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EXECUTIVE SUMMARY HAWK SPRINGS LEVEL II MASTER PLAN STUDY

Prepared For The

WYOMING WATER DEVELOPMENT COMMISSION

And The

HORSE CREEK CONSERVATION DISTRICT

Prepared By:

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IN ASSOCIATION WITH

ANDERSON CONSULTING ENGINEERS

HDR ENGINEERING INC.







• ENGINEER'S CERTIFICATE •

I have prepared or directly supervised the preparation of these reports and that I am a duly registered Professional Engineer and Land Surveyor in the State of Wyoming.

Bruce H. Perryman, P.E., P.L.S. Wyoming P.E., P.L.S. No. 5488



Report Summary by Task

Introduction

On June 7, 2012, AVI Professional Corporation (AVI) entered into a contract with the Wyoming Water Development Commission (WWDC) to provide professional services in conjunction with a Level II Master Plan Study for the Horse Creek Conservation District (HCCD). The purpose of the Study was to update the previous master plan, perform a bathymetric survey of Hawk Springs Reservoir, create a contour map of the reservoir bottom, determine sediment accumulation, develop a present day area capacity table, inventory/evaluate the District's infrastructure, and prepare a reservoir operations model.

The Consulting Team for this project included AVI, Anderson Consulting Engineers (ACE) and HDR Engineering (HDR).

AVI was responsible for overall project management, review of existing information, the bathymetric survey, prioritization of recommendations, project financing, and project reports. ACE completed the system inventory, the reservoir operations model, review of system operations, and concept designs and cost estimates. ACE also assisted with recommendations and project financing opportunities.

HDR had lead responsibility for review of water rights and provided valuable support in other tasks especially the reservoir operations model, coordination with staff of the State Engineer's Office, record review, and editing of the project report.

Task 1.Scoping and Project Meetings

A scoping meeting to familiarize the Project Sponsor with the Scope of the project and to allow an opportunity to provide input to the study process was was held on August 9, 2012. A second meeting with the Horse Creek Irrigation District Board of Commissioners was held in the HCCD office on January 24, 2013 to present the results of AVI's bathymetric survey and ACE's inventory of the District's conveyance system. A meeting to review the draft report was held in the Hawk Springs Community Center on August 7, 2013.

Task 2.Review of Existing Information

The project team researched multiple sources of information to compile existing data relating to Hawk Springs Reservoir, Sinnard Reservoir, and the HCCD conveyance system. The reservoir has a long history beginning with construction in the early 1900s.

Hawk Springs Reservoir has two storage water right priorities: May 25, 1908 and October 13, 1913.

Fifteen significant documents were located and are summarized in the main report. The bulk of existing information addresses activities associated with financing improvements to the dam and other system components. Several reports document disputes over access to the reservoir and surrounding lands owned by the HCCD. While some of the information in this section of the main report is not directly related to a Master Plan for the reservoir and conveyance system, it consolidates and summarizes information which may assist in understanding the complex issues affecting system operation and management.

Task 3. Inventory, Evaluate, and Map Existing System

Hawk Springs Reservoir is an off-channel irrigation storage facility receiving water from Horse Creek through the Hawk Springs Reservoir Ditch. When water is available and the District is in priority, the diversion generally takes the entire flow of Horse Creek just below the Spy Ditch diversion. Reservoir storage normally occurs outside the irrigation season. In the irrigation season, up-stream competing direct diversion senior rights take all available water. Approximately 99 irrigators receive water for 10,180 permitted acres. In water short years, the reservoir does not deliver a full supply of one acre foot per acre to all permitted acres.

The main canal below Hawk Springs Reservoir is 32 miles in length. Water is diverted into Sinnard Reservoir for re-regulation and to supply the Sinnard Ditch.

ACE had lead responsibility for the baseline inventory and evaluation of the system, including assessing and mapping the main delivery canals, selected laterals, and Sinnard Reservoir. The inventory was performed in two phases:

- Phase 1: Initial field inventory conducted during the irrigation season
- Phase 2: Detailed field inventory conducted during the non-irrigation season.

