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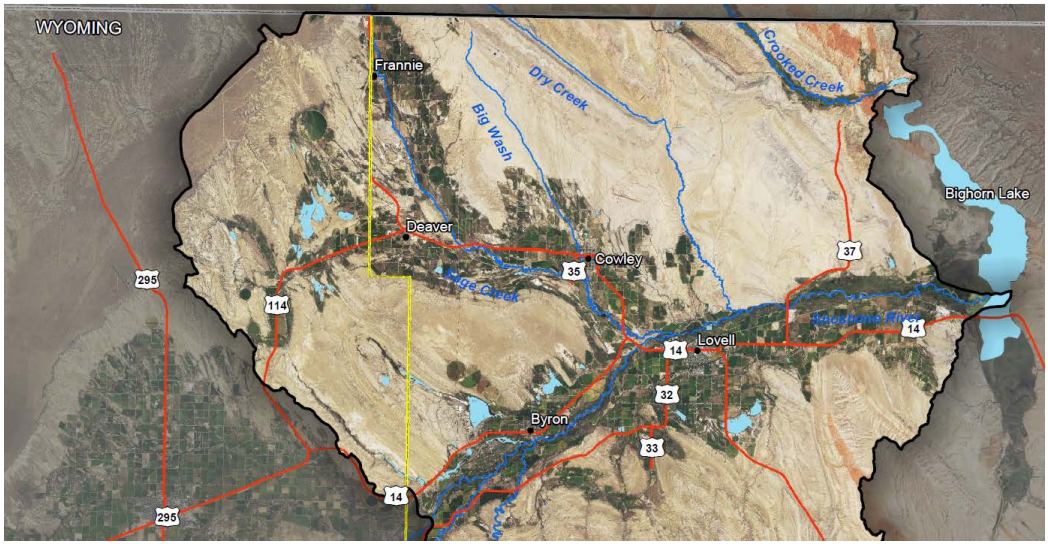
# LOWER SHOSHONE RIVER LEVEL I WATERSHED STUDY
# EXECUTIVE SUMMARY




MARCH 11, 2022

**PREPARED FOR:**
WYOMING WATER DEVELOPMENT COMMISSION
SHOSHONE CONSERVATION DISTRICT

**PREPARED BY:**
BIOTA RESEARCH AND CONSULTING, INC.

**IN ASSOCIATION WITH:**
SUNRISE ENGINEERING, INC.

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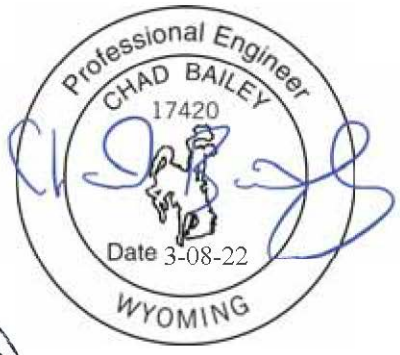


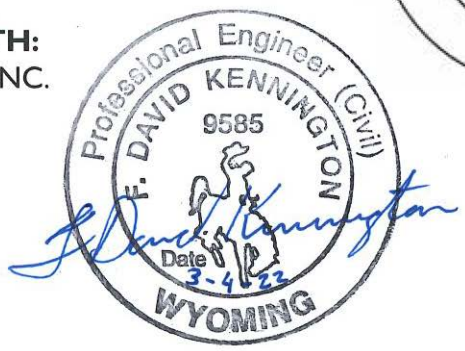


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MARCH 11, 2022

# TABLE OF CONTENTS



# FIGURES



# TABLES

# 1.0 INTRODUCTION

This Level I watershed study was prepared for the Wyoming Water Development Commission (WWDC). The watershed plan was sponsored by the Shoshone Conservation District (SCD) and developed for the use by landowners, land managers, and stakeholders in the Lower Shoshone River watershed. The study was completed by Biota Research and Consulting, Inc. (Biota) and Sunrise Engineering, Inc. (Sunrise). The final report and project deliverables contain a wealth of resources including 34 figures, 20 photographs, 57 tables of data, 39 maps, a digital bibliography, and a GIS geodatabase that is hyperlinked to project design plans (i.e., project description, design drawings, and cost estimates).

