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Mailing Address:

Water Resources Data System
University of Wyoming, Dept 3943
1000 E University Avenue
Laramie, WY 82071

Physical Address:

Wyoming Hall, Room 249
University of Wyoming
Laramie, WY 82071

Phone: (307) 766-6651

Fax: (307) 766-3785

Funding for WRDS and the creation of this electronic document was provided by the Wyoming Water Development Commission
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**EXECUTIVE SUMMARY
HORSE CREEK
WATERSHED LEVEL I STUDY**



Prepared for:
Wyoming Water Development Commission
6920 Yellowtail Road
Cheyenne, WY 82002

Prepared by:
Anderson Consulting Engineers, Inc.
375 E. Horsetooth Road, Bldg. 5
Fort Collins, CO 80525
(ACE Project No. WYWDC39)



ANDERSON CONSULTING ENGINEERS, INC.
Civil • Water Resources • Environmental

Hinckley Consulting

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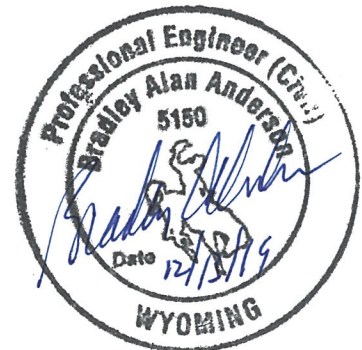
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December 13, 2019



1.0 INTRODUCTION

In 2016 the South Goshen Conservation District (SGCD) requested funding from the Wyoming Water Development Commission (WWDC) for the completion of a watershed management plan for the Horse Creek watershed. The intent of the funding request was to have a comprehensive watershed inventory completed, which identified issues related to land use and water resources, and to then develop a plan addressing those issues.

Six other requests for funding of watershed studies were also received and considered during the 2017 legislation session. Following a prioritization of the projects which resulted in the Horse Creek study to not be funded in 2017, it was funded the following year in 2018. Anderson Consulting Engineers, Inc. (ACE) was ultimately contracted in June 2018 to complete the project.

While the project sponsor is “officially” listed as the SGCD as they represent the entity which initially applied for the project and its funding, the Laramie County Conservation District (LCCD) is also a participating entity. There is actually more land within the project study area that is in Laramie County (46.1%) than in Goshen County (44.6%). Nonetheless, throughout this report, the SGCD is referred to as the project sponsor for simplicity.

