recurrence Interval</th>
<th>Flow Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7-day</td>
</tr>
<tr>
<td>2-year</td>
<td>25-37 cfs</td>
</tr>
<tr>
<td>5-year</td>
<td>12-24 cfs</td>
</tr>
<tr>
<td>10-year</td>
<td>8-20 cfs</td>
</tr>
</tbody>
</table>

The information in the table further indicates that once every 2 years, the Laramie River will average approximately 36 to 45 cfs for a period of 30 days.

To illustrate the relationship between inflows and outflows at Grayrocks Reservoir and the flow available at the USGS gage near Fort Laramie, an analysis of average monthly discharge was conducted. This analysis was conducted with discharge information obtained from the data base at the Wyoming Water Research Center for the years from 1981 to 1986. Figure 3.3 presents average monthly flow histograms for two representative years.
Figure 3.3. Laramie River Average Monthly Flow Histograms for 1981 and 1985.
Histograms for the remaining years of operation are provided in Appendix B. The results of this comparative analysis provide the following conclusions.

- Grayrocks Reservoir is obtaining the majority of its storage from October to April.
- Diversions between the reservoir and the pumping station appear to be offset by both irrigation return flows and direct runoff into the Laramie River.

A frequency analysis of annual peak flows was conducted to provide vital information for the design of the selected rehabilitation measure. For example, design of improvements to the pump station should include a consideration of the flooding elevation and velocity associated with the 50-year or 100-year flood. The results of the frequency analysis are provided on Figure 3.4 and summarized in the following table.

<table>
<thead>
<tr>
<th>Recurrence Interval</th>
<th>Discharge (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-year</td>
<td>800</td>
</tr>
<tr>
<td>5-year</td>
<td>1,920</td>
</tr>
<tr>
<td>10-year</td>
<td>2,990</td>
</tr>
<tr>
<td>25-year</td>
<td>4,750</td>
</tr>
<tr>
<td>50-year</td>
<td>6,330</td>
</tr>
<tr>
<td>100-year</td>
<td>8,200</td>
</tr>
</tbody>
</table>

### 3.4 Conclusions

This analysis evaluated the capability of the natural flows in the Laramie River to meet the supplemental supply requirements of the GID as well as all senior appropriators. The results suggest that daily flows available to satisfy the supplemental supply exceed 51 to 68 cfs at least 50% of the time. Furthermore, the lowest average daily flow that will occur once every two years and be sustained for 30 consecutive days ranges from 36 to 45
Figure 3.4. Results of the Laramie River Frequency Analysis.
cfs. Based on this information, a design flow of approximately 68 cfs appears reasonable for the pumping facility. Available river flows exceeding 100 cfs are not common during the late irrigation season and do not appear to justify a pumping facility that is capable of diverting the full supplemental supply. It must be recognized that any water not utilized by the GID on a regular basis (once every five years) or capable of being diverted by the pumping facility is subject to abandonment.

It should be noted that the analysis did not account for mandated releases implied under the agreement between Basin Electric Power Cooperative and the GID. If, in accordance with the agreement, the GID diverts water only when the natural flow exceeds 30 cfs at their point of diversion, a design flow rate much less than 68 cfs would appear reasonable based on flow availability. For example, to divert 68 cfs would require a flow of approximately 100 cfs which occurs 34 to 40% of the time on any given day from May 1st to September 30th. Similarly, the lowest average daily flow that will occur once every two years and be sustained for 30 consecutive days would be reduced to 6 to 15 cfs. The implications of the Basin Electric Agreement will be discussed in more detail in Chapter IV.
IV. INSTITUTIONAL CONSTRAINTS

4.1 General

Several institutional factors have been identified which may constrain or adversely impact the full utilization of the 100 cfs supplemental water supply from the Laramie River as well as the development and selection of rehabilitation alternatives. The most significant constraints identified during the completion of this study included the following:

- implications of the Basin Electric Power Cooperative Agreement,
- constraints imposed by the SEO,
- operational considerations of the U.S. Bureau of Reclamation (USBR) and the Corps of Engineers (COE), and
- implications of the North Platte Decree.

These issues are discussed in detail in the following paragraphs.

4.2 Implications of the Basin Electric Power Cooperative Agreement

On April 10, 1975 the GID entered into an agreement with the Basin Electric Power Cooperative regarding the diversion of water from the Laramie River. A copy of the signed agreement is provided in Appendix C. Per the agreement, the following restrictions are placed on the GID:

- water will not be diverted prior to May 1st or after September 30th;
- the diversion will be limited to not more than 4,050 acre feet (average discharge of 68 cfs) in any one calendar month; and
- no water will be diverted at any time the flow in the Laramie River at the point of diversion is less than 30 cfs.
It is duly noted that item number 3 in the agreement states "This Agreement is made and entered into subject to the approval of the State Engineer and the State Board of Control for the State of Wyoming." To date, neither the State Engineer nor the State Board of Control has approved of the agreement although the GID has formally agreed to its provisions. The agreement with the GID also states "Basin agrees that it will not challenge the validity of the District's water right under said Permit No. 4883 Enl., ..." This statement appears to imply that Basin Electric would challenge the 100 cfs water right and file an abandonment proceeding if the agreement is not approved by the GID. Recent conversations with board members of the GID have confirmed this observation.

Operational considerations of Grayrocks Reservoir may also impact the GID and the potential to divert their full supplemental water right. Per an agreement with the State of Nebraska, it is understood that (1) all natural inflows to Grayrocks Reservoir less than 40 cfs must be released; (2) 75% of the natural inflows above 40 cfs must be released up to a maximum of 200 cfs; and (3) 25% of the natural inflows above 40 cfs may be stored. Neither the State Engineer nor the State Board of Control have approved this agreement.

At this point in time, the GID has agreed to the stipulations imposed by Basin Electric. Consequently, they are limited to a maximum diversion of 68 cfs in any month. In view of the results of the hydrologic analysis, this does not appear to severely impact the GID. It is noted, however, that the agreement does limit the GID from diverting water from the Laramie River whenever flows are less than 30 cfs. If this implies that 30 cfs must be passed downstream of their point of diversion, a severe restriction is placed on the GID. This is especially evident during the months of July and August when a typical average flow in the Laramie River is 40 to 50 cfs.

4.3 Constraints Imposed by the SEO

The SEO and the Board of Control are responsible for administering all water rights within the State of Wyoming in accordance with Wyoming Statutes-Title 41. In that regard, the SEO is officially involved in the administration of the North Platte Decree and all water rights appropriated by the GID. As discussed previously, the SEO and Board of Control have not approved the Basin Electric Agreement with GID or the State of Nebraska.
According to Mr. Frank Carr of the Board of Control, approval of the Agreement with GID would be contingent on regulating the outlet of Grayrocks Reservoir to allow for storage and operational releases to meet other downstream demands in order of priority. Until this approval is received, the releases identified under the Agreement for the State of Nebraska may be diverted by appropriators in Wyoming. Furthermore, the SEO and Board of Control recognize and would enforce the 100 cfs supplemental supply of the GID on the basis of availability of water and priority.

Another issue that must be addressed is the subject of abandonment of water rights. According to Mr. Carr, abandonment proceedings may be filed if: (1) the GID does not have a facility to divert their full supplemental water right, or (2) the GID has not diverted their full appropriation once within the last five years. In light of these considerations, a portion of the GID supplemental supply has potential for abandonment.

4.4 Operational Considerations of the USBR and the COE

The USBR presently regulates all reservoirs on the North Platte River. Specific regulation with respect to the GID follows the operational rules established in the North Platte Decree. Daily coordination between the USBR, SEO, State of Nebraska and the GID is necessary to ensure compliance with the operational rules.

As discussed in Chapter I, the USBR completed construction of the Fort Laramie Canal and all associated structures in 1926; consequently, the federal government can be considered the owner of the canal and all the structures. In recent conversations with Mr. John Lawson of the USBR in Mills, Wyoming, it is understood that the GID has continually paid for the original construction of the Canal and has recently retired its repayment obligations. Should the GID formally petition the federal government for ownership of the Canal and all associated structures, it is likely that the federal government would approve the petition. According to Mr. Lawson, this matter was brought before the GID Board of Directors within the last year and the GID elected not to pursue ownership at that time. Presently, the GID annually pays the USBR for operation, maintenance and replacement costs associated with its storage facilities at Pathfinder and Guernsey Reservoirs.
The USBR has a contract with the GID to transport water to its users in Wyoming as well as downstream users in Nebraska. Per the contract, the natural flows entering the canal are apportioned on a percentage basis; 51% to Nebraska and 49% to the GID. This may imply that any improvements to the canal that would allow for increased conveyance should be apportioned on the same percentage basis. Although this may not impact the pump station on the Laramie River, improvements identified during the completion of Task B (Rehabilitation of Siphons and Tunnels) should seriously consider these implications of the contract.

According to Mr. Lawson, the federal government prohibits the diversion and conveyance of non-project water into a federal facility such as the Fort Laramie Canal unless it is conveyed to lands already irrigated by the project. Consequently, this statement implies that diverting water from the Laramie River into the canal to meet irrigation demands within the District would meet with the approval of the USBR. Unless it is already in existence, a formal agreement should be prepared and signed by both parties to document approval for the diversion of the Laramie River into the canal.

With respect to the COE, this federal agency is responsible for dictating the operation of designated flood pools in storage reservoirs. The operational rules enforced by the COE do not allow storage of surplus water in reservoirs with designated flood pools. This operational consideration often prevents the storage of valuable water needed to satisfy water shortages during dry years and/or late season irrigation requirements. The only reservoir on the North Platte River that has a designated flood pool is Glendo Reservoir. Since the GID does not have storage allocated in Glendo Reservoir, it is unlikely that operational considerations with respect to the flood pool will impact the water requirements of the GID.

4.5 Implications of the North Platte Decree

In accordance with the North Platte Decree, 75% of the natural flows of the North Platte River at Whalen Dam must be delivered to Nebraska. The decree specifically pertains to the natural flows associated with the North Platte River and all tributary inflows have been exempt. In recent years, a motion was filed by the State of Nebraska claiming
apportionment of the Laramie River in accordance with the North Platte Decree. A rebuttal was prepared by the Attorney General of Wyoming and recently resulted in a denial of the Nebraska claims. Presently, a motion has been filed by the State of Nebraska to establish a claim for non-irrigation season flows that may impact the natural flows of the Laramie River. A rebuttal to this claim is being prepared by the State Attorney General in cooperation with the State Engineer.
V. REHABILITATION PLAN

5.1 General

This chapter describes the development of alternatives for the rehabilitation, expansion or possible replacement of the existing pump station. The goal of the work described herein is to select an alternative that will divert the maximum available water to the Fort Laramie Canal while minimizing the capital construction and long-term operation and maintenance costs. Included in this chapter is an inventory and assessment of the existing pumping facility, development of rehabilitation alternatives, discussion of design considerations and finally, an evaluation and selection of a recommended alternative.

5.2 Inventory and Assessment of the Existing Pumping Facility

The existing pumping facility includes a CrisaFulli Model CP24CH pump unit which incorporates a 24-inch diameter discharge line and a closed impeller. The pump driver consists of a Reliance electric motor (200 horsepower) rated at 460 volts, 228 amps and 1,780 rpm. At the existing location, an average lift of 12 feet is required to divert the water from the Laramie River to the Canal. Based on pump curves provided by Crisafulli Pump Company, the capacity of the existing facility is estimated to be 35 cfs; efficiency ranges from 20% to 25%. Appendix D provides a copy of the pump curve for the CrisaFulli pump.

No permanent sump or intake structure presently exists for the pumping facility. Basically, the pump is mounted on a wood frame and lowered into a sump consisting of an excavated hole adjacent to the river bank. The depth of the existing sump varies from 5 to 6 feet. No screens or trash racks are present to prevent damage to the impeller caused by floating debris, channel bed saltation, or a heavy sediment load. The water level near the sump is controlled by backwater created by an irrigation diversion dam, located approximately 700 feet downstream, in the vicinity of the headgate for the Fort Laramie Ditch.