The HCCD conveyance system was field inventoried by ACE staff during the spring and summer of 2012. Crews drove the entire length of the principal canals (Upper and Lower Hawk Springs Ditches, Sinnard Ditch) from the point of diversion to the last farm turnout or wasteway. Selected locations along the lateral ditches were also inventoried with direction provided by representatives of the HCCD. The main dams at Hawk Springs and the Sinnard dam were inspected and found to be in good condition.

ACE developed a Geographic Information System (GIS) incorporating data collected and generated during this project. The GIS was created in the ArcView 10.1 environment. All spatial data in the GIS are within a single geodatabase, consequently, it is an entirely self-contained and stand-alone product not reliant upon online resources or external data servers. In addition to the results of the field inventory, additional pertinent data has also been incorporated to provide a more comprehensive geodatabase (for example public land survey system, soils mapping, etc.). Background layers including color aerial photography (2012), color infra-red photography (2012) and USGS topographic mapping were incorporated into the GIS.

A total of 116 structures and features were inventoried and evaluated during this phase of the project. For every structure inventoried, field crews assigned an overall condition ranging from "failing" to "good" based on functionality, operating conditions, and structural integrity.

Seepage losses were evaluated during the field inventory and recorded within the GIS environment. In the field, crews noted the presence and vigor of vegetation adjacent to ditches and laterals, standing water, or other indicators of the presence of water. In the GIS environment, analysts scanned color infrared photography looking for similar indicators. In general, seepage losses within the HCCD appear to be low to moderate with the exception of two sites. Field observations at these locations confirmed that seepage could be high or severe.

Due to the extensive structure replacement and rehabilitation needs identified during the 2012-2013 inventories, a means of prioritization was required. A database was generated from the GIS which incorporated data for every structure evaluated during the inventory phase of the project. Data include:

- Overall condition,
- Number of individual farm turnouts dependent upon the structure, and
- Type of structure.

Based on the evaluation criteria, a prioritized list of improvements and upgrades to system infrastructure was developed and is itemized in the full report.

Task 4. Bathymetric Survey

AVI was tasked to "complete a new bathymetric survey of the Hawk Springs Reservoir to determine the capacity of the minimum pool, detailing existing conditions, accurately determining total volume, and using specialized equipment required in accordance with industry standards."

AVI determined that survey requirements could be best met by conducting both a bathymetric survey below the water line (on December 17 and 18, 2012), and an extensive ground survey encompassing the area between the Normal High Water Line (NHWL) and the high water line existing in December 2012. Acquisition of this survey data provided information necessary to create a contour map of the reservoir bottom and develop an accurate present-day storage capacity curve at all water levels.

AVI conducted the bathymetric survey of the reservoir using Trimble sounding and data logging equipment. Standard ground survey techniques were used to record data above the area covered by the bathymetric survey. The combined ground and bathymetric survey consisted of 44,580 individual topographic observations resulted in a high level of confidence in the results A map of the existing reservoir bottom contours on one-foot intervals was created from the recorded low point at the outlet works at Dam #1 to the historical high water line as determined by debris accumulation.

Based on AVI's computations, the conservation pool has lost 866.96 acre feet of capacity, a reduction of 49%. No bathymetric survey or any other attempt to estimate or quantify sediment deposition was made during 1983 project planning when the conservation pool was established.

Reservoir capacity at NHWL has been reduced by a total 1,039.18 acre feet, a reduction of 6%. The 1983 reservoir capacity table records 14,956 acre feet available for irrigation (16,735 acre feet of storage at NHWL minus 1,779 acre feet for the minimum recreation pool).

The 2012 reservoir capacity table documents 14,783.78 acre feet available for irrigation (15,695.82 acre feet capacity at NHWL minus 912.04 acre feet in the State's minimum pool). The irrigation storage account has decreased by 172.22 acre feet, representing a 1.15% loss of capacity for the HCCD.