2.0 BACKGROUND

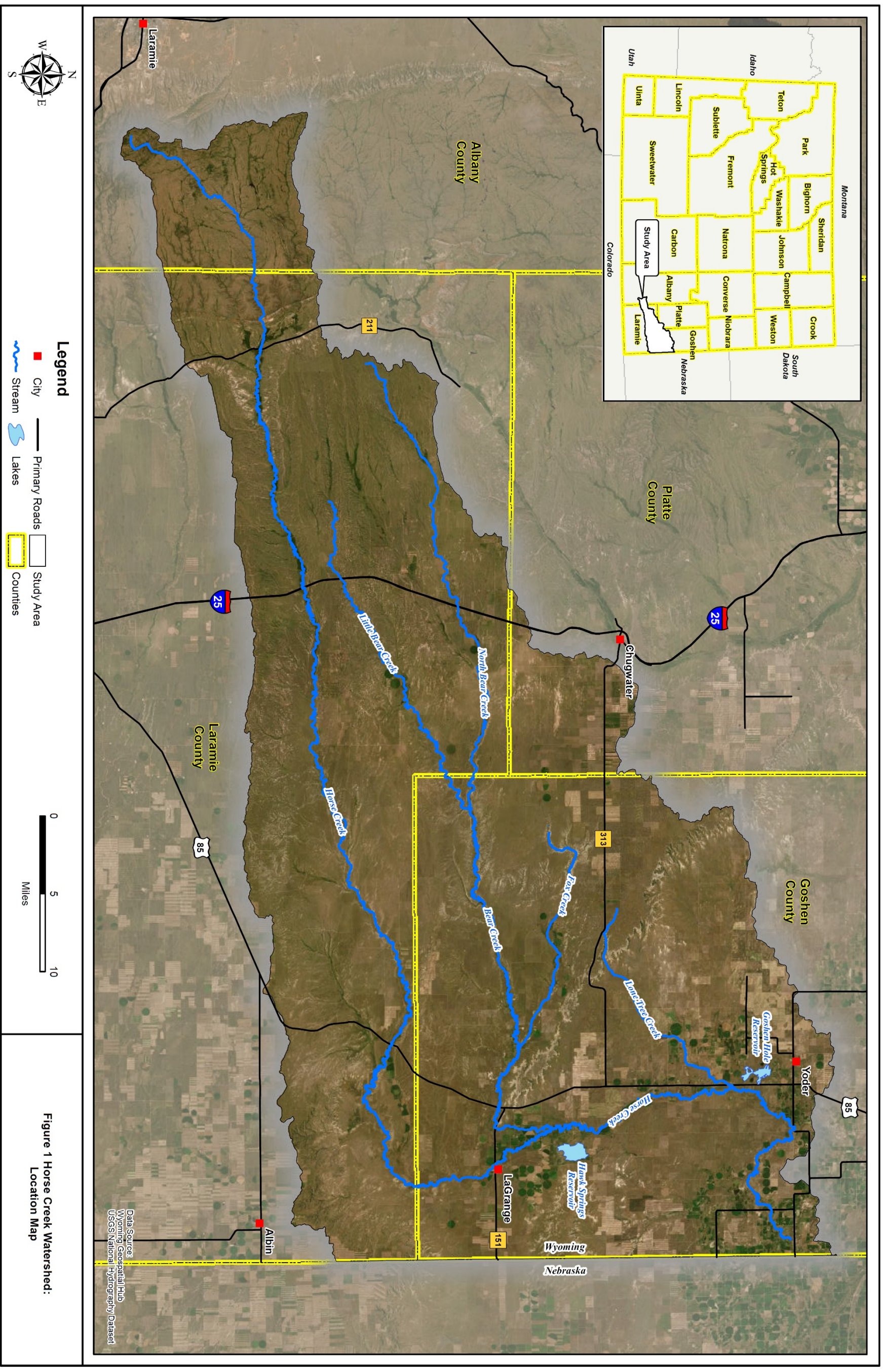
The project study area is located in southeastern Wyoming; primarily in Goshen and Laramie Counties, Wyoming (Figure 1). Horse Creek is defined by the United States Geologic Survey (USGS) as the fourth order basin: Horse Creek (Hydrologic Unit Code 10180012). Consequently, the project study area consists of Horse Creek and its principal tributaries: Bear Creek, Fox Creek, Little Bear Creek, and Kiowa Creek.

Horse Creek is a perennial stream with headwaters in the Laramie Mountains at elevations of approximately 8,400 ft. It extends approximately 130 miles easterly to its confluence with the North Platte River near Lyman, Nebraska at an elevation of approximately 4,500 ft. (Note, the Nebraska portion of the watershed is not included in the project study area.

The study area covers approximately 1,039,966 acres (1,625 sq. mi.) in southeast Wyoming. The watershed is mostly contained in Laramie and Goshen counties, with a small portion in Platte and Albany counties. The towns of La Grange and Yoder lie within the watershed boundary. The study area is sparsely populated and consists primarily of open range lands.

3.0 PROJECT PURPOSE AND OBJECTIVES

The purpose of this Level I watershed study was to combine the available data and information with the study-generated inventory data to develop a comprehensive watershed management and rehabilitation plan that outlines proposed and potential water-development opportunities. To accomplish this effort, the following objectives were completed:



- *Facilitate consensus building among the conservation district, landowners and the Wyoming Water Development Commission.*
- *Facilitate public participation through public meetings, open houses/workshops, SGCD contacts, and advertisements.*
- *Conduct an evaluation and description of the Horse Creek watershed, including quantity and quality of surface water resources, and riparian/upland conditions.*
- *Inventory and describe Irrigation systems, water storage, and flood control needs present within the watershed.*
- *Conduct a geomorphic assessment of the primary channels within the watershed and identify potential mitigation measures to improve impaired channel reaches.*
- *Conduct an irrigation system inventory and develop a rehabilitation plan for those ditches expressing an interest to participate.*
- *Conduct an evaluation of water storage needs and opportunities to augment water available for livestock and wildlife.*
- *Develop a watershed management plan which identifies water resource related within the watershed and proposes practical economic solutions.*
- *Identify permits, easements, and clearances necessary for plan implementation.*
- *Develop cost estimates for improvements.*
- *Complete an economic analysis and evaluate alternative sources of funding.*

4.0 WATERSHED MANAGEMENT PLAN

Potential improvements were developed and categorized into the following:

- **Irrigation System Conservation and Rehabilitation:** The inventory and evaluation of existing infrastructure was completed and improvements were identified.
- **Livestock/Wildlife Upland Watering Opportunities:** Based upon an evaluation of existing water sources and the condition of upland grazing resources, potential upland water source development projects were identified.
- **Grazing Management Opportunities:** Based upon a review of the pertinent Ecological Site Descriptions (ESDs) and the ambient vegetation and soil conditions, grazing strategies are presented.
- **Environmental Enhancement Opportunities:** Several projects were identified which would fall under the category of stream channel stability and environmental enhancement; including stream bank stabilization, wetland enhancement and fisheries-related opportunities.
- **Aquatic Vegetation Management:** The issue of management of aquatic vegetation was discussed early in the project. Projects identified under this component of the watershed management plan address potential options that could be employed by individuals or entities to manage nuisance aquatic vegetation in irrigation conveyance systems.

The plan is summarized in Table 1.

Table 1 Horse Creek Watershed Management Plan.

| Horse Creek Watershed Management Plan | | | |
|--|-------------------------------------|---------|--|
| Watershed Management Plan Component | Watershed Management Plan Component | County | Project Name |
| HC ENV-001 | Buchaults-002 | Goshen | Buchaults Check Structure - Horse Creek |
| HC ENV-002 | Frank-002 | Goshen | Horse Creek Bank Stabilization Project |
| HC ENV-003 | Kessler-001 | Goshen | Bear Creek Sedimentation Project |
| Irrigation Components | | | |
| IRR-001 | Alps-001 | Goshen | Alps Ditch Conversion Project |
| IRR-002 | Christofferson-001 | Laramie | Christofferson Ditch Diversion Reconstruction |
| IRR-003 | Davis-002 | Goshen | Davis Pipeline Project |
| IRR-004 | Frank-001 | Goshen | Scoon Ditch Diversion Rehabilitation Project |
| IRR-005 | Hanlon-001 | Goshen | Schwab Ditch Conversion Project |
| IRR-006 | Sipola-001 | Goshen | Sipola Ditch Conversion Project |
| IRR-007 | Tomayer-001 | Goshen | Tomayer Pipeline Project |
| IRR-008 | Thaler-002 | Goshen | Bear Creek Ditch Measurement Device |
| IRR-009 | Thaler-001 | Goshen | Fox Creek Diversion Structure |
| Livestock / Wildlife Water Supply Projects | | | |
| L/W-001 | Berry 001 | Laramie | Berry Well Construction Project No. 1 |
| L/W-002 | Berry 002 | Laramie | Berry Well Construction Project No. 2 |
| L/W-003 | Berry 003 | Laramie | Berry Well Rehabilitation Project |
| L/W-004 | Borchardt-001 | Laramie | Borchardt Solar Platform Installation |
| L/W-005 | Borchardt-002 | Laramie | Borchardt Pipeline Extension Project |
| L/W-006 | Borchardt-003 | Laramie | Borchardt Stock Tank Project |
| L/W-007 | Borchardt-004 | Laramie | Borchardt Spring Development Project |
| L/W-008 | Buchaults-001 | Goshen | Buchaults Pipeline Project |
| L/W-009 | Cecil-001 | Goshen | Cecil Well Construction Project |
| L/W-010 | Cecil-002 | Goshen | Cecil Pipeline Project No. 1 |
| L/W-011 | Cecil-003 | Goshen | Cecil Pipeline Project No. 2 |
| L/W-012 | Chamberlain-001 | Goshen | Chamberlain Pipeline Project |
| L/W-013 | Clark-001 | Laramie | Clark Well Construction |
| L/W-014 | Davis-001 | Goshen | Davis Stock Reservoir Rehabilitation |
| L/W-015 | Dereemer-001 | Laramie | Dereemer Pipeline Project |
| L/W-016 | Drake-001 | Laramie | Drake Well Construction Project |
| L/W-017 | Eklund-001 | Laramie | Eklund Solar Platform / Pipeline Project |
| L/W-018 | Frank-003 | Goshen | Frank Pipeline Project |
| L/W-019 | Grandstaff-001 | Goshen | Grandstaff Pipeline Project |
| L/W-020 | Jackson-001 | Goshen | Jackson Pipeline Project |
| L/W-021 | Ruiz-001 | Goshen | Ruiz Solar Platform Project |
| L/W-022 | Ruiz-002 | Goshen | Ruiz Pipeline Project No. 1 |
| L/W-023 | Ruiz-003 | Goshen | Ruiz Pipeline Project No. 2 |
| L/W-024 | ScheerD-001 | Goshen | Scheer D. Well Construction Project |
| L/W-025 | ScheerD-002 | Goshen | Scheer D. Solar Platform Project |
| L/W-026 | ScheerJ-001 | Goshen | Scheer J. Pipeline Project |
| L/W-027 | ScheerJ-002 | Goshen | Scheer J. Irrigation Pipeline Project |
| L/W-028 | Shimic-001 | Goshen | Shimic Stock Reservoir Project |
| L/W-029 | Shoun-001 | Goshen | Shoun Well Construction Project No. 1 |
| L/W-030 | Shoun-002 | Goshen | Shoun Well Construction Project No. 2 |
| L/W-031 | Tomayer-002 | Goshen | Tomayer Stock Reservoir Rehabilitation Project No. 1 |
| L/W-032 | Tomayer-003 | Goshen | Tomayer Stock Reservoir Rehabilitation Project No. 2 |
| L/W-033 | Tremain-001 | Goshen | Tremain Solar Platform Project No. 1 |
| L/W-034 | Tremain-002 | Goshen | Tremain Solar Platform Project No. 2 |
| L/W-035 | Tremain-003 | Goshen | Tremain Solar Platform Project No. 3 |
| L/W-036 | Yeik-001 | Goshen | Yeik Pipeline Project No. 1 |
| L/W-037 | Yeik-002 | Goshen | Yeik Pipeline Project No. 2 |
| L/W-038 | Zimmerer-001 | Goshen | Zimmerer Spring Development |
| Aquatic Vegetation Management | | | |
| AVM-001 | NA | Either | Chemical treatment |
| AVM-002 | NA | Either | Mechanical Screening Device |
| AVM-003 | NA | Either | Turbulent Fountain ("Bubbler") |
| AVM-004 | NA | Either | Coanda Screen Device |

