CHEYENNE SOUTH CROW DIVERSION PROJECT

PHASE II
FINAL REPORT
Executive Summary

Submitted to:
Wyoming Water Development Commission
Herschler Building, 4th Floor
122 West 25th Street
Cheyenne, WY 82002

Submitted by:
ECI
The Water Resource Division of FR Harris, Inc.
5660 Greenwood Plaza Boulevard
Suite 500
Englewood, CO 80111

August 2000
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August 2000
August 8, 2000

Mr. Bruce Brinkman
Wyoming Water Development Commission
Herschler Building 4th Floor West Wing
122 West 25th Street
Cheyenne, WY 82002

Dear Bruce:

Enclosed are 50 copies of our approved Executive Summary of the Final Report for the above-referenced project. The required reproducible unbound copy and the digital version of the executive summary is with the final report being submitted separately at this time. These services were performed per our contract dated June 6, 1999.

This executive summary summarizes the services performed for Phases I and II of this study, including an inventory of the existing system, problem identification, development of preliminary alternative plans, conceptual plans, geotechnical evaluations, identification of permitting and easements required, cost estimates and an economic analysis and project financing. We finalize this summary of the report after receipt of review comments from Wyoming Water Development Commission and the City of Cheyenne Board of Public Utilities.

We appreciated your support and the input and help we received from the good staff at the City’s Board of Public Utilities. If you need anything, please let us know and we will try to provide it.

Please call if you have questions.

Sincerely,

R. Joseph Bergquist
Project Manager

RJB/td

Enclosures
PROFESSIONAL CERTIFICATION

I, Richard Joseph Bergquist, P.E., hereby certify that the professional services required for the Cheyenne South Crow Diversion Project, Level I and II, were performed by me or under my direction and that I am a professional Engineer licensed in Wyoming as required by the provisions of W.S. 33-29-105 through W.S. 33-29-113. IN WITNESS WHEREOF I have hereunder set my hand and affixed my seal.

By:  
Richard Joseph Bergquist, P.E. #6330  
Projects Manager, ECI

I, Neil R. Sherrod, P.G., hereby certify that I am a Professional Geologist licensed as required by the provisions of W.S. 33-41-101 through W.S. 33-41-121, and that all geological work performed in relation to the Cheyenne South Crow Diversion Project, Level I and II, was performed by me or under my direction. IN WITNESS WHEREOF. I have hereunder set my hand and affixed my seal.

By:  
Neil R. Sherrod, P.G. #202  
Senior Engineer Geologist, Terracon
EXECUTIVE SUMMARY

INTRODUCTION

In 1999 the Wyoming Legislature authorized the Wyoming Water Development Commission to secure engineering services to conduct an investigation of the existing South Crow diversion dam and pipeline rehabilitation needs for the City of Cheyenne’s Board of Public Utilities. The investigation was divided into two phases; a reconnaissance (Level I) study and, a feasibility (Level II) study.

The Commission selected ECI, in association with AVI and Terracon Consultants, to provide the necessary engineering services for the study and evaluation. The main tasks of the two-phased study were the following:

- Determine the feasibility of either reconstructing the diversion structure or constructing a new dam upstream of the existing diversion structure.
- Establish the benefits of both alternatives: (1) rehabilitation of the diversion structure and (2) a new upstream water storage dam.
- Evaluate the condition of the existing 2.5-mile-long, 16-inch-diameter pipeline.
- Determine the remedial measures required to repair the existing pipeline, concrete diversion structure, and valve house.

PROJECT DESCRIPTION

The South Crow Diversion Dam is located approximately 22 miles west of Cheyenne, Wyoming, in Laramie County in the NW1/4 section T13N, R70W. It was constructed in 1911 by the City to impound and divert the flows of South Crow Creek for municipal use. The structure also serves as diversion for local irrigation users.

Based on available information, the South Crow diversion structure is approximately 26 feet high and 207 feet long. The impoundment is approximately 12-acre feet (acft) of water. Depending upon the time of year, a maximum of approximately 3 mgd can be diverted to help meet Cheyenne’s water supply needs. A 16-inch gate valve at the diversion controls the amount of water diverted through the pipeline to the City’s treatment facilities. Only manual control of the valve can be performed at the site.

INVENTORY

The study documented the following:

- The diversion structure and reservoir are located on City owned property, however normal access to the structure is across privately-owned land.
• The 90-year-old dam has structural problems and has deteriorated due to freeze-thaw action over the years. Past repairs have not been durable. Leaks through the structure in several locations along the horizontal construction joints have caused severe deterioration on the downstream side.