Task 5.Reservoir Operations Model

This project included the development of an operations model of Hawk Springs Reservoir. The purpose of the modeling effort is to provide a tool to assist in planning, evaluation, management and operation of the reservoir. Specifically, the model is intended to provide insight into the water supply and demand requirements associated with the Horse Creek Conservation District.

The model represents a starting point for further enhancements associated with future data collection programs. The reservoir simulation model should be considered a dynamic tool that can be improved through acquisition and integration of additional data thereby increasing the value and benefit of the model.

Several reservoir simulation models are available to meet the objectives of the project. Based on input provided by the WWDO, the US Army Corps of Engineers HEC-ResSim program was used to develop the operations model for Hawk Springs Reservoir. Simplistically, the model performs a water balance simulation utilizing time series data as input. The water balance focuses on the following items:Inflows

- Evaporation losses
- Seepage losses
- Rainfall
- Spills
- Releases

The model represents theoretical conditions and operations. HCCD may choose to operate the reservoir differently in real time. Anecdotal information indicates the District has done so in the past.

Task 6.Evaluate System Operations

An evaluation of management and operation of the irrigation system was completed to determine if procedural changes would benefit the HCCD. Recommendations from the evaluation were derived from the field inventory, inspection of existing facilities, conversations with the HCCD ditch riders, and results of the reservoir simulation modeling.

The efficiency of the irrigation conveyance system can be related to seepage losses, operational waste, and evaporation losses within the canal system. Seepage losses typically range from as low as 10% to over 20% along the main canal and lateral ditches associated with irrigation districts of similar size. Based on information in previous studies, the HCCD reported seepage losses exceeding 30% in small lateral ditches.

The District has made improvements to reduce seepage along the main delivery ditches and the laterals. However, a location where significant seepage was been documented still exists. In this area on the Hawk Springs Lower Ditch, a previous report (Lidstone & Anderson, 1998) documented as much as 4.5 cfs in seepage losses. This amounts to more than 1,300 acre-feet per year, approximately 10% of the average annual releases from Hawk Springs Reservoir.

Given the magnitude of these losses, the following improvements to the delivery system are recommended for consideration:

- In the area where the seepage losses in the Lower Hawk Springs Ditch are estimated to be 4.5 cfs, a siphon can be installed to mitigate these losses. Pertinent design and cost information is provided in Chapter 9.
- Efficiencies in system operation could be achieved through automation of the existing facilities. Automation of existing facilities should include the following:
 - Releases from Hawk Springs Reservoir and Sinnard Reservoir (The State Engineer's Office has recently installed upgraded measurement and monitoring devices to collect real-time data on stage, storage and releases from Hawk Springs Reservoir).
 - Installation and automation of measurement structures at the end of the main irrigation ditches and each major lateral.
 - Automation of the measurement structures along the main irrigation ditches and the major laterals.
 - Installation of a base station at the HCCD office with remote access to each automated facility through a radio telemetry system.

While system operation can result in more efficient operation, there are also advantages to the current HCCD practice of using on the ground ditch riders to manage water delivery.

Task 7.Review of Water Rights

HDR performed the analysis of HCCD's water rights. HDR reviewed Wyoming State Engineer's Office records including certificates of appropriation, permits, applications, and HCCD petitions as well as previous reports and SEO data relating to the operation of Hawk Springs Reservoir. HDR's review included the inundated spring water rights held by the Lincoln Land Company.

Hawk Springs Reservoir is an off-channel reservoir in the Horse Creek basin with a total permitted capacity of 16,735 acre feet. The Reservoir has two storage water right priorities of May 25, 1908 and October 13, 1913.

