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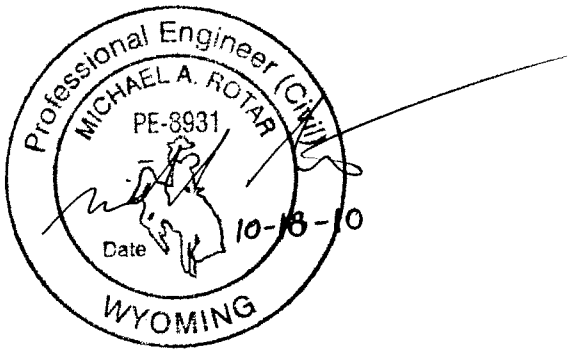
Kirby Creek Watershed Level I Study

Executive Summary
September 2010

Executive Summary

Kirby Creek Watershed

Level I Study



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September 2010

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1.0 INTRODUCTION

In May 2009 Post, Buckley, Schuh and Jernigan (PBS&J) was selected by the Wyoming Water Development Commission (WWDC) to conduct a Level I study of the Kirby Creek watershed. The Hot Springs Conservation District (HSCD), which is the local sponsor of the project, requested funding from the WWDC for an updated watershed study to gather information needed to develop a management and rehabilitation plan and to evaluate the effects of previous project implementation to current watershed function. A previous Level I watershed study was completed for the Kirby Creek watershed in 2005 (Sunrise Engineering, 2005).

1.1 PURPOSE AND SCOPE

The principal purposes of the Kirby Creek Watershed Study are to:

1) Inventory relevant physical and biological conditions in the watershed and describe the connections that exist between watershed condition and opportunities for water resource development. Provide a discussion of recently completed water development projects, and the effects of these projects on watershed function and management.
2) Complete a watershed management and rehabilitation plan that identifies and prioritizes future water development projects and management practices, including conceptual-level design of significant projects.
3) Determine which environmental regulations may affect potential projects and management strategies, and describe the applicable regulatory framework (i.e., permits, environmental studies) required to implement a project.
4) Provide conceptual-level cost estimates for water development projects and management practices identified in the watershed management plan.
5) Describe potential funding sources for identified projects, including an assessment of the sponsor's ability to provide funds assuming WWDC financing.