• There is limited erosion and no aggregation of the streambed downstream of the structure.

• The sluice has not been operated recently and is assumed to be blocked by sediment that have reduced the reservoir storage from 12 to 9 acft.

• The actual structure is shorter than depicted in the 1910 design drawings. It also was built without a dissipation basin and the valve house is closer to the spillway than the drawings indicate.

• The City has a diversion water right of 7 cfs with a 1910 date for the South Crow diversion structure. The City has an expired storage permit referred to as Lake Helen for a South Crow Creek Reservoir.

• The City has a sixty-foot easement for the South Crow Pipeline which grants the City the right to enter upon the land for the purpose of constructing, operating, repairing, maintaining, and inspecting the pipeline.

• BOPU staff has established the value of raw water to be approximately $1.32 per 1000 gallons or $200/acft. Treated water costs $2.02 per 1,000 gallons in 1999. They serve 65,000 residents in the City and surrounding area.

• The diversion structure and thus the future rehabilitation project is located in potential Prebles meadow jumping mouse protection areas

Field work conducted during the summer and fall established the following:

• The pipeline appears to be in good condition and has limited corrosion damage.

• Modern day devices, such as air-release valves, remote control, and motorized valve operators are not installed on the pipeline.

• Operation of the pipeline in the last 10 years has been limited to flushing and occasionally supplying water to the City of Cheyenne water treatment plants. The lack of more frequent operation has been due to water quality issues, especially the amount of turbidity associated with South Crow discharges.

EVALUATION

Pipeline Condition Assessment

Considering the existing pipeline was constructed over 90 years ago, it appears to be in good condition. Based on the sections examined, the exterior of the cast iron pipeline has minimal pitting. Soil analysis
and corrosivity tests indicated that even though the pipeline runs through "hot" areas (conducive to corrosion) it was best to not disturb the situation by adding cathodic protection at this time.

Hydraulic capacity of the South Crow pipeline is dependant on how it is operated in conjunction with the rest of the system. The estimated capacity of the South Crow pipeline with the Hecla pipeline in operation varies from 7.3 to 7.5 mgd (11.3 to 11.6 cfs). The South Crow line, with the Hecla line closed, can discharge 7.4 mgd (11.5 cfs). According to the water rights the City holds for the diversion the maximum discharge is 4.5 mgd (7 cfs).

The evaluation concluded that the pipeline is in good condition and, except for the noted deficiencies such as air valves, could be placed back into operation. Provided BOPU maintenance practices are continued, it is estimated that a number of years of serviceable life remains.

**Diversion Structure Condition Assessment**

According to the State of Wyoming dam safety criteria the South Crow Diversion is classified as a low hazard small size structure with aging problems. Portions of the diversion structure, due to deterioration from freeze-thaw action and ice loading, is not in good condition. Sections of the upstream face of the structure, below the depth of ice on the reservoir are in good condition. The most severe deterioration is on the downstream face along the right side of the non-overflow section. Exposed concrete on the left side of the non-overflow section appears to be in reasonably good condition compared to the right side.

The gravity method of analysis was used to check the overturning and sliding stability of this dam. The results indicated the existing South Crow Diversion Dam requires modification to be stable and meet the required guidelines. The conclusion was that unless the diversion structure is rehabilitated, it could possibly fail in the near future. Failure will be dependant on the rate of continued concrete deterioration.

**Easements and Permits**

Construction access easements will be required for the diversion structure rehabilitation. The last 2.5 miles of access road to the site from the Crystal Lake Road will require upgrading. Prior to the start of construction the BOPU should negotiate and obtain a permanent maintenance easement for access and finalize the appropriate permits. A summary of the most significant permits are included in the main report. Any new dam alternative would also require a current day priority right to store additional water and a filing for adjudication for new storage.

**DIVERSION STRUCTURE REHABILITATION ALTERNATIVES**

Evaluation of existing and collected data and discussions with project sponsors identified the following potential rehabilitation alternatives for the South Crow diversion structure:

- Replacement of existing structure.
- Seal upstream surface of diversion structure with sealants, geotextiles, or grout.
• Overlay upstream face of existing structure with concrete.
• Overlay downstream face of existing structure with concrete, RCC, or soil-cement.

The downstream overlay alternatives have an advantage, compared to an upstream overlay or surface treatments, because concrete work can be performed on the downstream side of the diversion structure in the dry without draining the reservoir. These alternatives were costed and compared. Environmental and other constraints were considered in selecting the alternative to carry into Phase II.

**PHASE I CONCLUSIONS AND RECOMMENDATION**

From the results of the Phase I work it was concluded:

• The downstream concrete overlay alternative would provide the best protection of the existing structure, create a more stable structure satisfying State Engineer criteria, and have the lowest cost.