According to SEO E-Permit System, the Hawk Springs Ditch under Permit No. 8514 is a combined direct flow (141.86 cfs) water right with a priority of July 18, 1908 and secondary supply (for storage from Hawk Springs Reservoir) water right with priority dates of May 25, 1908 and October 13, 1913 delivering water to 99 individual appropriators on 10,018.4 acres of land. An enlargement of the Hawk Spring Ditch secondary supply, Permit No. 4585 Enl., delivers water to two appropriators on 282 acres of land.

HCCD also holds eight groundwater permits with priority dates between 1965 and 1969 that provided additional water to Hawk Springs Reservoir when the wells were operated in the 1970s. Six other approved permits held by HCCD were cancelled according to a recent update in the SEO records. The permits for the eight wells remain valid although the wells have been idle for many years due to the conflicts with other groundwater appropriators located to the south and southeast of the HCCD well field.

Sinnard Reservoir holds a storage water right priority of February 11, 1920 for 1,358 acre feet. Sinnard Reservoir operates primarily as re-regulation facility for irrigation water deliveries released from HSR. The facility allows HCCD to move storage water from Hawk Springs Reservoir to Sinnard Reservoir to better serve irrigated lands held by HCCD members.

In addition, HCCD holds Permit No. 16076 for the Sinnard Lateral Ditch, an October 4, 1920 priority water right diverting from Sinnard Draw as the water source. This water right is for 5.22 cfs delivering water to 365.3 acres of original direct flow.

The construction of Hawk Springs Reservoir inundated various springs serving as the water source to an irrigation use Permit No. 482 with a priority of September 1, 1895.

This spring water right had an adjudicated quantity of 8.57 c.f.s. serving 600.0 irrigated acres. At the time of reservoir construction, a Memorandum of Agreement (MOA) was executed between Lincoln Land Company and Hawk Springs Development Company guaranteeing delivery of 8.57 cfs all times during the irrigation season.

Over time, abandonments have reduced this water right to 559 acres and 7.99 cfs. At the time of the 1980s reservoir rehabilitation project, the outlet serving the spring water right was replaced and a closed pipe conveyance installed at downstream toe of the dam connecting the new reservoir outlet to the existing spring water right ditch.

Task 8.Prioritization of Recommendations

This section was prepared assuming the following areas of potential activity by the HCCD and/or the State of Wyoming:

- <u>Improvements to existing infrastructure</u>. The inventory described in Task 3 developed a prioritization matrix for repair or replacement of various canal structures based on overall condition, the relative importance of the structure to system function, and the service area (number of acres served by the structure). Refer to Task 3 in the main report for an explanation of how structures were evaluated and to Appendix A in the main report for the list of all 116 structures in order of priority for repair or replacement.
- <u>Restoration of storage capacity</u> lost to sediment accumulation. Refer to Task 4 Bathymetric Survey for detailed information on changes to storage capacity. Note that the HCCD irrigation pool has lost 172 acre feet or about 1.15% of the District's permitted capacity of 14,783 acre feet. However, the State's conservation pool has lost almost half of the capacity described in SEO Permit No. 2568R, a decline from the 1,779 acre feet in that permit to 912 acre feet confirmed by AVI surveys.
- <u>Operational improvements</u> to reduce labor costs and inefficiencies for the District.

Improvements to existing infrastructure

In addition to the 116 individual existing structures evaluated and prioritized in Task 3, ACE developed conceptual plans and cost estimates for a siphon to mitigate seepage losses associated with the Lower Hawk Springs Ditch in Sections 30 and 31, Township 22 North, Range 62 West. HCCD identified this reach of the ditch as a source of significant conveyance loss in the delivery system. The ACE inventory confirmed significant seepage in the reach of ditch that would be replaced by a siphon.

Restoration of Storage Capacity

As noted in Task 4 Bathymetric Survey, both the District's storage and the State's recreation pool have been impacted by sediment accumulation. There are several options to restore respective storage capacities.

Enlargement of the Reservoir

One alternative is an enlargement of the reservoir. The potential for a vertical enlargement was evaluated in a 1992 report by Banner Associates of Laramie for the Water Development Commission. (Refer to Task 2 of the main report for details.)