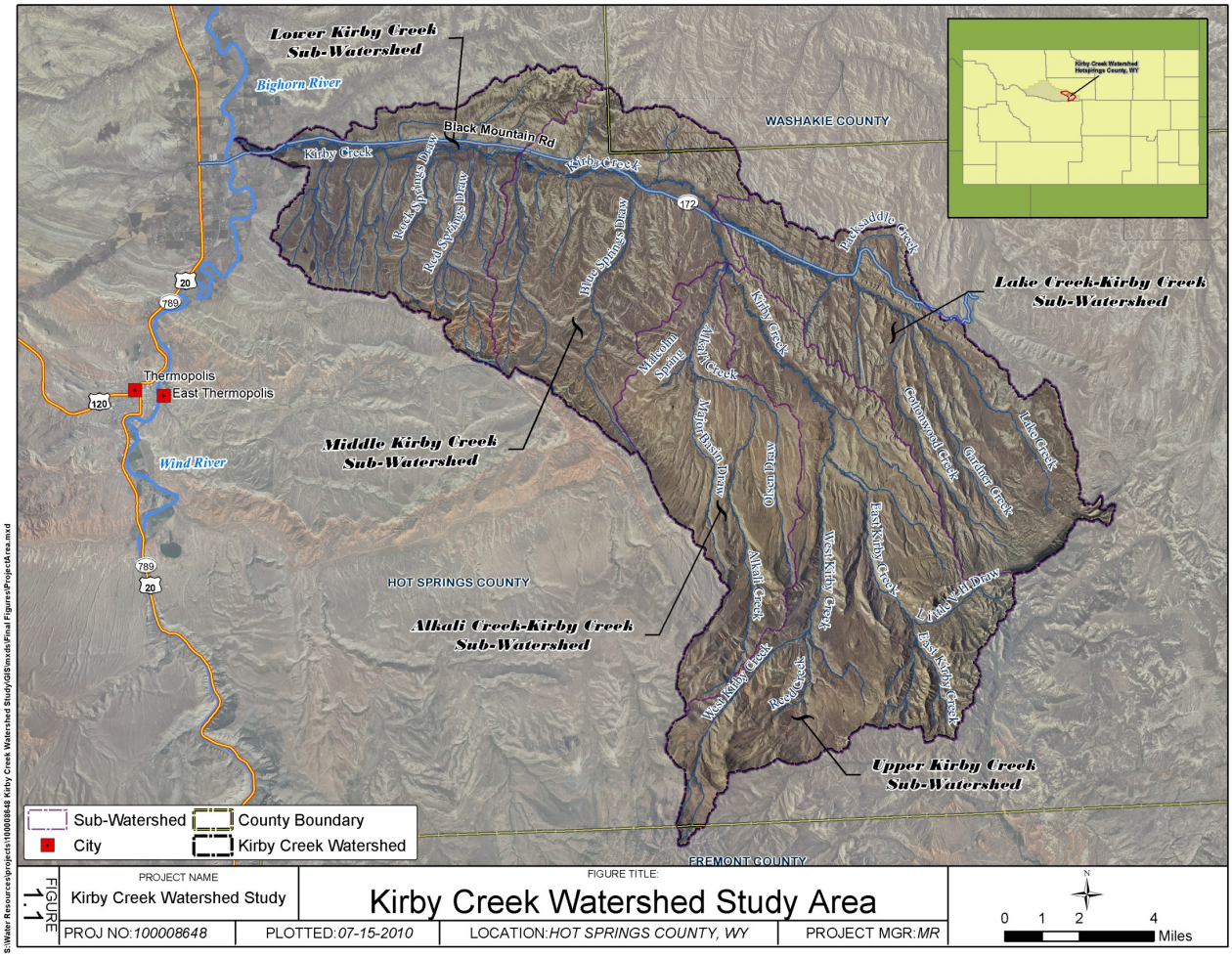
1.2 RESPONSIBILITY

Official authorization for the project is provided in the Consultant Contract for Services (#05SC0293899) dated June 4, 2009. The contractual representative for the WWDC was William E. Bensel, Chairman. Dr. Ron Vore, Project Manager at the Wyoming Water Development Office (WWDO), served as the main point of contact for PBS&J during the contract term. Michael Rotar, P.E. (WY License No. 8931), was the Project Manager for PBS&J. All engineering analyses and calculations were performed under his responsible charge. Natural Resource Options, Inc. (NRO) conducted the range assessment portion of the project under the direction of Dennis Phillippi, a Certified Range Management Consultant.

1.3 OVERVIEW OF PROJECT AREA

The Kirby Creek watershed is located at the southern end of the Big Horn Basin in north-central Wyoming (**Figure 1.1**). The watershed lies almost entirely within Hot Springs County, with very small areas also located in Fremont and Washakie Counties. The watershed covers approximately 200

square miles. Kirby Creek is tributary to the Big Horn River; the confluence is located just northeast of the community of Lucerne, Wyoming. Major tributaries to Kirby Creek within the watershed include Alkali Creek, East Kirby Creek, West Kirby Creek, and Lake Creek. Elevations within the watershed range from 4,260 feet at the Big Horn River confluence to 8,140 feet at the watershed's high point, resulting in a total relief of nearly 3,900 feet. There are no incorporated cities or towns within the watershed boundary. Wyoming State Highway 172, also known as Black Mountain Road, enters the watershed just east of the Big Horn River and traverses the northern portion of the watershed in generally an east-west alignment. It is the only paved road within the watershed.