The Shoshone River Watershed (HUC 10080014) covers an area of 944,835 acres located in Big Horn and Park Counties, Wyoming, and Carbon County, Montana. The Lower Shoshone River watershed Study Area covers an area of 406,133 acres primarily in the lower portion of the Shoshone River Watershed in Big Horn and Park Counties, Wyoming (Figure 1). The project area also includes the lower portion of the Crooked Creek drainage in the Big Horn Lake Watershed (HUC 10080010). The Shoshone Conservation District and the Powell Clarks-Fork Conservation District are within the Study Area. The major Shoshone River tributaries included in the Study Area are Whistle Creek, Coon Creek, Sage Creek, Big Wash, Dry Creek, and Crooked Creek. The communities of Byron, Lovell, Cowley, Deaver, and Frannie are all within the Study Area.

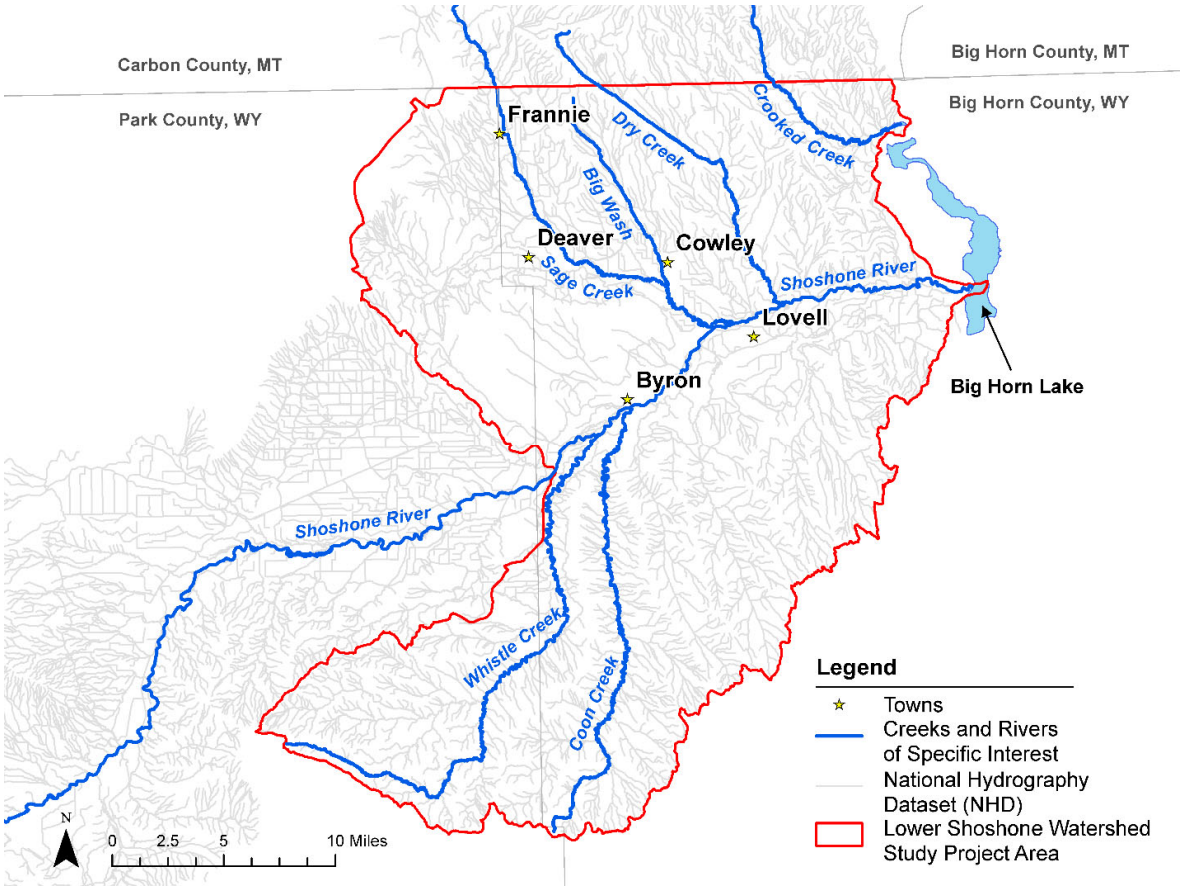


Figure 1. Lower Shoshone River Level I Watershed Study Project Area.