5.0 CONCLUSIONS

Upon completion of the watershed inventory phase of the project, the project team developed the watershed management plan. The plan was developed based upon findings of the inventory phase, a series of public meetings, and interaction with the SGCD and LCCD staff. In previous chapters, key issues, problems and opportunities were identified and ultimately, project goals and objectives were formulated to address them. Specifically, plans were developed associated with the following broad categories:

- Irrigation System Conservation and Rehabilitation,
- Livestock/Wildlife Upland Watering Opportunities,
- Surface Water Storage Opportunities,
- Environmental Enhancement Opportunities,
- Grazing Management Opportunities, and
- Aquatic Vegetation Management Opportunities.

In summary, the following conclusions are provided.

5.1 Irrigation System Components

1. Irrigated agriculture is a dominant activity within the study area. The extent of irrigated lands, and corresponding irrigation infrastructure is significant. The Horse Creek Conservation District (HCCD) represents the major stakeholder in the area with respect to irrigation and serves about 10,200 irrigated acres. An irrigation district master plan was completed in 2013 by AVI, PC and included a lengthy list of recommendations for district managers to use for planning purposes. The master plan should continue to be referenced by HCCD to drive future planning efforts.
2. Several of the projects included in the Watershed Management Plan were recommended by stakeholders within the HCCD and involve smaller conservation/pipeline projects on lands located “downstream” of HCCD responsibility. We recommend that the SGCD work together with these and other stakeholders and the HCCD to strive to develop projects that may benefit greater numbers of users and be consistent with HCCD infrastructure.
3. Funding assistance is available from a number of sources, as previously mentioned, especially from the WWDC Small Water Project Program but also from various programs administered by the NRCS. The HCCD, as a legal entity, is also eligible for other funding opportunities through the WWDC and other agencies and program.
4. Partnering opportunities may exist for construction of in-stream structures such as irrigation diversions. For example, Trout Unlimited (TU) has recently provided partial funding for projects within the region in an effort to enhance fisheries populations. Fish passage opportunities identified in the plan could potentially be funded by multiple entities.