Approximately 50% of the watershed consists of land managed by the federal government (U.S. Dept. of Interior, Bureau of Land Management - BLM). The State of Wyoming owns about 12% of the watershed. Private land ownership comprises the remaining 38% of the watershed area. The BLM manages 38 grazing allotments and 20 operators in the watershed. Land cover in the watershed is dominated by shrublands, followed by grasslands, riparian areas, and forested area. The majority of the shrublands in the Kirby Creek watershed are sagebrush dominated. The Kirby Creek watershed receives relatively little precipitation (10 to 16 inches per year), and is classified as semi-arid.

1.4 STUDY FOCAL POINTS

Landowners and project stakeholders are challenged in their management and utilization of water by the physical state of the watershed. To that end, this study focuses on several ongoing processes that influence overall watershed condition and health and which critically affect the development, distribution and efficient use of water resources. An emphasis is placed on identifying management strategies and potential projects that are compatible with existing conditions within the watershed and which have potential to mitigate current limitations to water development opportunities.

A number of key issues have been identified by the Kirby Creek Coordinated Resource Management (CRM) group, which has played a significant role in the direction and focus of this study. The Kirby Creek CRM group's mission is to assess, maintain and enhance the quality of the Kirby Creek watershed through a voluntary cooperative process while protecting the quality of life, custom, culture, and economic base of the community. It is currently comprised of individuals, landowners, and federal/state/local resource agency staff working together. The CRM-process provides a tool for people to manage and use natural resources for long-term productivity and environmental well-being. This can be best accomplished by local people addressing local issues in a collaborative and consensus-driven manner.

To date, an investment of approximately $1.5 million has been expended in the watershed through various funding sources for improvements such as weed control, fencing, streambank restoration, off-site water development and historic channel restoration. These projects have facilitated better livestock distribution which in turn has improved sage grouse and riparian habitat, and increased cottonwood and willow cover along portions of Kirby Creek. Continuing efforts are being made to tackle problems that include:

Water Quantity and Retention

- The Kirby Creek watershed is a semi-arid landscape with a limited water supply. Snowmelt runoff in the spring typically has a very short duration. Presently, there is limited ability and capacity to capture and store the runoff that is available.
- Limitations in available surface water can be partially mitigated by maximizing the ability to retain runoff in storage facilities (e.g., stock reservoirs), subject to water rights.

Channel Morphology and Stability

- Long-term geomorphic processes, both natural and human-induced, have resulted in significant channel degradation and incision throughout much of the watershed. In some areas channel incision is greater than 30 feet below the historic valley bottom. In many locations, the stream channel is currently in a state of recovery and a new, lowered floodplain surface has developed.

- The disconnect between historic floodplain surfaces and the present base elevation of stream channels presents obstacles to effective and efficient use of surface water for livestock/wildlife watering, irrigation, and support of aquatic and riparian habitat.

Grazing Management

- Livestock grazing is one of the main land uses in the watershed. Severe channel incision in many locations has resulted in limited access to surface waters for livestock watering. Numerous projects (including well development, water pipelines, and upland stock water tanks) have been implemented in the watershed to increase and distribute watering opportunities across a greater land area.

- Provision of upland watering sources away from riparian and wetland areas reduce the impact on these critical resources. Furthermore, proactive management of upland range can directly affect conditions in the riparian area. Consequently, it is important to consider the *entire* watershed when developing a grazing management strategy.