• The pipeline requires addition of air release and blowoff construction valves.

• The valve house requires an overhaul of the structure, valves and addition of new controls.

• The New Dam upstream alternative is uneconomical and would require trans basin imported water to function as an effective storage facility.

Phase I ended with the recommendation that the downstream concrete overlay with a 3-foot-high crest raise rehabilitation is the cost-effective alternative to carry forward into Phase II.

**PHASE II CONCEPTUAL DESIGN**

Components of the selected alternative based on the conceptual design are described in the following paragraphs:

**Pipeline**

Three air release valves should be located along the South Crow pipeline route: one downstream of the valve house, two at the high points in the pipeline. Two blowoff valves should be installed per BOPU instructions.

**Diversion Structure’s Concrete Gravity Section**

A downstream concrete overlay should be used to improve and stabilize the existing concrete gravity section. Stability analysis performed on this section, concluded the new mass of concrete should extend from the edge of the existing structure approximately 3.5 feet at the top to the downstream side. The shape and a new slope of 0.725H:1.0V should be used to define the new gravity section following
concrete gravity dam design criteria as required by Wyoming’s SEO Dam Safety Engineer. Above the junction of the sloping and vertical wall at elevation 7124, the concrete section becomes a rectangular section extending to elevation 7135.

Spillway
The spillway section should be similar to the non-spillway section with a new crest elevation set at 7132.42. Per free board requirements the top of dam should be set at elevation 7135. The new spillway should have a crest length of 50 feet. The rancher’s irrigation diversion intake should be incorporated into the new spillway section. Grouted riprap will be considered during the final design if rock is not sufficient at the base of the spillway.

Sluice Outlet
Rehabilitation for the existing sluice outlet should include replacement of the existing gate with a new silt proof gate housed in a new tower that provides access to the gate. The arrangement keeps the gate free from being block by sediment. This work should be conducted while the reservoir is lowered to repair the upstream concrete face.

Valve House and Valves
The valve house should be rebuilt above elevation 7132 and equipped with new motorized valves and a SCADA system. Grating should be added along with new trash screens and access ladders and safety railing.

SCADA
A system to provide monitoring of the water quality and control water releases from South Crow Diversion should be added. The preferred method of communications is via radio interface with the existing system. An alternative system would be to utilize a satellite or telephone line if phone lines are made available from Crystal Road to the site. When built the operation and management SCADA system should include receivers at the South Crow Dam site and the South Crow pipeline junction with the 20-inch Hecla south pipeline supported by a store and forward repeater situated at the Cooper King Mine site. For purposes of this study it was assumed a repeater could be located at this site if needed.

Access Road
A new construction road will be required for the 2.5 miles from the Crystal Lake Road to the site and should be built and eventually converted into an operation and maintenance road.

Transmission Line
Power for the South Crow facility should be provided by a new single phase 14.4 Kilovolt power line (approximately 2.5 miles) following the proposed access road from the Hecla pipe line junction to the South Crow Diversion.
Project Cost
The opinions of probable construction cost for these conceptualized components of the project provided herein are made on the basis of ECI’s experience and qualifications and represent our best judgement as an experienced and qualified professional engineers generally familiar with the construction industry. The estimated probable cost for the total project including engineering, site access easement, and permit assistance is $1,060,000.

ABILITY TO PAY
A repayment plan would be based on a 50 percent grant and 50 percent loan available from WWDC. The term of the loan would be 20 years with an interest ratio of 7.25 percent. These figures generate an annual cost to the City of Cheyenne’s BOPU of $61,000 per year, which works out to be an increase of $2.66 per equivalent 3/4 inch tap per year.

PHASE II FINAL CONCLUSIONS AND RECOMMENDATIONS
Based on the results of the work completed for Phase II the following conclusions and recommendations are provided:

1. Final design and rehabilitation efforts should proceed within the next two years to prolong the life and stabilize the structure and preserve the City’s diversion water rights.

2. The new dam alternative will only be economical if out-of-basin water can be imported and stored. The watershed annual runoff is already fully allocated and no new water for storage is available.

3. The recommended rehabilitation alternative for the diversion structure is a downstream concrete overlay.

4. The recommended rehabilitation alternative for the pipeline is addition of air release and blowoff valves in identified locations.

5. The recommended rehabilitation for the valve house includes removal of part of the old valve house structure, addition of new valves and motorized operators, and a new SCADA system.

6. An easement for construction access and future operation will be required. It is recommended that the City begin negotiations with landowners as soon as possible to secure this access.