5.2 Livestock/Wildlife Upland Watering Opportunities

1. There are numerous opportunities to improve range and riparian conditions by means of increasing the availability of upland water sources for wildlife and livestock use.
2. Opportunities to improve range and riparian conditions require installing and operating well-distributed, reliable upland water sources and watering facilities for wildlife and livestock. Installing pipelines and stock tanks is the foundation of effective grazing management and can be an economical way to improve rangeland conditions. Strategic fencing is frequently required to optimize these benefits.
3. Pipeline/tank systems appear to offer the most efficient and cost-effective means to provide adequate watering to large areas of rangeland. Water sources for these systems will depend on the location of the rangeland to be served and the available alternative sources. The most likely sources are wells or spring developments.
4. Through discussion with local landowners and stakeholders, a total of 38 potential livestock / wildlife water supply projects were identified. Conceptual plans and conceptual level cost estimates were prepared for each project. Projects ranged from installation of stock tanks to well spring development and pipeline construction.
5. All of the livestock / wildlife projects identified could be completed entirely on private lands. Consequently, permitting issues are greatly simplified.

5.3 Surface Water Storage Opportunities

1. No new storage facility projects were identified in this study and no previous studies were found which identified any potential projects. Limitations and complexities of water administration in the basin make development of storage opportunities possible, but problematic.

5.4 Stream Channel Condition and Stability

1. Based on the geomorphic assessment and input from the project Sponsor, the project team identified several locations where stream channel migration is resulting in bank erosion threatening infrastructure. It must be recognized that meandering streams will continually migrate laterally resulting in erosive banks in some locations and sediment deposition in others. However, when erosion threatens highways, irrigation structures, homes, or other infrastructure, mitigation is recommended. Likewise, mitigation is also prudent when channel migration threatens activities such as pastures, crops, etc.

2. Bear Creek and Fox Creek show signs of instability; sedimentation and aggradation of the channel is occurring. This is causing the stream to widen and become undefined through 'boggy' areas. The source of the sediment appears to be upstream bank erosion. Within the areas where sedimentation is occurring, irrigators face maintenance issues associated with sediment conveyed into ditches as well as diversions being problematic to use. Earthwork could restore channel alignment to make diversions feasible, however, efforts would likely be short-lived as sediment delivered from upstream would likely 'undo' these efforts. A more comprehensive plan involving stabilization of the upstream sediment sources should be undertaken.
3. Channel degradation does not appear to be systemic throughout the Horse Creek watershed. Significant or system-wide indicators of channel instability were not observed nor were they presented by area stakeholders. Impairments appear to be locally identifiable and include primarily:
 - Riparian Vegetation Degradation: Impaired riparian condition and habitat, and
 - Riparian Degradation: Generally, bank erosion and physical disturbance of stream banks.
 - Imbalance of Sediment Supply: Imbalance between stream capacity and sediment supply can lead to channel degradation or aggradation

5.5 Grazing Management Opportunities

1. Construction and operation of reliable water supply projects must be developed and implemented in areas with inadequate water sources before adjustments or alternatives in grazing management can be made on a particular area or allotment.
2. Development of reliable water sources and associated watering facilities can aid in distribution of grazing animals and the timing and frequency of grazing. However, additional measures such as cross-fencing, low-stress herding, mineral/salting, and stock density should be evaluated as part of the site-specific, grazing management inventory and plan.
3. Available tools such as the ESD and the STM can be used by landowners and managers to become aware of the growth potential of desirable vegetation and predicted responses on a particular range site.
4. These tools could be used in developing appropriate rangeland treatments and grazing practices to begin the transition from a current state or condition to a more desirable plant community condition.

5.6 Environmental Enhancement Opportunities

1. Several environmental enhancement opportunities were identified. Two of the projects involve construction of barriers to fish passage to facilitate fisheries management objectives. Funding for these projects could potentially be completed through partnering with agencies such as Wyoming Game and Fish and private entities such as Trout Unlimited.
2. Other environmental enhancement opportunities include the potential to convert abandoned stream channel oxbows to wetland features. Similar projects have been recently completed within the similar watersheds which could potentially be implemented providing valuable wetland habitat.

5.7 Aquatic Vegetation Management

1. Aquatic vegetation is reportedly problematic in area canals and ditches. Two general types of management strategies appear to exist:
 - (a) control of rooted vegetation which, when dense, can restrict conveyance capabilities of a canal/ditch system and
 - (b) floating or moving vegetation / debris which becomes problematic for sprinklers or gated pipe systems.
2. Chemical treatment, while expensive and increasingly more regulated to apply, appears to be the most effective means of controlling rooted vegetation.
3. Physical screening appears to be a viable means of managing vegetation / debris entrained in a canal/ditch to protect sprinklers and gated pipe systems.