Typically, the existing pumping facility has been operated for durations of two to three weeks during the late irrigation season. Operation expenses largely consist of the cost
of electricity to operate the pump. Energy costs associated with operation of the pumping facility have been excessive. This can be directly related to the inefficiency of the pumping system coupled with an excessively high demand charge per month of operation. For example, in 1990 the GID diverted approximately 648 acre-feet from the Laramie River during twelve days in August and one day in September. Due to the monthly demand charge levied by Wyrulec, the cost to divert the water was approximately $4,656 or $7.18 per acre-foot. Within the last year, Wyrulec has revised their rate structure and significantly reduced the monthly demand charge. Under the present rate structure, the cost to divert 648 acre-feet would be $3950 or $6.10 per acre-foot. As pumping is increased during the month, the cost per acre-foot will be significantly reduced. The estimated cost to pump for a 30-day period in one month (including a $720 annual facility fee) is estimated to be $2.20 per acre-foot utilizing the present rate structure. Considering the efficiency of the existing CrisaFulli pump, it is anticipated that a more efficient pump unit would result in an additional 50% to 60% reduction in monthly energy costs. Details related to the comparison of 1990 versus 1991 electrical costs are presented in Appendix E. Additional information regarding the long-term cost of providing electrical power is also provided in Appendix E.

Other than energy costs, the operation and maintenance costs associated with the existing facility have been minimal. Long-term operation and maintenance requirements will continue to consist predominantly of the cost of electricity. Given the limited usage of the pump unit, the life of the system is estimated to be an additional 10 to 15 years.

5.3 Design Considerations

Several factors influence the development and evaluation of the rehabilitation alternatives. These factors include impacts associated with the hydrologic, water rights, and institutional constraints; hydraulic and geomorphic characteristics of the channel in the vicinity of the pump station; design considerations of the sump and intake; and evaluation of the appropriate pump(s) and pump driver. These factors and considerations are presented in the following sections.
5.3.1 **Hydrologic, Water Rights and Institutional Constraints**

The results presented in Chapters III and IV provide valuable information regarding the magnitude and availability of water at the point of diversion. This information is utilized as a tool for determining the design capacity of the pump station. Three discharge levels (100 cfs, 68 cfs and 34 cfs) have been identified on the basis of water rights, flow availability and institutional constraints. Providing diversion capability for the full supplemental supply of 100 cfs would remove the potential for abandonment of the water right. Diverting this amount, however, would be in direct conflict with the maximum diversion (68 cfs) authorized by the Basin Electric Agreement. Furthermore, the availability of a flow of 100 cfs is limited; average daily flows exceeding 100 cfs occur less than 40% of the time during the irrigation season.

A pumping facility with a maximum capacity of 68 cfs would not conflict with the flow stipulations in the Basin Electric Agreement. Average daily flows exceeding 68 cfs are more prevalent and occur greater than 42% of the time. In accordance with Wyoming statutes, abandonment proceedings could be filed for the portion of the supplemental supply not diverted on a regular basis.

Selection of a pumping facility with a design discharge of 34 cfs provides the most attractive alternative with respect to flow availability and potential conflict with the Basin Electric Agreement. However, approximately 65 cfs of the supplemental supply could be abandoned due to inadequate capacity of the pump station.

5.3.2 **Hydraulic Considerations**

The performance of the pump station depends on the hydraulic characteristics (depth and velocity) of the channel flows. Increasing the channel depth and reducing the flow velocity for a given discharge would optimize the performance of the pump; in addition, information related to velocity and depth are utilized to design the sump and intake structure. The analysis of channel hydraulics also promotes a preliminary evaluation of the stability and hydraulic efficiency of the downstream diversion dam. Finally, the results of the hydraulic analysis provide the information needed to design appropriate erosion
protection measures in the vicinity of the pump station. The evaluation of channel hydraulics was accomplished by applying the Corps of Engineers HEC-2 model in the reach between the diversion dam and Laramie River Siphon.

To collect the data necessary to evaluate the channel hydraulics, a detailed field investigation of the Laramie River was conducted. The investigation included identifying surveying requirements for the hydraulic analysis, estimation of roughness coefficients, assessment of bed and bank stability, and evaluation of the hydraulic efficiency of the diversion dam. The flow in the Laramie River was also gaged during the field investigation to provide information necessary to calibrate the hydraulic model. Following the field work, the data collected was incorporated into the HEC-2 model to generate the depth and velocity information for various design flows. Figure 5.1 presents the limits of the study reach investigated during the hydraulic analysis as well as the location of the surveyed cross sections. The results of the HEC-2 modeling are indicated below.

### Table 5.1 Results of the HEC-2 Modeling

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<th>Discharge (cfs)</th>
<th>Water Surface Elevation (ft)</th>
<th>Velocity (fps)</th>
<th>Water Surface Elevation (ft)</th>
<th>Velocity (fps)</th>
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<td>4268.4</td>
<td>6.3</td>
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</table>

Detailed output for the HEC-2 simulation is provided in Appendix F along with a graphical presentation of water surface profiles. The information necessary for the pump station design is associated with the low flow events. Both velocity and depth of flow were utilized to develop preliminary design information for the sump and intake structure as well as the pump unit. Water surface elevations for the large storm events (50-year and 100-year flood events) were utilized to establish floodproofing elevations for the pump drivers and all...
Figure 5.1. Study Reach Investigated During the Hydraulic Analysis of the Laramie River.
critical components. Furthermore, the velocity information for the 100-year flood was utilized to design all erosion protection measures in the vicinity of the pump station.

5.3.3 Geomorphic Considerations

The pump station would be designed to be a permanent structure, capable of sustaining the flood flows generated by major storm events. With this in mind, the short-term and long-term stability of the Laramie River in the vicinity of the pump station is a critical concern. A dynamically active channel or channel reach could result in avulsion and abandonment of the channel near the pumping facility. An actively eroding upstream channel could result in an increased sediment load to the sump and intake structure thereby increasing maintenance requirements. Due to the presence of the canal, siphon and bridge, it is recognized that limited potential exists for channel migration. To address these issues, however, a geomorphic evaluation of the Laramie River in the vicinity of the pumping station was conducted.

Field Evaluation of the Study Reach

The field evaluation addressed the channel reach approximately 1,500 feet downstream and 8,000 feet upstream of the existing pump station. The study reach is presented on Figure 5.2. The downstream reach is characterized by a relatively low (5 to 9 feet) right bank (looking downstream) and a flood plain marked by recent sand deposits and overbank sand splays (Area D, Figure 5.2). The left bank is slightly higher and continues to rise toward the valley wall or adjacent bluff to the north. The flood plain above the right bank is moderately well forested, transitioning into agricultural fields on an upper terrace to the south. High water chutes and recently flooded overbank channels are present along the lower flood plain. There is minimal evidence of recent overbank activity along the left bank.

Approximately 800 feet downstream from the pump station a rock diversion dam extends across the Laramie River channel. The diversion dam diverts water into the Fort Laramie Ditch and creates a backwater condition, which extends upstream of the pump station.
Figure 5.2. Study Reach Investigated During the Geomorphic Analysis of the Laramie River.
station. Below the diversion dam the channel enters a low gradient meandering reach, characterized by a relatively narrow active channel and overbank sand splays on both the left bank and to a lesser degree, on the right bank flood plain (Area E). A review of historical aerial photography (1948-1978) suggests that the downstream reach, from the diversion dam to the confluence of the Laramie River with the North Platte River, has been a geomorphically active channel reach. The lower reach flood plain is characterized by abandoned channels, high water chutes and oxbows (abandoned meanders filled with sediment and encroached by vegetation). Historical mapping (1948-1950) indicates that the Laramie River was a relatively sinuous channel. The 1978 photo-revisions indicate that meander cutoffs and overall channel straightening have reduced the channel sinuosity.

Upstream from the pump station, the Laramie River is confined by a valley wall (bluff) to the north and the floodplain to the south. The channel becomes moderately incised in an upstream direction. Approximately 1,200 feet upstream of the pump station (Area C), the adjacent rancher has placed limited bank protection on an eroded portion of the right bank. The left bank, which marks the northward migration of the river channel across its flood plain, is a relatively resistant chalky white sandstone to tuffaceous sandstone. Interbedded units within the sandstone are highly calcareous (calcarenite) and represent a localized bank control.

Further upstream of this location, the channel enters a geomorphically active reach. An abandoned meander (Area B) is visible on the lower terrace to the south and east of the channel. The active channel and flood plain is characterized by a series of abandoned channels, high water chutes and overbank sand splays. The channel in the vicinity of Area A is choked with active channel bars, the resultant deposition of material generated from outside bank erosion of the upstream right bank. In the vicinity of Area A, the historic channel meander (1948 to present) has increased in meander amplitude and decreased in radius of curvature. Local channel incision in the vicinity of Area A possibly accelerated the abandonment of the old GID diversion ditch. The diversion ditch was active in 1925 but has not been utilized since the early 1950's.

Laboratory data from bed and bank material collected along the Laramie River is presented in Appendix G. The adjacent channel banks, at the sampling locations illustrated in Figure 5.2, are predominantly non-plastic silt fraction material with approximately 20%
fine to medium sands. The channel bed material, reflective of an upper basin source, can be characterized as a well rounded, moderately well graded gravel and sands. The median size material is a fine to medium gravel with local accumulations of cobble bed armor. The bank material, where oversteepened and exposed is erosive and supports the geomorphic interpretation of the long term adjustments to the meander pattern. The concentration of medium and coarse sand size material in the lower and middle quartile of the grain size distribution curve is reflective of the predominant transport load of the Laramie River.

**Long-Term Channel Stability**

As noted in the previous section, the Laramie River is a geomorphically active through the study reach and downstream to its confluence with the North Platte River. Over a thirty year period the channel has decreased in sinuosity and has increased in overall width. This channel change is possibly a reflection of the increased efficiency and quantity of irrigation waters removed from the mainstem. Typically, with the removal of irrigation flows, a disproportionately smaller sediment load is removed from the mainstem. Locally in the vicinity of Area A, the channel has increased its sinuosity and has served as a sediment production zone.

In the next 50 years, adjustments in meander pattern will continue to occur. The consequence of these adjustments will have limited impact on the Laramie River pump station. The presence of the sandstone bluff along the north bank of the Laramie River near Area C prevents the migration of the river away from the pump station. The overbank area in the vicinity of Area B has seen historical flows as evidenced by the abandoned meander. Post 1930 channel incision and adjustments in channel geometry (possibly due to changes in discharge and sediment load) have left this area characterized by a low river terrace or elevated flood plain. Because of the elevation of this terrace, short term recapture of the river is not likely to occur. In the event of long term recapture of the river, either through avulsion or meander migration, the presence of the elevated portion of the Fort Laramie Canal will force the river into its original channel course over the Laramie River Siphon and toward the diversion dam.
Downstream of the pump station, long term lateral migration or avulsion of the river around the diversion dam in the vicinity of Area D is likely to occur. Recent overbank sand splays and the presence of high water chutes along the right bank suggest that the river has moved out-of-bank on a relatively frequent basis. To date, the river has returned to its original banks during the waning stages of the high flow event. As sediment production continues upstream and sedimentation continues to occur due to the backwater above the diversion dam, channel aggradation will likely occur. The frequency of overbank flows will increase as a consequence of aggradation. Over the long term the channel will redirect its main channel course along one of the existing high water chutes and around the present diversion dam. With this in mind, the construction of a levee and channel protection along the right bank between the diversion dam and the siphon may be warranted. Construction of a low water notch at the diversion dam may allow flushing of the bed material load and reduce the rate and magnitude of channel aggradation along this critical reach.

5.3.4 Sump and Intake Design Considerations

Poor hydraulic design of a pump sump and intake could arise because of insufficient attention to detail at the early design stage or because of site constraints. Consequently, the design engineer must ensure that ideal flow conditions exist within the sump and at the intake to the pump. Specifically, the sump should be designed to avoid air entraining vortices or submerged vortices, swirling or rotational flow in the sump, large scale turbulence, and uneven distribution of flow. The main considerations regarding the design of the pump sump and intake are itemized below.

1. The flow approaching the pump intake, whether a horizontal or vertical bellmouth, should be uniform across the width of the channel.

2. A design velocity of 1 fps at minimum water surface elevation is desirable; generally, a lower velocity of flow in the sump will result in better sump operational characteristics. In order to maintain uniform flow velocity, the floor of the sump should be relatively flat for a distance not less than six times the diameter of the bellmouth.