## 1.1 Purpose and Scope

The purpose of this Level I watershed study and rehabilitation plan is to describe the Lower Shoshone River watershed current conditions and identify resolutions for water-related issues that provide opportunities for improvements.

Specific objectives of the project include the following:

1. Conduct an evaluation and description of the watershed, including quantity and quality of surface water resources, and riparian/upland conditions.
2. Conduct an evaluation of water storage needs and opportunities to augment upland water available for livestock and wildlife.
3. Conduct an irrigation system inventory and develop a rehabilitation plan for those ditches expressing an interest to participate.
4. Promote public participation in the study.
5. Facilitate participation and consensus building with the landowners and the public at large, the SCD, and the WWDC.
6. Identify natural resource issues within the watershed and propose practical economic solutions.
7. Identify permits, easements and clearances necessary for plan implementation.
8. Develop a watershed management and rehabilitation plan describing potential projects and management strategies to address water resource related issues.
9. Develop conceptual-level cost estimates for potential projects identified in the watershed management and rehabilitation plan.
10. Compile spatial data, relevant reports, and collected data into a comprehensive digital library (bibliography with linked pdfs) and geodatabase to be available as a resource for project sponsors, stakeholders, and future studies.
11. Conduct a geomorphic assessment of primary tributary channels within the watershed and identify potential mitigation measures to improve impaired reaches.

A primary focus of the Lower Shoshone River Watershed Study was the identification of potential projects and the development of a final report that is clear, concise, and accessible, for all anticipated users.

# 2.0 WATERSHED DESCRIPTIONS AND INVENTORY

A Level I watershed study includes both a description of the natural environmental and inventory of water development. The information included in the watershed description spans a wide variety of topic areas including hydrology, water quality, wetlands, wildlife, land use, climate, geology, soils, agricultural practices, and others. The watershed description and inventory is broadly grouped into three categories: 1) Physical Systems; 2) Biological Systems; and 3) Anthropogenic Systems.

The physical systems of the Study Area are associated with surface water, geomorphology, groundwater, and geology. The Study Area physical systems inventory and descriptions were focused on characterizing watershed existing conditions, function, and identifying impairments. The biological systems in the Study Area include various upland, wetland, and aquatic species. Wildlife in Wyoming are managed by the Wyoming Game and Fish Department (WGFD), which uses the State Wildlife Action Plan (SWAP) to provide strategies for managing the ecosystems and

wildlife groups present in Wyoming. The anthropogenic systems section of the report describes those systems affected by or resulting from human activity. The specific anthropogenic systems described are associated with agricultural water use, domestic water use, water storage, and land management. Each category has been evaluated as it relates to the impact of human activity on the relative physical and biological systems within the Study Area.

# 3.0 WATERSHED MANAGEMENT, DEVELOPMENT, AND REHABILITATION PLAN

An objective of the watershed study was to develop a feasible watershed management plan using recommendations of landowners and lessees. The investigative phase of this study focused on an assessment of the key issues in the watershed, and the identification and evaluation of opportunities to address identified watershed issues.

## 3.1 Key Issues in the Watershed

Key issues in the Lower Shoshone River watershed include water quality concerns, including *E. Coli* and sediment-related impacts. Substantial sediment sources in the Study Area are derived from naturally erosive soils, upland soil disturbance from land management on both private and BLM-administered lands, Shoshone River bank erosion, tributary erosion as a result of irrigation return flows, road and trail erosion, and post-fire erosion, among others. Property loss due to Shoshone River channel migration through bank erosion was identified as a key issue for landowners.