6.0 Recommendations

Based upon the information presented throughout this report, and the conclusions presented above, the recommendations listed below are presented for consideration:

1. Many of the irrigation rehabilitation alternatives and the livestock / wildlife upland watering alternatives fall within the constraints for funding eligibility of the WWDC's Small Water Project Program (SWPP). These projects should be reviewed and selected alternatives should be implemented as soon as is practical. Completion of one or more of these projects in the near future would serve to benefit those directly involved in the project and increase interest and awareness of the benefits associated with the watershed planning process.

Funding through the SWPP does not require formation of a public entity as defined by WWDC criteria. Consequently, individuals can seek funding through this program by applying through a

conservation district as their sponsor. As discussed in Chapter 7, grants are available for up to 50 percent of the total project cost or \$35,000, whichever is less.

Several alternative sources exist for funding of improvements within the watershed including on-farm improvements, irrigation rehabilitation projects, stream enhancements/restoration projects, and conservation and flood control projects. Creative strategies for funding/financing of projects should be more fully investigated following identification of projects worthy of additional evaluation and potential implementation. As an example, replacement of a failing ditch headgate and diversion which are also identified by WGFD as barriers to fish passage, could potentially be eligible for funding through SWPP. Additional funding may also be attained through WGFD, Trout Unlimited, and other sources because of the fisheries and stream habitat benefits achievable with completion of the project. *By combining funding sources, the owner could conceivably obtain grants for most, if not all, of the project costs.*

2. Continued communication between the SGCD, the LCCD, and stakeholders regarding irrigation system improvements is highly recommended. Irrigation system infrastructure is generally eligible for funding through the WWDCC's Small Water Project Program (SWPP). We have found through the completion of previous watershed studies, that interest in the program grows as projects are completed. Therefore, we highly recommend that the SGCD and the LCCD include reference to the SWPP in future newsletters and communications in an effort to broadcast its benefits. Upon completion and with consent of the existing participant, SGCD and LCCD could include reference of project completion to demonstrate SWPP opportunities.
3. Community-sponsored stream channel and habitat improvement projects could provide numerous benefits to the watershed. Potential projects would include efforts such as bank stabilization efforts using techniques such as willow plantings.
4. Landowners or managers seeking to participate in the SWPP should consult and coordinate with the SGCD and the LCCD, which is the eligible sponsor of SWPP applications and project agreements. Guidance and design from NRCS can help offset potential costs to the applicant.
5. The Horse Creek study's GIS and digital library should be used as a tool in planning and developing potential projects and should be updated as necessary from available information sources. This information used in conjunction with the Wyoming Association of Conservation District's (WACD) SuiteWater tools provide powerful watershed analytical capabilities. In addition, the Digital Library provided in this project contains a wealth of information and resources pertinent to SGCD and LCCD activities.
6. Potential funding opportunities exist for proposed and future improvement projects within the watershed including ranch and farm improvements, irrigation system rehabilitation, riparian/wetland enhancements, river corridor and stream channel restoration, and urban drainage and flood control projects. For example, the Saratoga Encampment Rawlins

Conservation District (SERCD) was recently granted funding through the USDA Regional Conservation Partnership Program (RCPP). The funding is intended for achieving resource management goals from improving water quality and wildlife habitat to streambank restoration. Where appropriate, partnering SWPP funding with RCPP funded projects could provide multiple financial benefits.

7. Innovative strategies for coordinated project funding and financing should be investigated and focus on local, collaborative endeavors that integrate more than one watershed issue or concern that could potentially result in achievement of multiple benefits.
8. Every effort was made to provide information within this document to support the application for SWPP funding from the WWDC with SGCD and LCCD sponsorship. Project narratives, conceptual designs, cost estimates, and discussion of project benefits can all be incorporated directly into the SWPP application by the SGCD and the LCCD.
9. The public outreach portion of this project attempted to accommodate all interested parties. To the best of the project team's knowledge, all who expressed interest in participating were contacted. However, our experience has shown that additional "new" individuals will come forward wishing to participate after this Level I study is completed. These individuals must be made aware that they are eligible for SWPP funding; the WWDC has removed the requirement of a completed watershed study for eligibility. They simply have not had the benefit of having met with the project team and having a portion of their application needs provided to them. They would be subject to the same application requirements and deadlines as those who did participate.
10. The Horse Creek Watershed Management plan was completed based primarily upon input obtained from the SGCD, the LCCD, and participating agencies, landowners, and stakeholders.



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