3. Screens used for trash exclusion should be included and may also act as flow straightening screens. Such screens and trash racks should be readily
accessible for maintenance operations. In addition, a basket strainer should be provided at the pump bellmouth to further protect the pump impeller.

4. Flow dividers in dual pump installations should be streamlined to obviate flow separation near the intake. Chamber widths should be 2 to 2.5 times the bellmouth diameter.

5. The minimum clearance between the pump bellmouth and the floor of the sump should be a minimum of half the diameter of the bellmouth. Similarly, the minimum clearance from the pump bellmouth to the end wall of the sump should be one-half to one-fourth the diameter of the bellmouth.

6. The minimum depth of submergence will be recommended by the pump manufacturers but will generally range from 2 to 4 times the bellmouth diameter.

A design schematic of a typical intake sump is provided in Figure 5.3.

5.3.5 Pump and Pump Driver

Selection of an appropriate pump and driver is influenced by such factors as system requirements, system layout, fluid characteristics, intended life, energy costs, and materials of construction. The pump should be matched to the system to ensure operation at its maximum efficiency point on the discharge-head curves. Centrifugal, mixed-flow and axial-flow pumps are available and were evaluated with respect to providing the required discharge at the most economical cost.

The choice of a driver type for the pumping equipment is as important as choosing the pump. Electrical costs can be excessive if the pump is inefficient. A cost comparison of diesel and electrical drives was conducted during the completion of this study. Based on electrical costs incurred during the 1990 irrigation season, it appeared likely that diesel motor drives would be more economical. Upon further research, it was determined that the excessively high electrical charges resulted from short pumping periods and high monthly demand charges. Revisions to the 1990 Wyrulec rate structure have resulted in more reasonable electrical costs. Consequently, the cost comparison indicated that an electric motor drive will result in lower operating costs than an equivalent diesel motor drive. The tabulated results of the cost comparison are provided in Appendix E. It is further noted
Figure 5.3. Typical Design Schematic of an Intake Sump.
that a 15% increase in overall electrical costs was included in the 1991 Wyrulec rate structure. Electrical costs are expected to increase an average of 1.5% per year. In contrast, diesel costs vary in accordance with the world economy and politics as well as other energy crises. Additional considerations with a diesel motor include the requirement for fuel storage and delivery, noise pollution, and potential environmental degradation associated with fuel spills and air pollutants.

Variable speed units can enable operation along the system-characteristic curve and thus save on power for partial-load operations. In addition, the capability to vary pumping rates is advantageous with respect to accommodating the varying flow within the Laramie River. A variable speed unit is preferable to a valve arrangement which returns excess flow from a fixed rate pumping system. After calibration is completed for a range of flow conditions, the operator will have the flexibility to match the pumping rate to the flow available in the river.

Since it is desirable to provide a range of pumping capacities, a dual pumping system with variable speed drive units appears to be the most appropriate. For example, a dual pumping system with a maximum capacity of 68 cfs can incorporate a range of pumping capacities varying from 17 to 68 cfs. These ranges depend on the pump characteristics and may vary during the final design.

5.4 Considered Alternatives

The range of considered alternatives varied from the "no action" alternative to the construction of a new pump station. Included within the construction of a new pump station were various options that considered diesel motor versus electric motor drives and single pump installations versus dual pump installations. The alternatives evaluated during this study included the following:

1. No action,
2. Abandon the existing facility,
3. Improve the existing facility,
4. Construct a new pump station: 100 cfs capacity,

5. Construct a new pump station: 68 cfs capacity,

6. Construct a new pump station: 34 cfs capacity,

7. Improve the existing facility and construct a new pump station with 68 cfs capacity (Alternatives #3 and #5),

8. Improve the existing facility and construct a new pump station with 34 cfs capacity (Alternatives #3 and #6), and

9. Install an alluvial well field.

The following information describes the major features of each considered alternative.

5.4.1 Alternative 1 - No Action

This alternative assumes that the existing system will be utilized without improvements to either the electric motor drive, CrisaFulli pump unit or the existing sump/intake structure. As discussed previously, inefficient operation of the pump will result in excessive operation costs. Furthermore, no variable speed capability exists with the present facility; there is no flexibility to vary the discharge from anything less than 35 cfs. There is value in using the existing pumping facility for limited time periods as a backup pump. Due to the energy costs, use of the existing facility as a supplemental pump over sustained durations may result in an excessive cost per acre-foot. Due to the inadequate pumping capacity, abandonment proceedings for a portion of the supplemental water right could occur. No adverse impacts will be generated based on the Basin Electric Agreement and flow is available in the Laramie River to satisfy the maximum diversion capability of 35 cfs the majority of the time.
5.4.2 Alternative 2 - Abandon the Existing Facility

This alternative assumes abandonment of the existing facility. The existing CrisaFulli pump unit and the electric motor offer limited salvage value. In addition, abandonment of the facility will undoubtedly result in abandonment of the supplemental supply water right. Furthermore, this alternative eliminates the potential use of the existing facility as a backup pump. No impact results from the Basin Electric Agreement and the water available for diversion is not an issue.

5.4.3 Alternative 3 - Improve the Existing Facility

Considered improvements to the existing facility included replacement of the electric motor drive with a diesel drive and modifications to the sump and intake structure. An analysis of energy costs subsequently resulted in an increase in operational costs associated with a diesel motor drive and the existing CrisaFulli pump. Appendix E presents the comparative cost analysis for diesel versus electric motor drives. The modifications to the sump and intake structure remained as the major component of this alternative. The maximum diversion capacity of 35 cfs would not conflict with the Basin Electric Agreement but abandonment proceedings for the remaining 65 cfs of the supplemental supply could be filed. Water is available for diversion of 35 cfs the majority of the irrigation season.

5.4.4 Alternative 4 - Construct a New Pump Station: 100 cfs Capacity

This alternative involves the construction of a new pump station with a diversion capacity of 100 cfs. To provide a wide range of delivery potential, a dual pump system is proposed with variable speed units associated with each pump. The range of pumping capacity is estimated to be 20 to 34 cfs for one pump and 41 to 100 cfs during the operation of both pumps. Both diesel and electric motor drives were evaluated. A new sump and intake structure is proposed along with a new discharge line to convey the water to the canal. This alternative would be severely impacted by the constraints imposed by the Basin Electric Agreement (68 cfs maximum diversion) as well as flow available in the Laramie
River (an average daily discharge of 100 cfs occurs less than 40% of the time during the irrigation season). Construction and utilization of the 100 cfs pumping capacity would avoid an abandonment proceeding on any portion of the supplemental water right.

5.4.5 **Alternative 5 - Construct a New Pump Station: 68 cfs Capacity**

This alternative involves the construction of a new pump station with a diversion capacity of 68 cfs. Consideration is given to either a single pump station or a dual pump station. Variable speed units are included with each pump and result in a delivery capacity ranging from 41 to 68 cfs for a single pump and 17 to 70 cfs for a dual pump system. Limited capability is provided to divert flows less than 41 cfs with the single pump. Both diesel and electric motor drives were evaluated. A new sump and intake structure is proposed along with a new discharge line to convey the water to the canal. This alternative would not be severely impacted by the constraints imposed by the Basin Electric Agreement (68 cfs maximum diversion). The flow available in the Laramie River exceeds 68 cfs on an average daily basis approximately 42 to 50% of the irrigation season. An abandonment proceeding on the remaining portion of the supplemental supply could be filed.

5.4.6 **Alternative 6 - Construct a New Pump Station: 34 cfs Capacity**

Construction of a new pump station with a diversion capacity of 34 cfs is assumed for this alternative. Due to the limited diversion capability with this alternative, a single pump station is proposed. Incorporation of a variable speed unit provides a pumping range of 20 to 34 cfs. The evaluation of this alternative included both diesel and electric motor drives. A new sump and intake structure is also included along with a new discharge line. This alternative would not be impacted by either the Basin Electric Agreement or flow availability in the Laramie River. The remaining portion of the supplemental supply could encounter the filing of an abandonment proceeding.
5.4.7 Alternative 7 - Improve the Existing Facility and Construct a New Pump Station with 68 cfs Capacity

This alternative combines the positive benefits of Alternative 3 with Alternative 5. The diversion capability is increased to 100 cfs by utilizing the existing facility as a supplemental pump. Given the range in flows provided by the new pump station, the pumping range for this alternative varies from 17 to 100 cfs. Excessive operational costs would be incurred to boost the capacity beyond the 68 cfs provided by the new pump station. The amount of time the flow will exceed 68 cfs is limited on an average daily basis; therefore utilization of the existing facility would also be limited. Abandonment proceedings will be avoided by providing a facility capable of diverting 100 cfs. Potential legal constraints will be imposed due to a direct conflict with pumping more than the maximum diversion of 68 cfs indicated by the Basin Electric Agreement.

5.4.8 Alternative 8 - Improve the Existing Facility and Construct a New Pump Station with 34 cfs Capacity

This alternative combines the positive benefits of Alternative 3 with Alternative 6. By utilizing the existing facility, the diversion capability is increased to 68 cfs. Given the range in flows provided by the new pump station, the pumping range for this alternative varies from 20 to 34 cfs and 55 to 68 cfs. Providing flows in excess of 34 cfs on a regular basis would incur excessive operational costs associated with the usage of the existing facility. Abandonment proceedings could be filed for the remaining portion of the supplemental supply. This alternative does not conflict with the maximum diversion indicated in the Basin Electric Agreement.

5.4.9 Alternative 9 - Installation of an Alluvial Well Field

This alternative implies the abandonment of the existing facility and replacement of supplemental water with an alluvial well field. The capacity of the well field is proposed to be 35 cfs. Included in the development of this alternative were costs associated with drilling, completion, development and testing of at least eight wells with a production rate
of 2000 gpm. Pumps capable of delivering the design discharge were also included in the
cost estimate along with property acquisition and the cost for power transmission lines.
Conveyance pipelines needed to deliver the water to the canal were also evaluated. The
capital construction associated with this alternative may be excessive. Selection of this
alternative would result in abandonment of the supplemental supply water right but will
pose no conflict with the stipulations of the Basin Electric Agreement. Flow availability in
the Laramie River would not be an issue. Filing for ground water rights must be considered
if implementation of this alternative is elected.

5.5 Alternative Evaluation

Based on the information provided in the preceding sections, an evaluation of the
nine alternatives was conducted. The goal of the evaluation is to develop a
recommendation for a preferred alternative or combination of alternatives for rehabilitation
of the existing pump station. Several criteria were utilized to evaluate the considered
alternatives listed in Section 5.4. These criteria included the impact of water rights and
abandonment proceedings, flow availability, capability to fulfill the late season irrigation
requirements, legal implications of institutional constraints imposed by the Basin Electric
Agreement, and estimated costs. All criteria have been discussed in detail in previous
sections of this report with the exception of cost for each alternative. Table 5.1 presents
capital construction and monthly energy cost information for Alternatives 1 to 8. Table 5.2
presents cost information for Alternative 9.