A well-recognized sediment source for the Lower Shoshone River is related to the ongoing operation and maintenance of the Willwood Dam. Large sediment releases and associated fish kills (and aquatic habitat loss) during a Willwood Dam malfunction in 2007 and maintenance operations in 2016 prompted an inter-agency effort to evaluate potential options for improving operation and maintenance of the dam. Project partners include DEQ, WGFD, WWDO, the U.S. Bureau of Reclamation (USBR), SEO, and other partners. The ongoing efforts of the three working groups are documented in a series of reports, online ArcGIS Story Maps, and project summary updates.

A noticeable irrigation practice that accentuates the sediment-related impacts to the Lower Shoshone River is the practice of over allocating water to diversions and canals, and then spilling that excess water into ephemeral draws or streams. Historically those draws were not situated to contain these flows, which has resulted in degradation and headcutting within those drainages. In many instances, those spill locations have resulted in severe headcuts back to erosive resistant bedrock, creating a waterfall and plunging flows. Those spills continue to destabilize channel beds and banks introducing erosive forces to the fine-grained soil channel banks and undersized bed sediment, which is then transported downstream to the mainstem river. The magnitude and duration of these practices should be reevaluated to alleviate the erosive conditions and production of sediment to downstream receiving waters.

The following list summarizes the recurring key issues identified in the agency meetings, public meetings, and site visits.

- Restore aquatic life and habitat damaged due to the release of accumulated sediment from the Willwood Dam reservoir into the Shoshone River
- Reduce and/or eliminate future need to release accumulated sediment from the dam in amounts and of duration that are harmful to aquatic life and the aquatic and riparian habitats downstream of the dam.
- Support the ongoing survey, monitoring, and data analysis efforts of the three Willwood Dam working groups.
- Support land use management improvements on federal and private lands that reduce sediment inputs and improve aquatic and riparian habitat conditions.
- Continue to address water quality impairments through the DEQ Water Quality Department (WQD) administration of the Clean Water Act (CWA) regulations.
- Develop a comprehensive Geographic Information System (GIS) dataset to be accessible by all stakeholders working in the area.
- Identify opportunities for water conservation, reuse, and recycling.
- Planning for future growth to properly manage and allocate water resources.
- Consider non-consumptive and aesthetic water uses and needs in planning.
- Irrigation water management and optimization is needed to improve the conveyance, use, distribution, and application of irrigation water in a more beneficial and efficient process.
- Irrigation districts and drainage districts communication is necessary to operate the irrigation supply and drainage in a more holistic manner.
- Stream stabilization is needed in specific areas to protect irrigation infrastructure and production land.
- There are irrigation improvements needed to minimize sedimentation to streams and irrigation infrastructure, reduce irrigation water supply loss, and enhance water quality.
- Use of canal spills or overflows should be minimized to reduce impacts to historically ephemeral drainages and draws to reduce scour and sedimentation in downstream drainages.
- Identify and pursue water storage opportunities to improve the reliability of existing late season water supplies for livestock watering and grazing improvements.
- Use of pipes and drains to minimize sub water and canal seepage with associated evaporation and salt accumulation.

## 3.2 Overview of Project Opportunities

Potential projects identified during the study were organized into the six general categories described below and shown on Figure 2.

The **Irrigation and Drainage System Improvements and Rehabilitation** category includes drainage improvements, ditch conversions, pipeline projects, sprinklers, canal lining, drain piping, and diversion improvements. The **Water Storage Opportunities** category includes small surface water storage and silt dam projects. The **Upland Wildlife/Livestock Water Developments**

category includes well and spring projects, wetland development, winter water holding ponds, and livestock pipeline projects. The **Stream Channel Restoration** category includes bank stabilization and channel crossing projects. The **Wetland Development and Enhancement** category includes a project to improve wetland crossing mitigation and habitat enhancement. The **Hydroelectric Power Generation** category included two suggested generation projects on canal siphons but were determined to not be feasible based on-site constraints. In addition, hydroelectric projects are not eligible for WWDC project funding.