While existing dam embankments could be modified to allow an enlargement, construction costs and mitigation of impacts to public and private property make enlarging the reservoir cost-prohibitive. In addition, any increase in storage capacity would require review and approval under the Platte River Recovery Implementation Program.

Dredging

Physical removal of accumulated sediment by dredging was evaluated. Recovery of the total 1,039 acre feet lost to sedimentation would require removal of approximately 1,676,000 cubic yards of material. In March of 2011, ACE bid a project involving dewatering and dredging 170,000 cubic yards of material. The cost per yard was \$10.50. This amount did not include mobilization, erosion control, field office, traffic control, or disposal of dredged material.

A reasonable estimate of current cost with other bid items included and escalated to a 2014 construction date is \$15.00 per cubic yard. The cost to recover the entire 1,039 acre feet of lost storage is roughly \$25 million dollars, cost prohibitive given the limited benefit.

Conventional Earthwork below the High Water Line

Reservoir capacity could be increased using conventional earth moving equipment to remove material below the existing high water line. However, removal of an equivalent amount of material – 1,676,000 cubic yards – would be required to restore lost storage capacity. Assuming that the reservoir bottom was dry enough to allow the use of dozers and scrapers, and that material could be stockpiled on HCCD property immediately adjacent to the reservoir, costs would be significantly lower than dredging. Costs could

still be on the order of \$2.50 to \$5.00 per cubic yard if the material were handled only once. Recovery of the entire amount of lost storage is unlikely with this method as the reservoir bottom has been saturated in cycles for almost 100 years and might never be dry enough for this method to work. Recovery of 500 acre feet of storage would require the removal of over 800,000 cubic yards at a cost of \$2 to \$4 million. No determination was made as to whether or not disturbing of the existing reservoir bottom could result in increased seepages losses to the underlying ground water.

System Operational Improvements

During the inventory and evaluation of the District's physical infrastructure conducted as part of Task 3 requirements, ACE identified operational changes that could result in increased efficiency and reduced costs to the HCCD.

Recommendations included improvements to water measurement devices, upgrades to record management, use of available data collected at Hawk Springs Reservoir by the SEO, and the automation of some system components.

Refer to Task 6 of the main report for details of the evaluation of system operations.

Task 9.Conceptual Level Designs and Cost Estimates

Conceptual drawings and detailed cost estimates were prepared for all structures recommended for replacement (see Appendix G of the main report for the conceptual drawings and cost estimates). For structures where rehabilitation is suggested instead of replacement, general cost estimates were tabulated. Cost estimates were grouped according to classification (poor or failing) and cost estimates developed according to WWDO guidelines. Refer to exhibits in Task 9 of the main report.

Task 10.Project Financing

This section of the main report contains information on the financial status of the HCCD including assessed acreage, budget information, current debt with terms, itemized debt payments, and reserve funds.

Potential sources of grants and loans for system improvements were investigated. While a number of funding sources were identified and discussed in the main report, the District Board expressed reluctance to incur additional debt above its current obligations. Debt service is by far the largest expense for the District, averaging over 40% of annual expenditures.

Task 11.WWDC Discretionary Task

The WWDC Discretionary task is intended to accommodate changes in the scope as the project develops or as new issues are discovered. Funds were transferred to Task 4 when difficulties were encountered in completing the bathymetric survey with the available task budget.

Task 12.Project Reports

The draft report was prepared in the format specified in the project contract and delivered to the WWDO project manager.

Review copies of the draft report were provided to the Project Sponsor.

Comments from HCCD and WWDO reviewers were incorporated into the final report which was delivered to WWDO along with the required electronic submittals, executive summary, and project notebook.

Task 13.Report Presentations

The Consulting Team and representatives of WWDO held a public meeting at the Hawk Springs Community Center on August 7, 2013 to present the results of the study, answer questions, and receive comments.