To assist in the selection of the recommended alternative or combination of
alternatives, a decision matrix was developed. Each alternative was evaluated based on the
above criteria with the results of the evaluation presented in the matrix in Table 5.3. As
indicated in the evaluation matrix, Alternative 5 (Construct a New Pump Station with a 68
cfs Capacity) received the highest rating. This alternative could involve a potential
abandonment of 32 cfs of the supplemental supply. It should be noted, however, the
availability of diverting the full supplemental supply requirement (100 cfs) on a continuous
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<td>$ 4,213</td>
<td>35</td>
</tr>
<tr>
<td>4 E-2 Pumps</td>
<td>100</td>
<td>$106,400</td>
<td>$109,600</td>
<td>$216,000</td>
<td>$ 4,286</td>
<td>20-34 &amp; 41-100</td>
</tr>
<tr>
<td>D-2 Pumps</td>
<td>100</td>
<td>$113,400</td>
<td>$112,000</td>
<td>$225,400</td>
<td>9,240</td>
<td>20-34 &amp; 41-100</td>
</tr>
<tr>
<td>5 E-1 Pump</td>
<td>68</td>
<td>$ 69,000</td>
<td>$ 87,000</td>
<td>$156,000</td>
<td>2,770</td>
<td>41-68</td>
</tr>
<tr>
<td>E-2 Pumps</td>
<td>68</td>
<td>$ 74,800</td>
<td>$ 98,500</td>
<td>$173,300</td>
<td>$ 3,032</td>
<td>20-34 &amp; 40-68 (4)</td>
</tr>
<tr>
<td>D-1 Pump</td>
<td>68</td>
<td>$ 72,600</td>
<td>$ 88,500</td>
<td>$161,100</td>
<td>$ 6,120</td>
<td>41-68</td>
</tr>
<tr>
<td>D-2 Pumps</td>
<td>68</td>
<td>$ 81,600</td>
<td>$ 98,500</td>
<td>$180,100</td>
<td>$ 6,240</td>
<td>20-34 &amp; 40-68</td>
</tr>
<tr>
<td>6 E-1 Pumps</td>
<td>34</td>
<td>$ 37,400</td>
<td>$ 71,400</td>
<td>$108,800</td>
<td>$ 1,516</td>
<td>20-34</td>
</tr>
<tr>
<td>D-1 Pump</td>
<td>34</td>
<td>$ 40,800</td>
<td>$ 72,500</td>
<td>$113,300</td>
<td>$ 3,120</td>
<td>20-34</td>
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<tr>
<td>7 E-1 Pump</td>
<td>100</td>
<td>$ 69,000</td>
<td>$ 92,000</td>
<td>$161,000</td>
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<td>41-68 &amp; 76-100</td>
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<td>E-2 Pump</td>
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<td>$ 74,800</td>
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<td>$ 72,600</td>
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<td>41-68 &amp; 76-100</td>
</tr>
<tr>
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<td>$103,500</td>
<td>$185,100</td>
<td>$10,453</td>
<td>20-34 &amp; 40-100</td>
</tr>
<tr>
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<td>$ 37,400</td>
<td>$ 76,400</td>
<td>$113,800</td>
<td>$ 5,729</td>
<td>20-34 &amp; 55-69</td>
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<td>68</td>
<td>$ 40,800</td>
<td>$ 77,500</td>
<td>$118,300</td>
<td>$ 7,333</td>
<td>20-34 &amp; 55-69</td>
</tr>
</tbody>
</table>

(1) Includes cost of motor drive, either electric motor (E) or diesel motor (D), cost of variable speed drive unit, and cost of pump.

(2) Facility cost includes water intake structure, screen grates, outlet pipe, fencing, and pump installation. Cost also includes diesel storage tank for 10 days of operation.

(3) Amortizes $720 annual facility improvement fee per 60 HP or larger motor over a two-month period.

(4) Utilizing 1-50 HP and 1-75 HP electric motor provides a capacity range of 17 to 70 cfs for Alternative #5 and provides a capacity range of 17 to 100 cfs for Alternative #7. Also, eliminates an annual facility fee of $720.

(*) Total cost does not include housing for pump, bank stabilization measures, engineering costs (10%), contingencies (15%), preparation of final plans and specifications (10%), cost for legal fees, permitting, etc.
TABLE 5.3 COSTS FOR ALLUVIAL WELL FIELD \(^{(1)}\)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>COST/WELL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling Completion &amp; Testing (^{(2)})</td>
<td>$4,800</td>
</tr>
<tr>
<td>Pump Bowl, Column, Shaft, Motor and Discharge Head</td>
<td>$10,600</td>
</tr>
<tr>
<td>Miscellaneous:</td>
<td>$5,000</td>
</tr>
<tr>
<td>- Property Acquisition</td>
<td></td>
</tr>
<tr>
<td>- Power Transmission Lines</td>
<td></td>
</tr>
<tr>
<td>- Conveyance Pipelines</td>
<td></td>
</tr>
<tr>
<td>SUBTOTAL</td>
<td>$20,400</td>
</tr>
<tr>
<td>TOTAL FOR EIGHT (8) WELLS</td>
<td>$163,200(^{(3)})</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Assumes 2000 gpm/well and 8 wells.

\(^{(2)}\) Wells 80 feet deep, 16-inch diameter, estimated to cost $60/ft.

\(^{(3)}\) Does not include monthly energy costs.
TABLE 5.4 EVALUATION MATRIX

<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>EVALUATION CRITERIA*</th>
<th>Water Rights</th>
<th>Flow Availability</th>
<th>Supplemental Irrigation Requirements</th>
<th>Institutional Constraints</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No Action Alternative</td>
<td></td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2.5</td>
<td>2.5</td>
<td>11</td>
</tr>
<tr>
<td>2. Abandon Existing System</td>
<td></td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>3. Improve Existing System</td>
<td></td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2.5</td>
<td>2.5</td>
<td>11</td>
</tr>
<tr>
<td>4. Construct New Pump (100 cfs)</td>
<td></td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>5. Construct New Pump (68 cfs)</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1.5</td>
<td>12.5</td>
</tr>
<tr>
<td>6. Construct New Pump (34 cfs)</td>
<td></td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2.5</td>
<td>2</td>
<td>10.5</td>
</tr>
<tr>
<td>7. Improve Existing System &amp; Construct New Pump (100 cfs)</td>
<td></td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1.5</td>
<td>11.5</td>
</tr>
<tr>
<td>8. Improve Existing System &amp; Construct New Pump (34 cfs)</td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>9. Install Alluvial Well Field</td>
<td></td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>1.5</td>
<td>10.5</td>
</tr>
</tbody>
</table>

* Water Rights:
  0 - Most likely for abandonment
  3 - Least likely for abandonment

Flow Availability:
  0 - Least available
  5 - Most available

Supplemental Irrigation Requirements:
  0 - Least favorable to GID
  5 - Most favorable to GID

Institutional Constraints:
  0 - Most potential for legal conflicts
  3 - Least potential for legal conflicts

Cost:
  1 - Least cost
  3 - Most cost
basis is limited; the potential for diverting flows exceeding 68 cfs is considerably higher. Furthermore, the diversion of 68 cfs is considerably more than the 35 cfs presently diverted by the existing system. Although legal implications are minimized with a diversion of 35 cfs or less, the diversion of 68 cfs meets the stipulation in the Basin Electric Agreement.

Additional coordination between the GID and Basin Electric Power Cooperative will be necessary to better define the limitation associated with releasing all flows less than 30 cfs to the mouth of the Laramie River. Finally, the cost to implement Alternative 5 appears to provide the most diversion capability with the least expense.

Given the results of the alternative evaluation, a conceptual design and detailed cost estimate was prepared for Alternative 5 (68 cfs capacity, a dual pump facility with electric motor drives and variable speed drive units).
VI. CONCEPTUAL DESIGN

Conceptual design information for the recommended alternative is provided in this chapter. The design is based on the results of the analysis documented in Chapters II to IV. The intent of the design information is to provide sufficient detail to promote the estimation of unit costs. Conceptual design details for the pump station are presented on Figure 6.1. Also shown on Figure 6.1 is the location of erosion protection measures for promoting the stability of the banks in the vicinity of the pump station. A typical detail for the bank protection is provided on Figure 6.2.
Figure 6.1. Conceptual Design of Laramie River Pump Station.

PLAN VIEW
N.T.S.

INTAKE STRUCTURE

SINGLE PUMP INSTALLATION
(PRELIMINARY PUMP STATION DESIGN FOR 68 cfs)
N.T.S.

INTAKE STRUCTURE

DUAL PUMP INSTALLATION
(PRELIMINARY PUMP STATION DESIGN FOR 68 cfs)
N.T.S.
Figure 6.2. Typical Details for Rock Riprap Bank Protection.
VII. PERMITS AND ENVIRONMENTAL STUDIES

For this project to proceed into construction, the GID may be required to obtain certain permits, rights-of-ways and easements. State and federal agencies were contacted regarding potential permitting requirements associated with the project improvements. The following information was generated during an investigation into these requirements.

1. U.S. Army Corps of Engineers

The Corps of Engineers (COE) were contacted regarding the need for a 404 permit. Because the project is considered a rehabilitation project of an existing irrigation structure, it is exempt from regulation by the COE. A letter confirming this exemption is provided in Appendix H.

2. Wyoming DEQ, Water Quality Division

Since a 404 permit is not required by the Corps of Engineers, the State does not require a 401 authorization. A permit to construct will be required if sedimentation ponds are utilized to control turbidity during construction of the pump station.

3. Wyoming State Engineer Office

Plans and specifications detailing the rehabilitation project must be filed with the State Engineers Office (SEO). These plans will be included with the records associated with the GID supplemental supply water right.

4. Wyoming Game & Fish Department

Since a 404 permit is not required, formal approval for construction of the pump station is not required. It is recommended, however, that the Wyoming Game & Fish Department be notified of the proposed construction prior to initiation of the work.

5. State Historic Preservation Office

Formal approval from the State Historic Preservation Office is not required for this project to proceed to construction.
6. Property Owners

Where applicable, permission should be negotiated for right-of-access for all construction activities associated with the project. To date, the GID has obtained copies of the right-of-way easements and information on the Fort Laramie Canal from the U.S. Bureau of Reclamation. Furthermore, the GID recently obtained an easement for land adjacent to the existing pumping station from Mr. John A. Stienmetz. Copies of this information are also provided in Appendix H.
VIII. COST ESTIMATES

Based on the conceptual design details provided in Chapter 6, detailed cost estimates for the construction of a new pump station on the Laramie River have been prepared. The capital construction cost associated with the implementation of Alternative 5 includes the following items.

- two axial flow pumps (34 cfs each);
- two electric motors, one 50-horsepower and one 75 horsepower;
- two variable speed motor drives;
- installation of the sump and intake structure including screen grates, bell strainers, outlet pipe, fencing, and pump installation;
- construction of the housing for the pumping facility; and
- installation of bank protection measures.

For the new pump station, unit costs for the various components are provided in Table 8.1. The total cost of the project components and final cost estimate are presented in Table 8.2. As indicated, the final cost estimates include 10% for engineering services during construction and 15% for construction contingencies. WWDC funding for the project is assumed to be in the form of a 50% grant and 50% loan. The term of the loan is anticipated to be 25 years with an interest rate of 4%. Assuming two months of pumping (60 days) and computing the annual energy costs accordingly results in an annual cost of $5,536 including the facility improvement fee; consequently, the cost per acre-foot of water diverted becomes $1.69. Over a period of 25 years, the annual cost to divert water for two months, based on annual increases in electrical costs of 1.5% and 3.0%, was also determined. The results of this cost analysis are presented in Table 8.3.
**TABLE 8.1 UNIT COSTS FOR PUMP COMPONENTS**

1. **Pump & Driver**

   60 HP Electrical Motor  2 each @ $1,800  $ 3,600
   RAD & Coupling         2 each @ $2,400  $ 4,800
   Starter                2 each @ $1,200  $ 2,400
   Variable Speed Drive   2 each @ $13,000 $ 26,000
   Pump (15,250 gpm, 34 cfs) 2 each @ $15,000 $ 30,000
   Automation             LS                   $ 8,000

   **Subtotal**             **$ 74,800**

2. **Intake & Sump Facility (Dual Pump Installation)**

   Mobilization            LS                   $ 5,300
   Reinforced Concrete     47 cy @ $360       $ 16,920
   Excavation & Backfill   218 cy @ $8.60     $ 1,875
   Bar Screens             196 SF @ $13.40    $ 2,625
   Coffer Dams & Pumping   LS                   $ 7,900
   Outlet Pipe (24-inch steel) 200 LF @ $89 $ 17,800
   Industrial Fence       115 LF @ $10.40    $ 1,200
   Industrial Gate        1 each @ $200       $  200
   Motor Cowling          2 each @ $600       $ 1,200
   Motor/Pump Installation LS                   $ 3,000
   Electric Service Panel 1 each @ $500       $  500
   Gravel                 10 tons @ $15      $   150