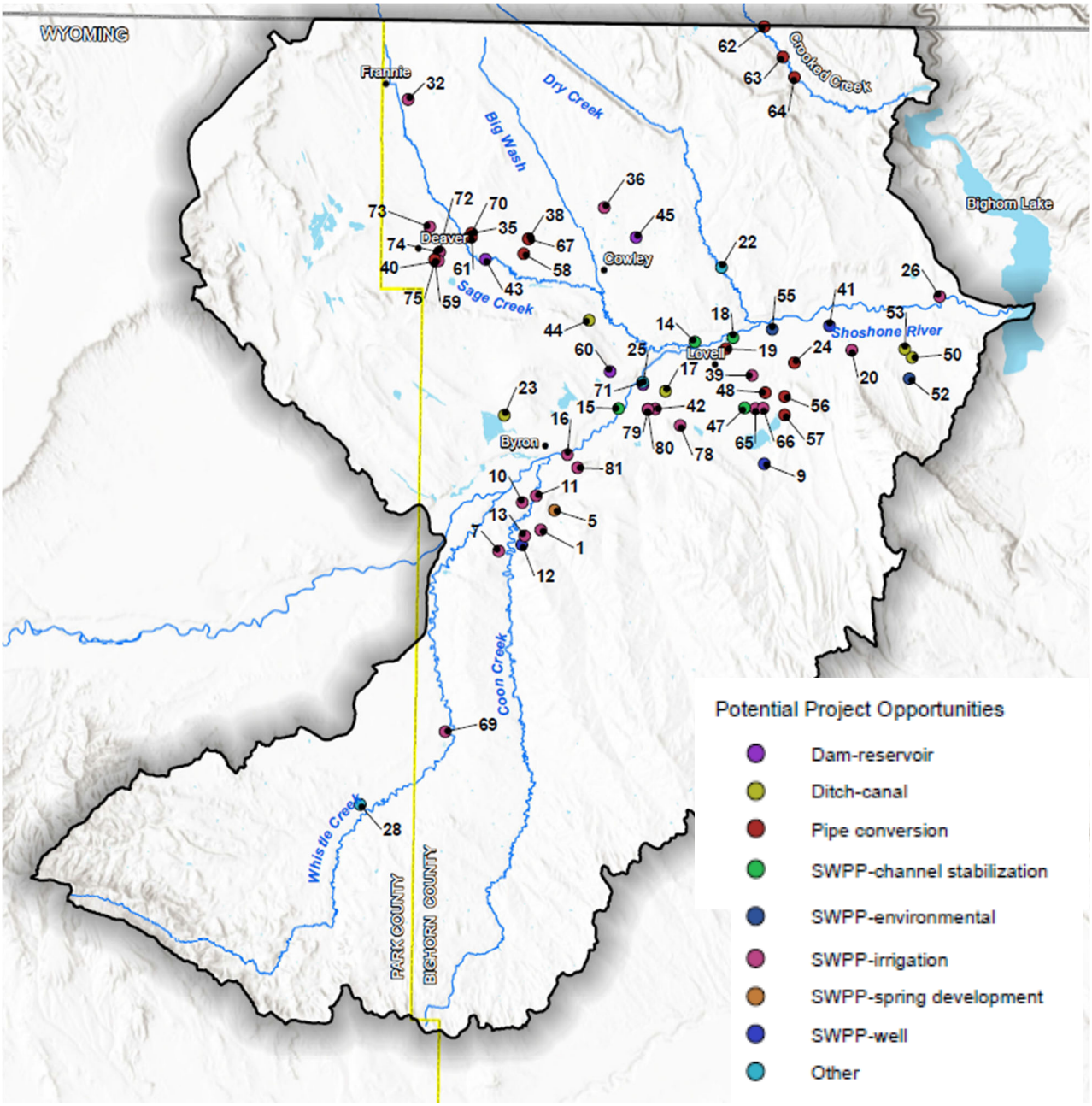


Figure 2. Map of potential projects by type in the Lower Shoshone River Level I Watershed Study Project Area.