2.0 WATERSHED MANAGEMENT PLAN

2.1 OVERVIEW

Several options for enhanced watershed management were explored through discussions with landowners and other watershed stakeholders, field investigations and computer based analysis. A watershed management plan was developed which outlines a strategy for enhancing water resources in the Kirby Creek watershed and includes recommended projects within the following categories:

- **Irrigation Infrastructure Improvements** - An inventory of inactive irrigation ditches was completed and recommendations for re-activation and/or other improvements were identified.
- **Upland Wildlife/Livestock Watering Opportunities** - The locations of existing, reliable upland water sources (springs, stock ponds, wells, and stock tanks) were inventoried, and the results used to identify areas that lack adequate water supply and which could benefit from potential upland water development projects.
- **In-stream Pond Opportunities** - Potential locations for in-stream pond development projects via re-activation of historic meanders and oxbows were evaluated. This type of water development project has been successfully implemented at several locations within the watershed.
- **Stream Channel Restoration Opportunities** - Restoration opportunities are identified to improve the function and stability of stream channels within the watershed. Primary project types include headcut stabilization and entrenched channel restoration.
- **Grazing Management Strategies and Opportunities** - Using Ecological Site Descriptions (ESDs) as a means of characterizing and measuring range condition and health, various approaches to grazing management are presented.
- **Other Upland Management Opportunities –** Additional management strategies and tools, including weed and pest control and the use of prescriptive fire, are discussed.

2.2 RECOMMENDED WATERSHED PROJECTS

The recommended watershed projects and improvements comprise an action plan; the implementation of which is designed to improve overall watershed function and health. Priority rankings are assigned to projects within some of the watershed plan categories. Within other categories, priority rankings are not defined due to factors such as landowner interest/need, permitting requirements, etc., which would require further assessment prior to ranking individual projects.

2.2.1 Irrigation Infrastructure Improvements

Three ditches in the Kirby Creek watershed were identified as inactive with the potential to be re-activated, including the Richardson #1 Ditch, the Kirby Creek Ditch and the Idared Ditch. The Richardson #1 Ditch and Idared Ditch are on West Kirby Creek, while the Kirby Creek Ditch is on East Kirby Creek. Out of these three ditches, the Richardson #1 Ditch is thought to have the highest potential as a water resource development project. **Table ES-2.1** provides a summary of the recommended ditch re-activation projects; including project components and estimated construction costs (refer to Section 4.2 of the Final Report for project descriptions and maps).

Table ES-2.1. Kirby Creek Watershed Plan – Irrigation Infrastructure Improvements.

Ditch Name	Priority [1]	Length of Ditch to Rehab. (lin. ft.)	Installation of check structure(s) at POD [2]		Ditch Re-conditioning ($5/lin. ft.)	Install measuring device [3]	Culverts for road crossings		Pipe for stream crossings		Total Estimated Cost
			Qty.	Total Cost			Qty.	Cost	Qty.	Cost	
Richardson #1 Ditch	3	2150	3	$25,000	$10,750	$3,000	0	0	0	0	**$39,000**
Kirby Creek Ditch	2	3650	3	$25,000	$18,250	$3,000	1	$4,000	1	$3,000	**$53,000**
Idared Ditch	1	3700	3	$25,000	$18,500	$3,000	1	$2,000	1	$1,800	**$50,000**

[1] Priority of 3 = highest, 1 = lowest; project prioritization is relative only between each of the ditch re-activation projects.

[2] POD = Point of Diversion

[3] assumes 24" Parshall flume

2.2.2 Upland Wildlife/Livestock Watering Opportunities

Field meetings were conducted with most of the landowners and operators in the watershed to evaluate existing upland water developments and gain first-hand information regarding their grazing operations. Using this information, coupled with an inventory of reliable upland water sources (i.e., springs, wells, stock tanks and viable stock ponds), a number of conceptual water development projects were identified. These included pipeline/stock tank projects (including additions to existing pipeline systems and completely new pipeline systems), a spring development project at Blue Springs, and a new stock pond on the Paradise K Ranch. **Figure 2.1** (Figure 4.7, Final Report) shows the locations of these conceptual projects, along with an alphanumeric descriptor for each project which is referenced in the overall watershed plan. **Table ES-2.2** provides details for the upland water development projects shown in Figure 2.1, including a summary of project components and estimated design, permitting, and construction costs.