   **Subtotal**             **$ 58,670**

   **10% Contingency**      **$ 5,830**

   **Subtotal**             **$ 64,500**

3. **Pump House**

   LS                       $ 34,000

   **TOTAL COST**           **$173,300**
TABLE 8.2 FINAL COST ESTIMATE AND REPAYMENT PLAN

<table>
<thead>
<tr>
<th>ITEM</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumps and Drivers</td>
<td>$74,800</td>
</tr>
<tr>
<td>Sump and Intake Facility</td>
<td>$98,500</td>
</tr>
<tr>
<td>Bank Protection</td>
<td>$5,250</td>
</tr>
<tr>
<td><strong>COST OF PROJECT COMPONENTS</strong></td>
<td><strong>$178,550</strong></td>
</tr>
<tr>
<td>Engineering Costs (10%)</td>
<td>$17,855</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$196,405</td>
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<tr>
<td>Contingency (15%)</td>
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<td><strong>TOTAL CONSTRUCTION</strong></td>
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<tr>
<td>Final Plans and Specs</td>
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<td>Permitting and Mitigation</td>
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<td>Legal Fees</td>
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<tr>
<td>Access and Right-of-Way</td>
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<td><strong>TOTAL PROJECT COST</strong></td>
<td><strong>$255,450</strong></td>
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<td>50% Loan</td>
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<td>Repayment Factor (25 yrs @ 4%)</td>
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<tr>
<td><strong>ANNUAL PAYMENT</strong></td>
<td><strong>$8,176</strong></td>
</tr>
</tbody>
</table>
TABLE 8.3 TOTAL DIVERSION COST BASED ON 1.5% AND 3.0% ANNUAL INCREASES IN ELECTRICAL COSTS

<table>
<thead>
<tr>
<th>YEAR</th>
<th>ANNUAL PAYMENT (4% Loan, 25 years)</th>
<th>SCENARIO #1</th>
<th></th>
<th>SCENARIO #2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ELECTRICAL COST (1.5% Annual Increase)</td>
<td>TOTAL COST PER AF</td>
<td>ELECTRICAL COST (3.0% Annual Increase)</td>
<td>TOTAL COST PER AF</td>
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<tr>
<td>2016</td>
<td>$8,176</td>
<td>$7,914</td>
<td>$1.99</td>
<td>$11,253</td>
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</table>
IX. ECONOMIC ANALYSIS

9.1 General

Typical of any construction project, economics often becomes the overriding factor in determining feasibility and practicality. The economic analysis was completed to assess the ability of the agricultural water users to pay for the supplemental water made available from improvements to the pumping station. To avoid unnecessary duplication of previous effort, the results of this analysis were based on an economic analysis performed by Western Research Corporation and documented in the WWDC report entitled "Horse Creek Reservoir - Level II Study" and dated November, 1986.

9.2 Crop Budget Information

In accordance with the information in the Horse Creek Reservoir Level II study report, estimates of ability-to-pay were based on a three step process. First, annual crop production costs and returns for a composite baseline operation are estimated. Next, crop production costs and returns are estimated for the baseline operation under the assumption that supplemental water was available. The supplemental water available was assumed to be 68 cfs for the months of July and August. Finally, ability-to-pay estimates were based on the difference between these two scenarios.

As documented in the Horse Creek Reservoir Level II study report, the net return for all crops grown in the baseline operation was $102.80 per acre. This amount is a return to land and water after all other production costs have been taken into account.

The supplemental water supply of 68 cfs for the months of July and August results in an additional 8,360 acre-feet of water during the irrigation season. On a per acre basis, an additional 0.08 acre-feet would be available each month (July and August) for 52,484 acres irrigated under the Fort Laramie Canal. Assuming a combined GID and farm field efficiency of 50 percent, 0.48 inches per acre per month of additional consumptive irrigation water would be available during July and August. This value is similar to the 0.42 inches per acre per month of available water determined by Western Research Center during the
Horse Creek Reservoir Level II study. Consequently, the overall net return for the future scenario was assumed to be the same as that reported by Western Water Research and was taken to be $106.45 per acre. This represent an increase of $3.65 over the net returns of $102.80 in the baseline scenario.

9.3 Ability-To-Pay

The overall net return of $3.65 represents a per-acre estimate of ability-to-pay for the additional water assuming no land improvement costs are necessary to use the water. This results from an increase of 0.08 acre-feet per month for July and August or 0.16 acre-feet for the season; therefore the ability-to-pay for an acre-foot of water becomes approximately $22.90.

9.4 Cost-Benefit Analysis

Net benefits attributable to the project were estimated to be $22.90 per acre-foot of water. As indicated in Chapter VIII, the cost to divert the additional water is approximately $1.69 per acre-foot including costs for annual operation and maintenance of the facility. Without including the annual operation and maintenance costs, the cost to divert the water is approximately $1.01 per acre-foot compared with benefits received of $22.90 per acre-foot.

9.5 Impact of Proposed Improvements on Existing Assessment

The annual assessment levied by the GID to its water users is reported to be $18.76 per acre for fiscal year 1991. This assessment includes operation and maintenance expenses ($17.25), rehabilitation expense ($0.96), and money allocated to the equipment contingency fund ($0.55). The proposed project costs of $8,176 per year represent a $0.16 increase in the existing assessment or a total of $18.92 per year. Including the cost of annual operation and maintenance for the proposed pumping facility for two months ($5,536), the assessment increases by $0.26 to $19.02 per year.
X. CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided in the previous chapters, the following conclusions and recommendations are provided.

1. This project should proceed to Level III with rehabilitation of the pump station consisting of:
   • installation of a dual pump facility with the capacity to divert 68 cfs; the pump system should be driven by two electric motors with variable speed units; and
   • placement of bank protection measures in the vicinity of the pumping facility.

2. With construction of the proposed pumping facility, the cost to divert the water is estimated to be $1.01 per acre-foot compared with potential benefits received of $22.90 per acre-foot.

3. Costs associated with construction of the proposed project are estimated to increase the annual assessment from $18.76 per acre to $18.92 per acre.

4. Maintenance of the downstream diversion dam is not warranted at this time; however, future floods may dictate the need to place remedial bank protection measures upstream of the diversion dam. The potential for sedimentation and the subsequent overbank flows will be reduced if a small notch is placed in the diversion dam. It is recognized that this type of remedial activity will require coordination and the approval of the water users diverting water into the Fort Laramie Ditch.

5. Additional coordination with Basin Electric Power Cooperative is required to clarify the minimum release of 30 cfs at the point of diversion for the pumping station. The analysis in this study presumed a flow available without consideration of this minimum release.
XI. REFERENCES


APPENDIX A

Scoping Meeting Agenda and Minutes
August 5, 1991

Mr. Mike Carnevale  
Wyoming Water Development Commission  
Herschler Building, 4th Floor  
Cheyenne, WY 82001

Re: Goshen Irrigation District Rehabilitation Project-Level II

Dear Mike:

Enclosed are the minutes to the scoping meeting conducted on June 27, 1991. At your convenience, please review the information to ensure that I accurately reflected the discussions that were held that day.

I will be calling you in the near future to update you on the progress of our work.

Sincerely,

Bradley A. Anderson, P.E.
President
BAA/tlt
Enclosure
MEMORANDUM

TO: Mike Carnevale
FROM: Brad Anderson, Lidstone & Anderson, Inc.
SUBJECT: Scoping Meeting Minutes, Goshen Irrigation District Rehabilitation Project, Level II
DATE: August 1, 1991

On June 27, 1991 a scoping meeting was scheduled at the office of the Goshen Irrigation District in Torrington, Wyoming. A proposed agenda for the meeting is attached.

At approximately 1:30 PM, Mike Carnevale of the WWDC called the meeting to order. Those in attendance included:

<table>
<thead>
<tr>
<th>Name</th>
<th>Representing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brad Anderson</td>
<td>Lidstone &amp; Anderson</td>
</tr>
<tr>
<td>Marty Jones</td>
<td>Lidstone &amp; Anderson</td>
</tr>
<tr>
<td>Jon Anderson</td>
<td>AVI p.c.</td>
</tr>
<tr>
<td>Mike Carnevale</td>
<td>WWDC</td>
</tr>
<tr>
<td>John Jackson</td>
<td>WWDC</td>
</tr>
<tr>
<td>Norm DeMott</td>
<td>GID</td>
</tr>
<tr>
<td>Bill Franks</td>
<td>GID</td>
</tr>
<tr>
<td>Emmett Coxbill</td>
<td>GID</td>
</tr>
<tr>
<td>L. Roy Feagler</td>
<td>GID</td>
</tr>
<tr>
<td>Howard Haas</td>
<td>GID</td>
</tr>
<tr>
<td>Neal Payne</td>
<td>GID</td>
</tr>
<tr>
<td>Bill Vandivort</td>
<td>GID</td>
</tr>
<tr>
<td>Leroy Laird</td>
<td>GID</td>
</tr>
</tbody>
</table>

The meeting was initiated by an informal introduction of all those present. Following the introduction, Mike Carnevale discussed the project objectives and touched upon existing problems and outstanding issues that need to be addressed during the completion of the work. These issues included (1) determination of a design discharge/capacity for the Laramie River pump station, (2) potential for increasing the capacity of the existing structures beyond 300 cfs, perhaps to an additional 600 cfs, and (3) feasibility of obtaining Corn Creek Irrigation Water to supplement the irrigation requirements for the GID.
Prior to the full discussion of these issues, Mr. Brad Anderson discussed the scope of work and project schedule for both the rehabilitation of the pump station as well as the tunnels, siphons and wasteways. Task A involving the pump station is scheduled to be completed by November of 1991. This task will investigate the rehabilitation alternatives including (1) no action, (2) abandonment of the existing pump station, (3) construction of a new pump station, and (4) rehabilitation of the existing pump station. Depending upon the availability of water in the Laramie River and the constraints imposed by the SEQ and the Basin Electric Agreement, a potential exists to rehabilitate the existing pump station to provide for backup pumping capacity in excess of the design requirement. Task B entails the feasibility of increasing the capacity of the two tunnels and four siphons in the canal along with rehabilitation of seven existing wasteways. Completion of this task is scheduled for May of 1992.

With respect to the important issues discussed during the meeting, the following information is provided:

1. Design Capacity of the Laramie River Pump Station

Specific input regarding the design capacity of the Laramie River pump station was requested during the meeting. The options included designing the pump station to (1) fulfill the entire 100 cfs supplemental water right, (2) fulfill the 68 cfs in accordance with the Basin Electric Agreement, or (3) fulfill a smaller discharge capacity in the range of 35 to 40 cfs (historically the discharge provided by the existing pump station). The 100 cfs supplemental water right was discussed at length. Discussions between the GID and the SEO indicate that, as far as the SEQ is concerned, the GID can divert up to 100 cfs as long as the diversion is in priority. The potential for abandonment of the supplemental supply was also discussed. The SEO has indicated to the GID that it is unlikely that an abandonment proceeding on a supplemental supply would be successful.

With respect to the Basin Electric Agreement, the GID is bound to release all natural river flows below 30 cfs to the North Platte River. The GID is also restricted by the agreement to not divert in excess of 68 cfs. The 30 cfs release is specifically not recognized by the GID and the Board was unanimous in their decision to not release this amount to the North Platte River during periods of limited flows in the Laramie River.

The results of this discussion led the GID to initially set the minimum acceptable design discharge for the pump at 68 cfs. This discharge will be tempered by the results of the hydrology study being completed by Lidstone & Anderson. If the hydrology study indicates that 68 cfs can be
diverted relatively frequently, then the minimum discharge will remain at 68 cfs. On the other hand, should the results indicated that a much lower discharge is more likely to occur, the design discharge may be reduced. It is important to note, however, that the GID indicated that a design discharge much lower than 68 cfs would have limited benefit compared to the rehabilitation cost of the pump station.

2. Increasing the Capacity of the Canal

The capacity of the existing canal was also discussed. The potential to increase the capacity of the existing structures by an additional 300 cfs is being investigated as part of Task B. However, further increasing the capacity of the structures to convey an additional 600 cfs was posed as an item for discussion. Basically, the existing canal is near capacity at several locations when 1500 cfs is diverted at Whalen Dam. Increasing the irrigation diversion to 1800 cfs may require significant canal improvements to convey the additional water; consequently, the potential for increasing the capacity by 600 cfs is limited. Although not a part of this project, the GID recognized the need to conduct an inventory of the canal to determine the improvements needed to convey the additional diversion requirements.