Prioritization ranking criteria defined by Biota and WWDC were used in the ranking of potential projects. Project stakeholders can use the information developed for their respective projects to investigate funding opportunities and project advancement. The project summaries also designate a public sponsor and project details for each project. Potential projects that were not developed in detail due to feasibility concerns or a lack of information are also identified in the prioritization matrix.

Table 1. Number of projects by rank for each of the project type categories.

| Project Type | Number of Projects by Rank | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| Dam-reservoir | 1 | 1 | | 1 | 1 | | | | | | **4** |
| Ditch-canal | 3 | 1 | | 1 | 1 | | | | | | **6** |
| Pipe conversion | 3 | 2 | 2 | 4 | 3 | | | | | | **14** |
| SWPP-channel stabilization | | 1 | 3 | 1 | | | | | | | **5** |
| SWPP-environmental | | | 1 | | | | 1 | | | | **2** |
| SWPP-irrigation | 1 | 1 | 4 | 11 | 4 | | 4 | 1 | 2 | 1 | **29** |
| SWPP-spring development | | | 1 | | | | | | | | **1** |
| SWPP-well | 1 | 1 | 1 | | | | | | | | **3** |
| Other-stock water, grazing | | | | 1 | | 1 | | 1 | | | **3** |
| **Total** | **9** | **7** | **12** | **19** | **9** | **1** | **5** | **2** | **2** | **1** | **67** |

## 4.0 CONCLUSIONS AND RECOMMENDATIONS

Proposed water development projects will have multiple benefits in most instances. Increased irrigation efficiency can result in less water loss through infiltration and over supply due to flood irrigation. The higher efficiency can result in less water being diverted from the Shoshone River and less irrigation return water induced erosion within the tributaries. These projects could result in the protection of future streamflow and water availability for irrigation, grazing, wildlife, and supply to the Bighorn Lake and Yellowtail Wildlife Management Area, as well as increased groundwater recharge. Projects increasing bank stability would benefit water quality and fisheries health through the reduction of sediment input, improved bank shading for reduced water temperature and improved fisheries cover, and potential reduction of bar development producing additional channel migration and bank erosion downstream. Wetland enhancement could improve habitat and increase overbank water filtration, improving instream water quality. Projects reducing surface evaporation from the soil could reduce deposition of salts and improve land quality. Some projects may have negative effects to rivers and wetlands if implemented, such as reducing irrigation water quantity through the use of sprinklers may reduce the amount of water supporting anthropogenic wetlands in drains and other man-made depressions. It is crucial to consider and evaluate all potential effects to the watershed health, both negative and positive, for these projects prior to pursuing funding and implementation. Specific project recommendations are summarized below.