Project Type	Name	Symbol Number
Spring Development	SD-1: Blue Springs	1
Stock Pond	SP-1: Paradise K Ranch - Pat's Pond	1
UWD	UWD-1: Mud Creek Pipeline Extension	1
UWD	UWD-2: Lake Creek Pipeline Project	2
UWD	UWD-3: Pack Saddle Creek Pipeline Project	3
UWD	UWD-4: V-H Draw North Pipeline Project	4
UWD	UWD-5: V-H Draw South Pipeline Project	5
UWD	UWD-6: Reed Creek Pipeline Project	6
UWD	UWD-7: Major Basin Pipeline Project	7
UWD	UWD-8: Blue Springs Pipeline Project-1	8
UWD	UWD-9: Blue Springs Pipeline Project-2	9
UWD	UWD-10: Blue Springs-Kirby Pipeline Project	10
UWD	UWD-11: Red Springs Draw Pipeline Project	11
UWD	UWD-12: South Lucerne Pipeline Project	12

0 1 2 4 Miles

New Projects
- Stock Pond
- UWD
- Spring Development
- Sub-Watershed
- Kirby Creek Watershed

Water Development Components (.5 mile buffer)
- Springs
- Stock Tanks
- Stock Ponds
- City
- Streams
- County Boundary

FIGURE TITLE: Water Development Components

PROJECT NAME: Kirby Creek Watershed Study

PROJECT MGR:*MR*

LOCATION:*HOT SPRINGS COUNTY, WY*

PLOTTED:*07-15-2010*

PROJ NO:*100008648*

FIGURE 2.1

S:\Water Resources\projects\100008648 Kirby Creek Watershed Study\GIS\mxds\Final Figures\Water Development Components .mxd

Table ES-2.2. Kirby Creek Watershed Plan - Upland Wildlife/Livestock Water Development Projects.