3. Availability of Corn Creek Irrigation District Water

As a means of obtaining additional storage water, the water assigned to the Corn Creek Irrigation District (CCID) was discussed. The GID is interested in the additional water and has purchased only limited amounts allocated to the CCID in previous years. This will be more fully investigated during the course of the project.

4. Drilling Alluvial Wells

As an alternative to rehabilitation of the pump station, an option was presented to install alluvial wells to provide supplemental water to the GID. This alternative offers some benefits in that water rights are less problematical. The number of alluvial wells along with piping and pumping costs, however, may be costly. Lidstone & Anderson will conduct a preliminary evaluation to investigate the feasibility of this alternative.

Additional discussions included the feasibility of utilizing an existing diversion ditch/canal to convey the supplemental water supply from the Laramie River to the Gehring-Fort Laramie Canal. Due to the topography of the land in close proximity to the Laramie River and the Canal, it is unlikely that either
the old diversion could be utilized or that a new diversion would be able to obtain a positive grade into the Canal. Members of the GID mentioned that the old diversion was effective only during times of low or minimal flow in the canal system. Consequently, no additional investigation of a diversion canal was deemed appropriate for this project.

Finally, the potential for transferring the Laramie River water rights (supplemental supply) to the North Platte River was also discussed. Conversations between the GID and the SEQ indicated that due to the regulation of the North Platte River, transfer of the water right would be difficult. The SEQ further indicated that additional investigation into this matter would not be warranted.

Following these discussions, the representatives of the WWDC, Lidstone & Anderson, Inc. and AVI were excused and the GID Board continued with their monthly meeting.
APPENDIX B

AVERAGE MONTHLY DISCHARGE
LARAMIE RIVER

Calendar Year 1982

Months of the Year

Average Discharge (cfs)

- Ft Laramie
- Greyrocks Outflow
- Greyrocks Inflow

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Y-axis: Average Discharge (cfs)
X-axis: Months of the Year

150 ft³/s
140 ft³/s
130 ft³/s
120 ft³/s
110 ft³/s
100 ft³/s
90 ft³/s
80 ft³/s
70 ft³/s
60 ft³/s
50 ft³/s
40 ft³/s
30 ft³/s
20 ft³/s
10 ft³/s
0 ft³/s

100 cfs
68 cfs
35 cfs
AVERAGE MONTHLY DISCHARGE
LARAMIE RIVER

Calendar Year 1983

Average Discharge (cfs)

- Greyrocks Outflow
- Greyrocks Inflow
- Ft Laramie

Months of the Year

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

100 cfs
68 cfs
35 cfs
AVERAGE MONTHLY DISCHARGE
LARAMIE RIVER

Calendar Year 1986
Months of the Year

Average Discharge (cfs)

- @ Ft Laramie
- Greyrocks Outflow
- Greyrocks Inflow

100 cfs
68 cfs
35 cfs
APPENDIX C

Signed Agreement Between GID and Basin Electric Power Cooperative
AGREEMENT

THIS AGREEMENT, made and entered into this 10th day of April, 1975, by and between THE GOSIEN IRRIGATION DISTRICT, a Wyoming corporation, of Torrington, Wyoming, hereinafter for convenience being referred to as the "District", and BASIN ELECTRIC POWER COOPERATIVE, a corporation, 624 Provident Life Building, Bismarck, North Dakota, hereinafter for convenience being referred to as "Basin", WITNESSETH:

WHEREAS, Basin is the owner of the Grayrocks Reservoir Appropriation, Permit No. 7649 Res. (Temporary Filing No. 21 1/220) unadjudicated, for the storage of water from the Laramie River, tributary to the North Platte, for industrial and recreational purposes, the said permit having a priority date of April 24, 1973, together with the necessary structures and appurtenances, and Basin is also the owner of the Laramie River Pipeline Appropriation, Permit No. 24551 (Temporary Filing No. 21 6/214) unadjudicated, taking water from the Laramie River, tributary of the North Platte River, for industrial purposes, said permit having a priority date of April 2, 1973, together with the necessary pipeline and appurtenances;

WHEREAS, the District is the owner of the enlargement of the Laramie River Diversion Canal Appropriation, Permit No. 4883 Enl., supplemental supply, for the use of water from the Laramie River, tributary of the North Platte River, for irrigation purposes, as adjudicated under Proof No. __________, with a priority of January 20, 1932, C.R. 70, Pages 223 through 500, and C.R. 71, Pages 133 through 139;

WHEREAS, the District desires to change the point of diversion of its water right, known as the enlargement of the Laramie River Diversion Canal Appropriation, Permit No. 4883 Enl., from its present location to the point at which the Fort Laramie Syphon crosses the Laramie River;

NOW THEREFORE, for and in consideration of the mutual promises, covenants and agreements herein, it is mutually understood and agreed between the parties as follows:

1. Under its said Permit No. 4883 Enl., the District covenants and
agrees as follows:

(a) It will not divert any water under said permit in any calendar year prior to May 1st.

(b) It will not divert any water under said permit in any calendar year after September 30th.

(c) It will never divert any water in excess of 4,050 acre feet in any one (1) calendar month during the said months of May, June, July, August and September of any one (1) year.

(d) It will not divert any water at any time that the water available to its said right under Permit No. 4883 Enl. is less than 30 cubic feet per second.

2. Basin agrees that it will not challenge the validity of the District's water right under said Permit No. 4883 Enl., and hereby consents that the District may change its point of diversion of said Permit from its present location to the point at which the Fort Laramie Syphon crosses the Laramie River.

3. This Agreement is made and entered into subject to the approval of the State Engineer and the State Board of Control of the State of Wyoming.

IN WITNESS WHEREOF, the parties on the day and year first above set forth have hereunto affixed their hands and seals.

THE GOSHEN IRRIGATION DISTRICT,
A Corporation,

By: ____________________________
    Title: President

Attest:

______________________________
acting Secretary

BASIN ELECTRIC POWER COOPERATIVE,
A Corporation,

By: ____________________________
    President

Attest:

______________________________
Assistant Secretary
STATE OF WYOMING  
SS
COUNTY OF GOSHEN  

On this 10th day of April, 1975, before me personally appeared Neal S. Payne and L. E. Whitman, to me personally known, who, being by me duly sworn, did say that they are the President and Acting Secretary, respectively, of The Goshen Irrigation District, a Wyoming corporation, and that the seal affixed to said instrument is the corporate seal of said corporation, and that the said instrument was signed and sealed in behalf of said corporation by authority of its Board of Directors, and said Neal S. Payne and L. E. Whitman acknowledged said instrument to be the free act and deed of said corporation.

WITNESS my hand and seal this 10th day of April, 1975.

Notary Public


STATE OF NORTH DAKOTA  
SS
COUNTY OF BURLEIGH  

On this 18th day of April, 1975, before me personally appeared Arthur Jones and Dennis Lindberg, to me personally known, who, being by me duly sworn, did say that they are the President and Assistant Secretary, respectively, of Basin Electric Power Cooperative, a corporation, and that the seal affixed to said instrument is the corporate seal of said corporation, and that the said instrument was signed and sealed in behalf of said corporation by authority of its Board of Directors, and said Arthur Jones and Dennis Lindberg acknowledged said instrument to be the free act and deed of said corporation.

WITNESS my hand and seal this 18th day of April, 1975.

Notary Public

My Commission Expires: MICHAEL J. HINMAN
Notary Public, BURLEIGH CO., ND
My Commission Expires DEC. 19, 1969
APPENDIX D

Pump Curve for the CrisaFulli Pump
CRISAFULLI PUMP COMPANY

P.O. BOX 1051 GLENDIVE, MONTANA 59330
TELEPHONE: 1-800-442-PUMP (7867) OR 406-365-3393
FAX# 1-406-365-8088

CP24CH

24" DISCHARGE DIAMETER
CLOSED IMPELLER
PUMP SPEED: (Various)
DATE: FEBRUARY 5, 1991

TOTAL HEAD (FEET)

620 RPM
560 RPM
540 RPM
500 RPM

S/N 6944
24" HISO:

CAPACITY (U.S. GALLONS PER MINUTE)

0 2500 5000 7500 10000 12500 15000 17500

FEET X 0.305 = METERS
GPM X 0.227 = CUBIC METERS/HOUR
APPENDIX E

Detailed Electrical and Diesel Cost Information and Comparative Analysis
PRESENT WYRULEC BILLING EXAMPLES

RATE STRUCTURE

- $720 PER electric motor 60 HP or over; billed in May of each year for facility improvement costs.
- The first 100 hours each month of the demand load is billed at the rate of $0.149 per kilowatt hour.
- The electrical rate in excess of the first 100 hours is $0.021 per kilowatt hour.

EXAMPLE: EXISTING 200 HP ELECTRIC MOTOR FOR A 30-DAY BILLING PERIOD

The demand load for this motor is 138 KW/hr

Cost for the first 100 hours of operation

\[ 138 \times 100 \times 0.149 \]  
\[ = 2,056.20 \]  

Cost for electricity in excess of 100 hours

\[ 138 \times (30 \times 24 - 100) \times 0.021 \]  
\[ = 1,796.76 \]  

TOTAL COST  
\[ = 3,852.96 \]  

Average cost per hour:  
\[ \frac{3,852.96}{30 \times 24} \]  
\[ = 5.35/hr \]

EXAMPLE: EXISTING 200 HP ELECTRIC MOTOR FOR A 10-DAY BILLING PERIOD

Cost for the first 100 hours of operation

\[ 138 \times 100 \times 0.149 \]  
\[ = 2,056.20 \]  

Cost for electricity in excess of 100 hours

\[ 138 \times (30 \times 24 - 100) \times 0.021 \]  
\[ = 115.92 \]  

TOTAL COST  
\[ = 2,172.12 \]  

Average cost per hour:  
\[ \frac{2,172.12}{10 \times 24} \]  
\[ = 9.05/hr \] (69% increase)

Note: Electrical costs include a recent rate increase of approximately 15%.
Long-term average rate increases are anticipated to be 1% per year based on recent conversations with Jim Hudelson of Wyrulec.
1990 WYRULEC BILLING EXAMPLES

RATE STRUCTURE

- $735.52 per electric motor 60 HP or over; billed in May as a facility service charge
- $11.21 per KW demand paid each month the electric motor is operated
- $0.0189 per kilowatt hour paid for the total kilowatts used each month

EXAMPLE: USAGE OF THE EXISTING 200 HP ELECTRIC MOTOR DURING AUGUST OF 1990 (USAGE = 39,651 KW, APPROXIMATELY 12 CONTINUOUS DAYS)

1990 Billing Structure

138 KW Demand x $11.21 per KW $ 1,546.98
39,651 KW x $0.0189 per kilowatt hour $ 748.21
TOTAL COST $ 2,295.19

1991 Billing Structure

138 KW Demand x 100 hrs x $0.149/kw hr $ 2,056.20
(39,651 KW - 13,800 KW) x $0.021/kw hr $ 542.87
TOTAL COST $ 2,599.07

This represents a 13% increase

EXAMPLE: USAGE OF THE EXISTING 200 HP ELECTRIC MOTOR FOR ONE DAY IN A SEPTEMBER, 1990 (USAGE 4,236 KW, APPROXIMATELY 30 HOURS)

1990 Billing Structure

138 KW Demand x $11.21 per KW $ 1,546.98
4,236 KW x $0.0189 per kilowatt hour $ 79.93
TOTAL COST $ 1,626.91

1991 Billing Structure

138 KW Demand x 100 hrs = 13,800 kw hr
13,800 KW > 4,236 KW; USE 4,236 KW x $0.149 $ 631.16
TOTAL COST $ 631.16

Cost is much less for limited usage
ESTIMATED ELECTRICAL COSTS (1991 BILLING SCHEDULE)

<table>
<thead>
<tr>
<th>(1) Motor Horsepower</th>
<th>(2) Equivalent Electrical Horsepower (HP x 0.746) KW/HR</th>
<th>(3) Demand Electrical Rate (HP x 0.925) KW/HR</th>
<th>(4) KW/30 Days [(3) x 24 x 30] KW</th>
<th>(5) Demand Rate [(3) x 100 hrs] @ $0.145/KW $</th>
<th>(6) Basic Rate [(4)-((3) x 100)] @ 2.1¢/KW $</th>
<th>(7) Estimated 30-Day Billing $</th>
<th>(8) Cost/AF/ Month $</th>
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</thead>
<tbody>
<tr>
<td>*200 (35 CFS)</td>
<td>149.2</td>
<td>138.0</td>
<td>99360</td>
<td>2056.20</td>
<td>1796.76</td>
<td>3852.96</td>
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<td>125 (68 CFS)</td>
<td>93.3</td>
<td>86.3</td>
<td>62136</td>
<td>1285.87</td>
<td>1123.63</td>
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<td>60 (34 CFS)</td>
<td>44.8</td>
<td>41.4</td>
<td>29808</td>
<td>616.86</td>
<td>539.03</td>
<td>1155.89</td>
<td>0.57</td>
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</table>

* Existing electrical pump drive.