- **Irrigation and Drainage System Improvements and Rehabilitation:** The irrigation improvement opportunities focus on increasing irrigation coverage on fallow areas, more efficient use of the watershed's water resources, and reduce sediment impacts generated with over application of water to fields and canals. A common discussion with landowners and stakeholders was the need for more efficient irrigation to reduce the need to spill excess water from canals, reduce saturation of erosive soils, reduce salination of soils caused by over application and evaporation of flooded crops and pastures, and eliminate the need to drain fields to reduce stagnant waters that support mosquitos and other pests. In many instances, producers could convert irrigation systems from flood irrigation (e.g. gated pipe) to a low head sprinkler system (e.g. center pivot), but the capital costs for the conversion were typically beyond the economic means of the producers. A watershed wide effort should be developed to improve the economic viability to introduce these conversions that allow the producers to improve their production and reduce impacts to the watershed. In summary, specific recommendations include converting dirt ditches to gated pipe, installing pipelines, improving diversion structures, improving drainage, canal lining, and improving irrigation systems (e.g., pivot sprinklers) to increase efficiency. A total of 48 potential irrigation and drainage systems improvement and rehabilitation projects were identified ranging in estimated cost from $10,528 to $2,875,848.
- **Water Storage Opportunities:** The water storage improvement opportunities focus on improving upland water storage for winter or off-season grazing support for cattle and other livestock and settling ponds to remove sediment prior to flowing downstream to irrigation infrastructure. Existing upland BLM reservoirs were suggested for rehabilitation, but no specific projects were identified. There appears to be numerous relict reservoirs on the upland BLM land south of Lovell that could be rehabilitated to collect and store seasonal runoff to be applied during the drier times of the year or to support grazing leases on the public land. Specific recommendations include piping existing water rights to uplands for winter watering and rehabilitation of existing reservoirs. No large-scale reservoir projects were identified by project stakeholders. Many stakeholders discussed that the existing Buffalo Bill reservoir has sufficient storage capacity to provide their irrigation needs. A total of 4 potential water storage projects were identified ranging in cost from $82,159 to $874,076.
- **Livestock/Wildlife Upland Water Development Opportunities:**
  The upland water storage improvement opportunities focus on projects discussed above. A total of 5 potential upland water development projects were identified ranging in cost from $33,101 to $614,829.
- **Stream Channel Restoration:**
  The stream channel restoration opportunities focus on stabilizing several highly erodible banks, reducing sediment input, protecting important irrigation infrastructure and production areas, and improving shading and habitat for fish and aquatic species. Specific recommendations include installing non-erodible toe protection, bio-engineered bank

protection, and creation of a bankfull bench to improve floodplain function and reduce near bank shear stress. A total of 4 potential channel stabilization projects were identified ranging in cost from $36,308 to $332,904.

- **Wetland Development and Enhancement:**
  One potential wetland project was identified. The focus of the wetland development and enhancement opportunity is on installing a cattle crossing on an existing wetland to reduce routine impacts and pocket excavation to improve deeper water habitat for waterfowl and other species. Specific recommendations include removal of monoculture cattails through excavation to produce pocket water habitat to create diversified hemi-marsh habitat. The estimated cost of for the potential wetland project is $34,000.
- **Hydroelectric Power Generation:**
  Hydropower benefits are very limited for most of the small reservoirs present and identified in this study. Sites with elevated canals offer hydro potential (without a reservoir) by dropping the water to a lower elevation. Unfortunately, this drop also reduces the ability to use the water for irrigation at elevations above the hydro plant. Locations such as siphons can produce power however the water will be unable to rise back to the outlet of the siphon and must be used at lower elevations. In the case of the Deaver Canal and Lovell Canal there are potential sites where the canal is elevated and hydro potential exists. Capital cost is the primary hurdle for any hydropower project. For budgetary purposes costs run about $5million per MW. A 0.36 MW unit, which is the anticipated size of a project in one of the canals, would cost about $1.8 million or about $157,000 per year based on 6% for 20 years. The power production based on 10 months or 300 days of annual operation would be about 2,073 MWh equivalent to $103,650 per year at $0.05 per kWh. When O&M costs are accounted for the feasibility is further diminished. No projects were further developed for this study due to the high capital cost and minimal economic feasibility.
- **Range and Grazing Management:** Range and grazing management opportunities in the watershed include the development or rehabilitation of upland water developments, fencing, mineral block placement, and invasive species management. Water developments and invasive species management are discussed in dedicated sections of the report. Mineral block placement and fencing are management tools that can be utilized to encourage grazing in underutilized areas and reduce livestock pressure on sensitive riparian zones.
- **Invasive species:** Invasive species management opportunities are concentrated in the riparian corridors and primarily involve the control of Russian olive and salt cedar. If left unchecked, Russian olive and salt cedar form dense monocultures that outcompete native vegetation, encroach on pastureland, reduce wildlife habitat values, and limit human access. In addition to the woody species, there are a number of herbaceous weeds (e.g., Canada thistle, Russian knapweed, whitetop, etc.) that have been identified as treatment priorities in the watershed. Both Park and Big Horn County Weed and Pest Districts offer technical and financial assistance for treating these species.