	Project Name		Mud Creek Pipeline Extension Project	Lake Creek Pipeline Project	Pack Saddle Creek Pipeline Project	V-H Draw North Pipeline Project	V-H Draw South Pipeline Project	Reed Creek Pipeline Project	Major Basin Pipeline Project	Blue Springs Pipeline Project - 1	Blue Springs Pipeline Project -2	Blue Spgs.- Kirby Ck. Pipeline Project	Red Springs Draw Pipeline Project	South Lucerne Pipeline Project	Blue Springs Development	Pat's Pond Paradise K Ranch
	Project Identifier		**UWD-1**	**UWD-2**	**UWD-3**	**UWD-4**	**UWD-5**	**UWD-6**	**UWD-7**	**UWD-8**	**UWD-9**	**UWD-10**	**UWD-11**	**UWD-12**	**UWD-13**	**UWD-14**
Project Element	**Water Source**															
	Well Construction or Improvement / Spring Development	Well / Spring	Existing Well	Existing Well	New Well	Existing Well	Existing Well	New Well	Existing Well	Existing Well / Storage Tanks	Existing Well	Spg. Development	Existing Well	Unknown	Spg. Development	N/A
		Quantity (each)	N/A	N/A	1	N/A	N/A	1	N/A		N/A	1	N/A	N/A	1	
		Well Depth (ft)			3,000			500		N/A		N/A			N/A	
		Unit cost ($/LF or $/ea)			$32.50			$26				$3,000			$3,000	
		Well Screen ($2500/ea)			$2,500			$2,500				N/A			N/A	
		Subtotal	$0	$0	$100,000	$0	$0	$15,500	$0	$0	$0	$3,000	$0	$0	$3,000	$0
	Water Distribution															
	Pump	Quantity (each)	N/A	1	1	1	1	1	1	N/A	1	1	N/A	Unknown	N/A	N/A
		Type		Electric	Electric	Solar	Solar	Solar	Solar		Solar	Solar		N/A		
		Unit Cost (each)		$5,000	$5,000	$7,500	$7,500	$7,500	$7,500		$7,500	$7,500				
	Pipeline	Quantity (lin.ft.)	6,100	17,200	11,800	21,200	6,900	14,600	21,300	10,200	12,700	8,500	7,400	3,200	N/A	N/A
		Unit Cost ($/lin. ft.)	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50		
	Storage Tank	Quantity (each)	N/A	1	1	1	1	1	1	N/A	1	1	N/A	N/A	N/A	N/A
		Size (gal.)		8,000	8,000	12,000	4,000	12,000	12,000		12,000	8,000				
		Unit Cost ($/gal.)		$0.75	$0.75	$0.75	$0.75	$0.75	$0.75		$0.75	$0.75				
		Subtotal	$9,150	$36,800	$28,700	$48,300	$20,850	$38,400	$48,450		$35,550	$26,250	$11,100	$4,800	$0	$0
	Water Supply															
	Stock Tanks	Quantity (each)	N/A	5	4	6	3	4	5	3	5	N/A	2	N/A	N/A	N/A
		Size (gal.)		1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200		1,200			
		Unit Cost (each)		$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500		$2,500			
	Stock Ponds	Quantity (each)	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A	N/A	1	1
		Unit Cost (each)	$5,000									Existing			Existing	$10,000
		Subtotal	$10,000	$12,500	$10,000	$15,000	$7,500	$10,000	$12,500	$7,500	$12,500	2,000	5,000	0	2,000	$10,000
	Construction Subtotal		$19,150	$49,300	$138,700	$63,300	$28,350	$63,900	$60,950	$7,500	$48,050	$31,250	$16,100	$4,800	$5,000	$10,000
	Project Design and Engineering (10%)		$1,915	$4,930	$13,870	$6,330	$2,835	$6,390	$6,095	$750	$4,805	$3,125	$1,610	$480	$500	$1,000
	Design, Engineering & Construction Subtotal		$21,065	$54,230	$152,570	$69,630	$31,185	$70,290	$67,045	$8,250	$52,855	$34,375	$17,710	$5,280	$5,500	$11,000
	Contingency (15%)		$3,160	$8,135	$22,886	$10,445	$4,678	$10,544	$10,057	$1,238	$7,928	$5,156	$2,657	$792	$825	$1,650
	Environmental, Permitting, Legal (5%)		$1,053	$2,712	$7,629	$3,482	$1,559	$3,515	$3,352	$413	$2,643	$1,719	$886	$264	$275	$550
	TOTAL ESTIMATED PROJECT COST		**$25,278**	**$65,077**	**$183,085**	**$83,557**	**$37,422**	**$84,349**	**$80,454**	**$9,901**	**$63,426**	**$41,250**	**$21,253**	**$6,336**	**$6,600**	**$13,200**

NOTE: Due to several factors (e.g., landowner interest/need, permit requirements, etc.), upland water development projects were not prioritized for implementation.

2.2.3 In-stream Pond Opportunities

The potential to develop in-stream ponds through re-activation of historic meanders and developing historic oxbows was evaluated using color aerial imagery and on-the-ground reconnaissance. The goal of this assessment was to identify areas where potential restoration projects similar to the recently completed Lucy Moore project, and the planned Stan's Folly project, could be implemented. In these two projects, historic meander channels were re-activated, and the existing channel was converted into a series of in-stream ponds. These projects increase water storage through surface water impoundment, as well as by subsurface retention in the alluvium, especially during flood events.

The historic meander channel assessment was conducted along the mainstem of Kirby Creek and along Lake Creek. Potential sites for in-stream pond development, historic meander re-activation, and historic oxbow development were identified. There appeared to be relatively little potential for these types of projects on East Kirby Creek, West Kirby Creek, or Alkali Creek since these stream channels are generally confined within narrow valleys, though there may be some potential in localized areas. A total of 42 potential sites were identified, with 38 sites along Kirby Creek and four sites along Lake Creek. After additional field investigation, nine sites were recommended for projects including the Stan's Folly project that was recently constructed this summer (2010). **Table ES-2.3** provides a summary of the in-stream pond projects.