Electrical Rates:
- $720 per motor 60 HP or larger, annual cost to repay loan for electrical facilities (not included above).
- 14.9 ¢/KW for first 100 KW hours (demand rate).
- 2.1 ¢/KW for additional KW over demand rate.
ELECTRIC VERSUS FUEL COSTS

<table>
<thead>
<tr>
<th>DRIVE MOTOR (HP)</th>
<th>ESTIMATED 30-DAY ELECTRIC/FUEL COSTS (Cost in Dollars)</th>
<th>AVERAGE COST PER DAY (Cost in Dollars)</th>
<th>AVERAGE COST PER ACRE-FOOT (Cost in Dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 (Q=35 cfs)</td>
<td>3853 + 360 = 4213</td>
<td>140</td>
<td>2.01</td>
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<tr>
<td>125 (Q=68 cfs)</td>
<td>2410 + 360 = 2770</td>
<td>92</td>
<td>0.68</td>
</tr>
<tr>
<td>60 (Q=34 cfs)</td>
<td>1156 + 360 = 1516</td>
<td>51</td>
<td>0.76</td>
</tr>
<tr>
<td>2 @ 60 (Q=68 cfs)</td>
<td>2312 + 720 = 3032</td>
<td>101</td>
<td>0.75</td>
</tr>
</tbody>
</table>

**ELECTRIC**

**DIESEL**

| 161 (Q=68 cfs)  | 6120                                   | 204                                    | 1.51                                          |
| 82 (Q=34 cfs)   | 3120                                   | 104                                    | 1.54                                          |
| 2 @ 82 (Q=68 cfs)| 6240                                   | 208                                    | 1.54                                          |

1. Costs are at present day rates assuming $1.10 per gallon for diesel.

2. Electricity costs include annual facility improvement fee of $720 per electric motor 60 HP and over, amortized over a two month period.
Dear Consumer,

Tri-State Generation and Transmission Association, the cooperative power supplier to Wyrulec Company, your rural electric system, buys a substantial amount of power from the federal hydroelectric system. Such power from the Colorado River Storage Project (CRSP) is a valuable resource to Tri-State and its member systems. We are now, however, faced with huge increases in the rates of the CRSP power that is marketed to Tri-State by the Western Area Power Administration.

A rate increase of 46 percent was implemented on October 1 and another increase of approximately 65 percent is proposed to take effect July 1, 1992. The second of these two rate increases will drive the cost of CRSP power to Tri-State from 11.8 mills per kilowatt-hour in 1990 to slightly over 22 mills per kilowatt-hour in 1992. Tri-State has budgeted an additional $8.5 million for 1992 to cover these rate increases.

What is driving the CRSP rate increases? The U.S. Bureau of Reclamation (USBR) has the primary responsibility for operating the CRSP power facilities. Recreational interests and environmental concerns for the Colorado River below the Glen Canyon Dam are causing the USBR to change the river flows at the dam, thereby reducing the peak generating capacity at the dam by between 400,000 to 500,000 kilowatts. This lost capacity must be replaced at incredible expense, and this replacement power is less desirable environmentally than the lost hydro power.

Before Glen Canyon Dam was constructed river rafting was available to only a few rugged individuals each year. Typical river flows were a torrential flood in the spring and the flow of a minimal creek in the late fall. With Glen Canyon Dam capturing and storing the spring run-off, river flows can support rafting year-round, and tens of thousands of users are able to raft the river each year.

Fluctuating water flows are a nuisance to rafters, and campsites for all these people are at a premium. Apparently there are those who believe the Glen Canyon Dam should be operated so that tens of thousands more can crowd into the canyon. Although environmental concerns are raised, additional people will cause more harm to the canyon and its ecology. We believe there must be a balance between recreational purposes and power production.

The interim operations proposed for immediate implementation by the USBR are not supported by scientific study as required by the National Environmental Policy Act. The decision-makers are altering the operation of the river in favor of rafting while the study is underway, and alternatives other than flow changes are not being given serious consideration.
Fortunately, there is some good news. Tri-State will not be passing on a rate increase to its member systems in 1992 even though Tri-State’s power costs are increasing substantially. Tri-State is able to avoid increasing rates primarily because an additional firm power sales contract to Public Service Company of Colorado becomes effective early in 1992. However, this does not reduce our concern about the increasing costs coming from the federal hydro system.

Although Tri-State is not raising its rates at this time, such cost increases will rapidly advance the day that Tri-State will be forced to raise rates. Moreover, the day is brought closer when a new power plant will be needed to replace the lost capacity at Glen Canyon Dam.

We are doing everything we can to reduce the impact of these increases. Please join us in voicing your strong opposition to these unwarranted and unbalanced approaches to resource management. Your power rates are paying for most of the costs of the Colorado River Storage Project. You have a right to be heard and a right to have your interests protected.

Sincerely,

James Hudelson
Manager

Frank R. Knutson
General Manager

FRK:JD/dvs

Send your concerns about increasing power costs and the inequitable handling of the Colorado River Storage Project to:

Secretary Manuel Lujan, Jr.
Department of Interior
1849 C Street, NW
Washington, DC 20240
November 12, 1991

Secretary Manuel Lujan, Jr.
Department of Interior
1849 C Street, NW
Washington, DC 20240

Dear Mr. Lujan:

We would like to voice our opposition to the increases being passed on to the consumers of the federal hydroelectric system on the Colorado River Storage Project. An 111% increase in cost is prohibitive to the consumers, a large portion of which are farmers and rural communities.

We would also like to question the right of recreation-ist to alter the flows of the river when they contribute nothing to the operation of the Glen Canyon Dam or the river. Like most projects in the west the dams and regulated river flows are what has made recreation possible in otherwise dry or low river beds. Now the very people who have benefited from the control of the rivers want even more to the detriment of the rest of the users on the river. The hydropower production pays for the operation of the rivers and dams, and to the benefit of a lot of people in the west. Regulation of the river for recreational use will also lose water that would have been used for irrigation and place additional hardships on the farmer. Some day the question will come down to "Do we want to raft and keep the endangered species alive or the people of this great country alive"? We believe we have a relatively simple answer, both the recreation and the endangered species have come alive under the river regulation as it has been......for irrigation and hydropower generation. If it isn't broken, don't fix it.

Sincerely,

FOR THE BOARD OF COMMISSIONERS

William J. Franks, President

WJF/smh
APPENDIX F

Detailed Output for the HEC-2 Simulation
### HEC-2 Water Surface Profiles

**Version 4.6.0; February 1991**

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#### 1. WYDOC-02 GID Laramie River

**T2 Low Flow Analysis & 100 Yr Event 10-2-91**

**Laramie River**

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<th>ICHECK</th>
<th>INQ</th>
<th>NINV</th>
<th>IDIR</th>
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<th>HVINS</th>
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<td>2</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>4260.5</td>
<td></td>
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#### Rating Curve Data

| JR | 10 | 260.0 | 20 | 4260.5 | 35 | 4260.70 | 2000 | 4262.20 | 8500 | 4265.00 |

---

#### NPROF IPLOT PRFVS XSECV XSECH FN ALLDC IBW CHNIM ITRACE

| 1 | 0 | -1 | 0 | 0 | 0 | -1 |

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#### Variable Codes for Summary Printout

<table>
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**EC-2 WATER SURFACE PROFILES

rsion 4.6.0; February 1991

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** LARAMIE RIVER

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APPENDIX G

Laboratory Data From Bed and Bank Material Collected Along the Laramie River
August 27, 1991

Lidstone & Anderson, Inc.
736 Whalers Way, Suite F-200
Ft. Collins, Colorado 80525

ATTN: Mr. Chris Lidstone

RE: Miscellaneous
Laboratory Testing
Laramie River Materials
Job No. 12911009

Gentlemen:

During the period August 23 through August 27, 1991, Terracon Consultants SE, Inc. personnel provided laboratory testing services to you for the referenced project. The results of that laboratory testing are included with this report.

As requested, Terracon personnel performed Atterberg limits and washed sieve analyses tests on soil samples you delivered to our laboratory on August 23 and August 26. The requested testing was completed on the individual samples in general accordance with ASTM Specifications C-117, C-136 and D-4318. Results of the grain size analyses and Atterberg limits are summarized on the attached data sheets.
We have not been asked to interpret the data or to make design and/or construction recommendations based on the data, and cannot assume responsibility or liability for interpretation of this data by others.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we can be of further service to you in any other way, please do not hesitate to contact us.

Very truly yours,

TERRACON CONSULTANTS SE, INC.

Robert L. Decker, C.E.T.

Lester L. Litton, P.E.
Colorado No. 23957

RLD/dmf
## ANALYSIS OF AGGREGATES REPORT

Job No. 12911009  
Date: August 1991

Architect or Engineer: Lidstone & Anderson, Inc.  
Contractor: ________________

Project: Laramie River  
Source: Bank #1

### REPORT OF TESTS OF Washed Sieve Analysis and Atterberg Limits

<table>
<thead>
<tr>
<th>Sieve Size or No.</th>
<th>Weight Retained</th>
<th>% Retained</th>
<th>% Passing</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 1/2-inch</td>
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<td>0</td>
<td>100</td>
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<tr>
<td>2-inch</td>
<td>0.7</td>
<td>0.2</td>
<td>99.8</td>
<td></td>
</tr>
<tr>
<td>1 1/2-inch</td>
<td>3.4</td>
<td>0.8</td>
<td>99.2</td>
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<tr>
<td>1-inch</td>
<td>11.1</td>
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</tr>
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<td>3/4-inch</td>
<td>15.0</td>
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<td>1/2-inch</td>
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<tr>
<td>1/4-inch</td>
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<td>91.7</td>
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<td>No. 8</td>
<td>84.3</td>
<td>20.5</td>
<td>79.5</td>
<td>(79.4% -200 Wash)</td>
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<tr>
<td>No. 10</td>
<td>84.4</td>
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</table>

Remarks: L.L. = Cannot be Determined  
P.L. = N.P.