Table ES-2.3. Kirby Creek Watershed Plan – In-stream Pond Projects.

Watershed Plan Category: In-stream Pond Opportunities (refer to Section 4.4 of the Final Report for project descriptions and maps)	
Priority [C]	**Project Name**
3	**KCM-03:** Kirby Creek - Historic Oxbow Development
2	**KCM-05:** Kirby Creek - Historic Oxbow Development
3	**KCM-14:** Kirby Creek - Historic Channel Re-activation
1	**KCM-20:** Kirby Creek - Historic Channel Re-activation
N/A	**KCM-22/23:** Stan's Folly Project [D]
2	**LCM-03:** Lake Creek - Historic Channel Re-activation
3	**Kirby Creek:** Potential Channel Avulsion
1	**Kirby Creek:** In-stream Pond
2	**Alkali Creek:** In-stream Pond
[C] Priority of 3 = highest, 1 = lowest	
[D] As of September 2010, the Stan's Folly project has been completed.	

Although specific, in-stream pond projects are presented in Table ES-2.3, designs were not completed to a level sufficient to provide meaningful cost comparisons between projects.

2.2.4 Stream Channel Restoration Opportunities

A significant percentage of the perennial stream channel length in the watershed is entrenched. In reaches that are severely entrenched, there is the potential to develop a new floodplain at the new base elevation. Restoring these entrenched reaches can have many benefits, including reducing sediment loads from streambank erosion, increasing floodplain surface/subsurface water storage, dissipating flood energy which could help reduce additional downcutting in downstream reaches, expanding riparian habitat, increasing forage production in these areas, improving livestock access to water in the stream, along with improving the overall habitat quality and aesthetic characteristics of the valley through which Kirby Creek flows. Most of the channel restoration projects constructed in the watershed during the last decade have restored incised reaches of channel to varying degrees.

Given the wide variation in scope of entrenched channel restoration projects, and the fact that preliminary design of such projects was outside the scope of this study (beyond those already included in the list of in-stream pond projects, all of which will also provide some level of entrenched channel restoration), it is difficult to provide accurate cost estimates. **Table ES-2.4** provides unit costs for a few of the common elements that are typically included in historic channel re-activation projects.

Table ES-2.4. Estimated Unit Costs for Typical Entrenched Channel Restoration Project Components.

Project Component	Unit Cost [3]
Earthen Grade Control Structure [1]	$7.00/cu. yd.
Rock Grade Control Structure [2]	$54 - $103/cu. yd.
Floodplain Excavation (Earthwork)	$5.00/cu. yd.
Bioengineering (Vegetation Only)	$2.80/lin. ft.
Bioengineering with Rock Toe	$9.40/lin. ft.
Channel Revegetation (Willow Planting)	$0.50/lin. ft.
Channel Revegetation (Wetland Planting)	$9.30/lin. ft.

[1] The number of diversion/drop structures required is dependent on project size, channel gradient, and degree of channel incision.

[2] Range in unit cost is based on the height of the rock structure ($54/cu. yd. for heights up to 36", $103/cu. yd. for heights greater than 36")

[3] Unit costs are from NRCS-EQIP project cost data (2009).

2.2.4.1 Headcut Stabilization

Stabilization of active headcuts was identified as a critical element in the watershed management plan. Locations of 50 major headcuts were identified and prioritized as part of the analysis. Similar to some of the other stream restoration strategies described in this study, it is difficult to provide cost estimates for stabilization of the identified headcuts due to the absence of preliminary design information. Under the supposition that many of the headcuts could be stabilized using rock drops and/or chutes, with several examples already in-place within the watershed, the following unit costs and estimated ranges of material quantities are provided in **Table ES-2.5**. Total costs (including design/engineering and contingency) for a headcut stabilization project can be expected to vary significantly, depending on the magnitude of the headcut, with an approximate range of $1,500 for a small headcut to $15,000, or greater, for deep headcuts in larger channels.

Table ES-2.5. Estimated Unit Costs and Ranges of Quantities for Headcut Stabilization Project Elements.

Project Component	Typical Range of Quantities [2]	Unit Cost [3]	Range of Est. Costs
Rock Riprap (rock chute application)	10 - 200	$38/cu. yd.	$380 - $7,600
Rock Drop Structure(s) [1]	10 – 50 cubic yards (each)	$80/cu. yd.	$800 - $4,000
Channel Earthwork/Grading	0 – 100 cubic yards	$5.00/cu. yd.	0 - $500

[1] The number of diversion/drop structures required is dependent on project size, channel gradient, and depth of headcut.

[2] Range of quantities shown represents the size of priority projects identified in the watershed plan.

[3] Unit costs are from NRCS-EQIP project cost data (2009).

2.2.5 Grazing Management Opportunities

Using a site's Ecological Site Description (ESD) coupled with the S/T model, land managers can target certain grazing practices towards achieving improvements in rangeland health. Other management practices that can be used to improve overall range conditions and watershed function include:

1. Upland water development to facilitate more balanced grazing distribution across the landscape. Movement of livestock away from riparian areas, to the extent practicable, can result in improved riparian area health.
2. Fencing of riparian areas to reduce impacts on stream channels and banks. This practice can be implemented informally, or in a more formal manner via programs such as the Continuous Conservation Reserve Program (CCRP) through the USDA-Farm Services Agency (FSA).
3. Inclusion of wildlife-compatible components in range management practices. These can include: smooth wire fencing, and installation of wildlife escape ramps in water development projects.
4. Utilization of Integrated Pest Management (IPM) strategies to control weeds and pest animals and insects.
5. Seeps and springs should be protected from livestock trampling to prevent damage to the spring, maintain water quality and enhance the growth of food forbs for sage grouse and other wildlife.
6. Prescribed fire can be used as a tool to promote range health. Time-of-year is a major burn prescription component for obtaining desired results. Burns should be conducted when preferred plants are dormant.

3.0 RECOMMENDATIONS

Based on the existing conditions in the watershed, field meetings with landowners, and discussions with interested stakeholders, coupled with the results of analyses in this study, the following recommendations for moving forward are offered:

1. Most of the recommended upland water development projects could be reasonably taken to the next level of design and permitting evaluation based on the information presented in this study. Furthermore, many of these projects are potentially eligible for funding through the WWDC's Small Water Projects Program (SWPP).

2. Local landowners, the Kirby Creek CRM, and other interested stakeholders have been very active in this watershed over the past decade. In order to keep this momentum going, it is recommended that some of the projects outlined herein be advanced to the next level of planning and analysis such that a heightened level of awareness and interest in watershed projects is maintained.

3. In regards to the identified in-stream pond opportunities (including historic meander re-activation and oxbow development projects) and stream channel restoration opportunities (entrenched channel restoration and headcut stabilization), **the stabilization of active headcuts is clearly considered a priority**. Continued channel incision, left unchecked, will further exacerbate degraded conditions in the watershed and hinder efforts to make substantive improvements to watershed function through implementation of restoration projects and application of improved grazing management practices.

4. Numerous potential funding sources (outside of those administered by the WWDC) are available for the types of projects outlined in this study (refer to **Section 7.0**). This study presents a good medium through which representatives of resource agencies and other funding sources could be introduced to the ongoing efforts in the watershed (if they are not already aware). Collaborative approaches to funding and financing of projects can be investigated in greater detail once a short-list of projects is identified for further consideration.

5. Since streamflow data for Kirby Creek is relatively old, additional streamflow measurements within the watershed would likely be beneficial for future water development planning. **Section 3.4.4.4** identifies potential locations for installation of streamflow measurement devices.