Received at Laboratory: 8/26/91

Quantity Represented: ________________

Submitted by: Lidstone & Anderson

Sampled from: Laramie River

Identification: LA3 RB

Date Sampled: ________________  
Delivered: ________________

Intended Use: ________________

Remarks:
- Organic matter, colorimetric
- Coal & Lignite
- Clay Lumps
- Chert
- Soft Particles
- Percent Absorption
- Specific Gravity
- Dry Rodded Weight
- Weight Before Washing: 410.4 gms
- Weight After Washing: 84.5 gms

---

**Terracon**
ANALYSIS OF AGGREGATES REPORT

Job No. 12911009
Date August 1991

Architect or Engineer Lidstone & Anderson, Inc. Contractor ______________________

Project Laramie River Source Bed Sample #1

REPORT OF TESTS OF Washed Sieve Analysis

<table>
<thead>
<tr>
<th>Sieve Size or No.</th>
<th>Weight Retained</th>
<th>% Retained</th>
<th>% Passing</th>
<th>Specifications</th>
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<tr>
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<td>1427.1</td>
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Received at Laboratory 8/23/91

Quantity Represented __________________

Submitted by Lidstone & Anderson

Sampled from Laramie River

Identification GID Canal Siphon

Date Sampled Delivered

Intended Use _______________________

Remarks:

Organic matter, colorimetric _______________________

Coal & Lignite _______________________

Clay Lumps _______________________

Chert _______________________

Soft Particles _______________________

Percent Absorption _______________________

Specific Gravity _______________________

Dry Rodded Weight _______________________

Weight Before Washing 1495.4 gms

Weight After Washing 1427.2 gms

(4.6% -200 Wash)
ANALYSIS OF AGGREGATES REPORT

Job No. 12911009
Date August 1991

Architect or Engineer Lidstone & Anderson, Inc. Contractor

Project Laramie River Source Bank Sample #2

REPORT OF TESTS OF Washed Sieve Analysis and Atterberg Limits

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<th>% Retained</th>
<th>% Passing</th>
<th>Specifications</th>
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Remarks:

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<td>P.L. = N.P.</td>
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Received at Laboratory 8/23/91

Quantity Represented

Submitted by Lidstone & Anderson

Sampled from Laramie River

Identification RB, U.S. of Old Diversion

Date Sampled Delivered

Intended Use

Remarks:

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</tr>
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<td>Chert</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Soft Particles</td>
<td></td>
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</tr>
<tr>
<td>Percent Absorption</td>
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<td>Specific Gravity</td>
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<td>Weight Before Washing</td>
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<td>Weight After Washing</td>
<td>265.1 gms</td>
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<tr>
<td>(56.5% -200 Wash)</td>
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ANALYSIS OF AGGREGATES REPORT

Job No. 12911009
Date August 1991

Architect or Engineer  Lidstone & Anderson, Inc.  Contractor ______________

Project  Laramie River  Source  Bed Sample #2

REPORT OF TESTS OF  Washed Sieve Analysis

<table>
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<th>Sieve Size or No.</th>
<th>Weight Retained</th>
<th>% Retained</th>
<th>% Passing</th>
<th>Specifications</th>
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<td>1231.8</td>
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Received at Laboratory  8/23/91
Quantity Represented  ______________
Submitted by  Lidstone & Anderson
Sampled from  Laramie River
Identification  NR Old Diversion
Date Sampled  Delivered
Intended Use  ______________
Remarks:
Organic matter, colorimetric  ______________
Coal & Lignite  ______________
Clay Lumps  ______________
Chert  ______________
Soft Particles  ______________
Percent Absorption  ______________
Specific Gravity  ______________
Dry Rodded Weight  ______________
Weight Before Washing  1257.5 gms
Weight After Washing  1231.8 gms
(2.0% -200 Wash)

Remarks:  ______________
APPENDIX H

Letter of Exemption from COE and Easement Information
September 4, 1991

Cheyenne Regulatory Office  
504 West 17th Street, Suite 280  
Cheyenne, Wyoming 82001

Mr. Bradley Anderson  
Lidstone & Anderson, Inc.  
Water Resources and Environmental Consultants  
736 Whalers Way, Suite F-200  
Fort Collins, Colorado 80525

Dear Mr. Anderson:

This letter is in reference to our meeting on August 15, 1991, and your follow-up letter of August 16, 1991, concerning the rehabilitation of a pumping station owned by the Goshen Irrigation District. The pumping station is located in the SW 1/4 SW 1/4, Section 30, Township 26 North, Range 64 West, Goshen County, Wyoming.

The Corps of Engineers regulates the placement of dredged and fill material into Wyoming waterways and wetlands as authorized primarily by Section 404 of the Clean Water Act (33 U.S.C. 1344).

Based on the information provided, it has been determined that your proposed work is not subject to Corps regulation. Part 323.4(a)(3) of the Corps rules and regulations, as published in the November 13, 1986, edition of the Federal Register, states that the following activity is not subject to Corps regulation:

"Construction or maintenance of farm or stock ponds or irrigation ditches or the maintenance (but not construction) of drainage ditches. Discharges associated with siphons, pumps, headgates, wingwalls, weirs, diversion structures, and such other facilities as are appurtenant and functionally related to irrigation ditches are included in the exemption."

Although Corps of Engineers authorization is not required for the project you have described, this does not eliminate the requirement that you obtain any other applicable Federal, state, or local permits as required.

We would encourage you to undertake any necessary work in an environmentally sound manner and to keep river impacts to a minimum. You may want to discuss your proposed project with your local Wyoming Game and Fish Department representatives.
Thank you for your interest in cooperating with the requirements of the Corps regulatory program.

If you have any questions on this matter, please call me at (307) 772-2300.

Sincerely,

Matthew A. Bilodeau
Regulatory Branch
Operations Division

Copy Furnished:

Mike Carnevale, WWDC, Herschler Building, 4th Floor West, Cheyenne, Wyoming 82002
KNOW ALL MEN BY THESE PRESENTS:

That the undersigned, John A. Stienmetz and Jenness J. Stienmetz, husband and wife, (hereinafter called Grantor, whether one or more, his heirs, executors, administrators, agents, successors or assigns) for and in consideration of the sum of Ten and no/100 Dollars ($10.00) and other good and valuable consideration, in hand paid, the receipt of which is hereby acknowledged, does hereby grant, bargain, sell, convey and warrant to GOSHEN IRRIGATION DISTRICT, its successors and assigns (hereinafter called Grantee), upon the terms and conditions herein specified, a perpetual right-of-way and easement on which to locate, establish, install, construct, maintain, operate, alter, repair and remove, a pump(s) and pumping station, together with all appurtenances incidental to and necessary for the operation of such pump(s) and pumping station, on, over, under and through certain lands in which the undersigned has an interest, situated in the County of Goshen, State of Wyoming. Said land being more particularly described as follows:

SEE EXHIBIT "A" ATTACHED

TO HAVE AND TO HOLD the above described rights and easement unto the Grantee, its successors and assigns, together with the right to assign the rights and easement herein granted, either in whole or in part, subject to the terms of this grant.

The pump(s), pumping station and other appurtenances installed by Grantee within the easement shall at all times remain the property of Grantee. Grantee shall, at its expense, maintain its improvements in a reasonable manner, keeping same in a neat and presentable condition.

Grantor reserves the right to full use and enjoyment of said premises except for the purposes herein granted, provided that such use and enjoyment shall not hinder, conflict or interfere with the exercise of Grantee's rights hereunder or damage the pump(s), pumping station or appurtenances owned by Grantee. No excavation, building, structure, or other obstructions shall be
constructed on the said easement without Grantee's prior written consent.

Grantors represent, covenant and warrant they are the owners of fee simple title, subject only to encumbrances, if any, now on record in said county.

Grantee shall assure that all phases of construction work and maintenance will be performed in a workmanlike manner to prevent excessive and unnecessary damage to property, including trees, and with a minimum disruption of traffic flow to and from Grantor's property.

Immediately following the initial installation and construction, Grantee will cause to be removed from the above-described property, all debris, surplus material and construction equipment and leave such property in a neat and presentable condition.

The provisions hereof shall inure to the benefit of and be binding upon the parties hereto, their respective heirs, personal representatives, successors and assigns.

Hereby waiving and releasing all rights under and by virtue of the homestead exemption laws of the State of Wyoming.

IN WITNESS WHEREOF, these presents are hereby signed this ____ day of May, 1991.

John A. Stienmetz

Jenness J. Stienmetz

STATE OF WYOMING  }  SS.
COUNTY OF GOSHEN  }

The foregoing instrument was acknowledged before me by John A. Stienmetz and Jenness J. Stienmetz, husband and wife, this ____ day of May, 1991.

Witness my hand and official seal.

EXHIBIT "A"

(ATTACHED TO AND MADE A PART OF THAT CERTAIN GRANT OF EASEMENT BETWEEN JOHN A. STIENMETZ AND JENNESS J. STIENMETZ, GRANTOR, AND GOSHEN IRRIGATION DISTRICT, GRANTEE, DATED MAY ___, 1991.)

DESCRIPTION FOR EASEMENT

That part of the SW₁/₄NW₁/₄, Section 30, T26N, R64W and of the SW₁/₄NE₁/₄, Section 25, T26N, R65W of the 6th P.M., Goshen County, Wyoming more particularly described as follows:

Beginning at a true point of beginning and which point lies on the west boundary of the SW₁/₄NW₁/₄, Section 30, T26N, R64W and which point lies on the south bank of the Laramie River and further which point lies north 620.0 feet from the west ¼ corner of said Section 30, said north bearing being considered as base bearing with all other bearings relative thereto; thence from this TRUE POINT OF BEGINNING S77°06'E 20.0 feet along said river bank; thence S12°54'W 50.0 feet; thence N77°06'W 275.0 feet; thence N12°54'E 50.0 feet to a point on said river bank; thence following said bank S77°06'E 255.0 feet to the point of beginning containing 0.32 acres more or less.

J. Kenneth Kennedy
Wyo. Lic. P.E. & L.S. No. 550

Prepared for: Goshen Irrigation District
Date: April 29, 1991
Mr. Norman DeMott  
Manager, Goshen Irrigation District  
P.O. Box 717  
Torrington WY 82240

Subject: Request for Information Concerning a Right-of-Way Easement on the Ft. Laramie Canal (Right-of-Way)

Dear Mr. DeMott:

Pursuant to your letter dated July 13, 1990, requesting information concerning rights-of-way/easements on the Ft. Laramie Canal at the point where the Laramie River crosses the canal, we have enclosed for your information copies of the following:


If you have any questions, please call Mike Piccirilli of this office at telephone number (307) 261-5678.

Sincerely,

John H. Lawson  
Project Manager

Enclosures
BUREAU OF RECLAMATION
REGION 7
RIGHTS-OF-WAY
REGISTER

NORTH PLATTE

Location T. 26 N., R. 65 W., 6th P. M.
Laramie River Diversion Canal
Goshen County, Wyoming
Ft. Laramie Canal System (Wyo.)
Section 25: E4SW1, NW1SE1
(Tract in)

Map No. 17D-171

Contract No. Canal Act

Date of Cont. 9/16/26

Possession "

Name of Vendor Glade, A. F., et ux.

Address Ft. Laramie, Wyoming

Acreage 3.45

Rights Conveyed 100 Ft., 40 Ft., & 60 Ft. R/W Easement

By Act of 8/30/1890 Dated

Instrument of conveyance recorded in Count
on ______________, in book ______ at page ______________

Purchase Price Contr. $ 0.00 Appraisal No. 

Damages $ 121.50 for No. 

Net $ 121.50 Voucher Date Amount 

Water rights Acquired Yes

Improvements Acquired

__________________________ _____________________
Appraised value Salv. value

Remarks Contract 113r-25 covers Agreement for damages, recorded in Goshen County, Wyoming on 11/10/26, Book 87, Page 225.

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Vendor Glade, A. F., et ux.
**Project** | NORTH PLATTE
---|---
**Location** | T. 26 N., R. 65 W., 6th P. M.
**Feature** | Laramie River Diversion Canal
**Map No.** | District Map
**Contract No.** | Canal Act
**Date of Cont.** | 10/7/15
**Possession** | "

**Name of Vendor** | Barnard, G. G.

**Address** | Ft. Laramie, Wyoming
**Acreage** | 1.3

**Rights Conveyed** | 100 ft. G/W Canvass

**By** | Act of 8/30/1890
**Dated** | _______

**Instrument of conveyance recorded in** | _______
**County** | on ______, in book ______ at page ______

**Purchase Price Contr.** | $ 0.00
**Appraisal No.** | _______
**Less** | ______ for ______
**Net** | $ 0.00
**Voucher Date** | ______
**Amount** | ______

**Water rights Acquired** | ______

**Improvements Acquired** | ______
**Appraised value** | ______
**Salv. value** | ______

**Remarks** | ______

**Platted by** | CHS
**Date contract distributed** | ______
**Vendor** | Barnard, G. G.
Project: NORTH PLATTE

Location: T. 26 N., R. 65 W., 6th P. M.

Feature: Ft. Laramie Canal System (Wyo.)

Goshen Irrigation District

Map No. Map

Section 25: SE1/4, E1SE1/4

Contract No. Canal Act

Date of Cont. 10/7/15

Possession

Name of Vendor: Barnard, G. G.

Address: Ft. Laramie, Wyoming

Acreage: 7.4

Rights Conveyed: 100 ft. of Canal.

By Act of 8/30/1890 Dated

Instrument of conveyance recorded in Count

on , in book at page

Purchase Price Contr. $ 0.00 Appraisal No.

Less for No.

Net $ 0.00 Voucher Date Amount

Water rights Acquired

Improvements Acquired

Appraised value Salv. value

Remarks

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Vendor Barnard, G. G.